

**The Use of Technology during Academic Acculturation: Case Studies of Chinese-
Speaking International Doctoral Students**

DISSERTATION

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Abstract

The number of international students who pursue higher education in Western countries, such as the United States, increases yearly. Asian international students are a significant proportion of international students from different countries (Institute of International Education, 2015). Numerous researchers have identified various challenges encountered by this group of international students, including difficulties in adjusting to new linguistic and academic environments (Scheyvens, Wild, & Overton, 2003; Yeh & Inose, 2003), struggling to learn Western styles of academic writing (Silva, 1992), inadequately participating in class discussions (Currie, 2007; Liu, 2000; Morita, 2004), being isolated from faculty and peers (Le & Gardner, 2010; Trice, 2003), and lacking the knowledge of local culture (Scheyvens et al., 2003). Some researchers also discovered that the use of technology could assist international students in developing their L2 competence (e.g., Bakar & Ismail, 2009; Kessler, Bikowski, & Boggs, 2012), increasing their participation in course-related discussions (e.g., Kamhi-Stein, 2000; Kim, 2011), and making connections with people from the identical ethnic group (Cao & Zhang, 2012; Fan, 2008; Kim, 2010; Kim et al., 2009) and from the target culture (Fan, 2008; Hodis & Hodis, 2012; Kim, 2010; Kim et al., 2009) in a foreign country.

Nevertheless, a few studies (e.g., Hughes, 2013) have investigated the influence of the use of technology on international students' discipline-specific learning. This present study, therefore, examined the role of technology during Asian international doctoral

students' acculturation to their particular academic disciplines. Vygotsky's (1978) sociocultural theory, Lave and Wenger's (Lave & Wenger, 1991; Wenger, 1998) communities of practice, and Casanave, Li, and other scholars' academic acculturation (Casanave, 2002; Casanave & Li, 2008) were adopted to design this research, collect and analyze data, and interpret findings. Participants were three Chinese-speaking international students who studied in different doctoral programs but in the same institution in the Midwestern United States. The data were gathered through a survey, interviews, weekly journals, and field notes. Case study, including individual cases and a cross case, was utilized to present data analysis and detailed information on the research phenomenon.

The finding shows that the Chinese-speaking international doctoral students acculturated to not only their academic disciplines but also the English environment and the Western academic culture. During their acculturation processes, they confronted various academic difficulties, such as challenges of clearly expressing own ideas in speaking and writing in academic English. The result also indicates that overall technology serves as an assistive role during their academic acculturation processes. They utilized assorted technologies (e.g., academic search engines, social interactional software, citation software, and online lexical resources) to surmount some academic challenges they encountered, participate in discipline-specific communities of practice (e.g., undertaking research), and accomplish varied academic tasks (e.g., fulfilling course requirements and writing conference proposals in English). However, their use of technologies could not completely enhance their academic English competence, discipline-specific knowledge, and research ability. Moreover, exclusively employing

technology could not aid them in adjusting to the Western academic culture and socializing into their discipline-specific communities. Attaining these goals necessitates sufficient guidance and support from more experienced members and/or experts of the Western academic communities and their discipline-specific communities. Otherwise, they might legitimately but peripherally participate in communities of practice and not successfully socialize into the Western academic culture and their discipline-specific communities.

In addition, their use of some technologies was problematic and which could hinder them from socializing into the Western academic culture and their discipline-specific communities. For instance, some of the participants solely utilized one search engine (Google Scholar) to look for academic articles for their research and for acquiring discipline-specific knowledge. Nevertheless, each academic search engine has its own advantages and disadvantages (e.g., only including academic articles from certain journals or not including scholarly works published latest). Employing multiple academic search engines might counterbalance an individual search engine's weaknesses. Another example is that they relied on citation counts, which an academic search engine generated, to determine the significance of academic articles. Academic articles with higher citation counts were considered to be important by the participants. Nonetheless, this high citation counts could be misleading especially when some academic articles that are published lately so those articles have not been read and cited by too many scholars as compared with academic articles published a long time ago.

Acknowledgments

It is a long and arduous journey to pursue a doctoral degree in the U.S. for me as an international student. On this journey, I, like other international doctoral students, confronted various academic and non-academic difficulties. These difficulties were impossible to overcome by myself but with others' support. I, therefore, greatly thank my family's, friends', peers', professors', advisor's, and my candidacy and dissertation committee members' support and encouragement. In addition, I appreciate my participants' willingness to spare their time to participate in my study and share their stories of past academic learning in Taiwan, and being international students and pursuing a doctoral degree in the U.S. Moreover, I particularly acknowledge my doctoral peers, Yanty Wirza and David Wandera, to share their research experience and perspectives and provide suggestions for my dissertation. Without the support and encouragement from all of them, I would be unable to tackle the challenges I encountered during my doctoral study in this foreign country and to persist in completing it.

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Specialization: Foreign Language Education

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Chapter 1: Introduction

1.1 Background of the Study

I, as an international student, traveled thousands of miles from Taiwan to the United States and started my doctoral study several years ago. At the beginning of the journey, I thought my sixteen-year educational training with ten-year English learning in Taiwan could help me smoothly adjust to a new academic culture and pursue the doctoral program of Foreign, Second, and Multilingual Language Education in the new culture. However, linguistic and academic cultural differences between Taiwan and the U.S. and other factors complicate my academic acculturation processes. In terms of academic culture, American education emphasizes critical thinking, expression of one's thoughts and opinions, independent learning, originality, and engagement in scholarly conversations through comprehending their main arguments, proposing own viewpoints with scholars' support, and making contributions in the field. On the contrary, Taiwan education stresses the importance of learning from instructors and textbooks (Scheyvens, Wild, & Overton, 2003; Yeh & Inose, 2003), and views instructors and scholars in textbooks as authoritative figures with broad and profound knowledge. Students tend to quietly listen to instructors' lectures and not question their knowledge but ask for further clarification of certain taught content during a class. Moreover, students tend to do their assignments through finding answers from textbooks to answer short questions rather

than writing a long essay. Furthermore, students only review teaching content for examinations.

Due to the cultural belief that authoritative knowledge should be respected and not be challenged, my earlier graduate student years in the U.S. were characterized by physically showing up in class to be "a good student" without asking questions or actively participating in discussions to express my opinions. In addition, I struggled to read an overwhelming amount of English academic texts and read with critical eyes because in Taiwan I rarely read English academic texts, let alone read with critical eyes. I did not even know what critical thinking meant at that time. Moreover, I wrestled with writing long English academic papers and writing different genres for different academic purposes and for different professors. In Taiwan, what I learned about English writing was to only write a five-paragraph composition which was usually no more than two pages with single-space and without citations. The concept of citing sources to support own arguments was not in my mind at that time. These differences, such as the foreign language, dissimilar beliefs about learning and teaching, unfamiliar American graduate academic culture, and implicit rules of participating in my academic communities, sometimes make me feel disoriented, helpless, and depressed. Some academic issues I encountered could not be resolved through support from attending English as Second Language (ESL) courses or from my graduate program, such as writing conference proposals and a research proposal. Therefore, these issues made me look for support from other sources. These sources, for example, include utilizing online information to learn important components in a conference or a research proposal, using computer-mediated communication (CMC) tools to discuss course assignments and research with peers

outside of class, and reading online discussion posts which some writers shared their experience of writing a conference or a research proposal. I, like other international doctoral students, confronted numerous difficulties in adapting to the Western academic culture, graduate school, and the culture of the discipline-specific communities. The more I talked to other international doctoral students, the more I realized that this suffering is a shared phenomenon. Thus, I asked myself the questions— how do Chinese-speaking international doctoral students solve their academic problems and how the use of technology might aid them in adjusting to their particular academic disciplines? These questions stimulated me to explore further the role of technology during Chinese-speaking international doctoral students' academic acculturation.

1.2 Statement of the Problem

Numerous researchers (Scheyvens, Wild, & Overton, 2003; Yeh & Inose, 2003) have paid attention to Asian international graduate students' acculturative challenges. They found out that Asian international graduate students generally face problems of adapting to a new linguistic and academic environment (Scheyvens et al., 2003; Yeh & Inose, 2003). In addition, this group of students seems to experience difficulties in integrating with American students (Trice, 2003) and to be isolated from faculty members and peers (Le & Gardner, 2010). Moreover, they lack knowledge of the local culture (Scheyvens et al., 2003) and endure psychological suffering due to acculturative stress (Poyrazli, Kavanaugh, Baker, & Al-Timimi, 2004; Yeh & Inose, 2003). Furthermore, they struggle to learn the Western style of academic writing (Silva, 1992). They also face difficulty in participating in class discussions (Currie, 2007; Liu, 2000; Morita, 2004).

Some of the above non-academic acculturative problems that Asian international students encountered could be solved through using technology. For instance, research has revealed that Asian international students improve their English proficiency through utilizing the Internet to access English multimedia artifacts (Fan, 2008; Lee, 2005; Reece & Palmgreen, 2000). In addition, they employ CMC tools, such as Skype, instant messages, and Facebook, to maintain relationships with their family and friends in their native countries (Cemalcilar, Falbo, & Stapleton, 2005; Kim, 2010; Kim, Yun, & Yoon, 2009; Kline & Liu, 2005). These connections further help them reduce acculturative stress in a new country (Cemalcilar et al., 2005; Fan, 2008; Kline & Liu, 2005). Moreover, the connections and access to their native countries' information, such as news, through the Internet also assist them in sustaining their original identity (Cemalcilar et al., 2005; Fan, 2008; Kim, 2010). Furthermore, their use of CMC tools aids them in making connections with people from identical ethnic groups and target-cultural groups in a new territory (Fan, 2008; Kim, 2010; Kim et al., 2009). These connections further help them cope with general living difficulties in a new territory (Fan, 2008; Kim, 2010; Kim et al., 2009). Additionally, their use of the television to watch target-cultural (L2) TV shows and the use of the Internet to read L2 news assist them in learning the target culture (Fan, 2008; Reece & Palmgreen, 2000).

Another line of literature has investigated international students' use of technology during their academic acculturation processes (Bakar & Ismail, 2009; Bradleya, Lindstroma, & Rystedta, 2010; Braine, 1997). Some studies have shown that the use of technology assists international students in developing their L2 academic writing competence, such as producing more L2 texts (Bakar & Ismail, 2009; Bradleya et al.,

2010; Dekhinet, 2008; Kessler, Bikowski, & Boggs, 2012; Kol & Schcolnik, 2008), enhancing accuracy of writing through receiving more e-feedback from peers and instructors (Bakar & Ismail, 2009; Bradleya et al., 2010; Kessler et al., 2012), and increasing lexico-grammar and English awareness (Kaur & Hegelheimer, 2005; Varley, 2009; Yoon, 2008). Nonetheless, these studies tend to focus on international students' use of technology in ESL or English for Academic Purposes (EAP) classes. Besides enhancing L2 academic writing skills, some studies have established that online discussion boards or forums could facilitate collaborative and student-centered learning (Kamhi-Stein, 2000; Pilkington & Walker, 2003; Sotillo, 2000) and promote equal participation in class discussions (Warschauer, 1996). In face-to-face discussions, international students have a tendency to be silent due to several reasons, such as their insufficient English competence (Ellwood & Nakane, 2009; Morita, 2004; Liu, 2000; Liu & Kuo, 1996; Yang, 2010) and unfamiliarity with topics (Liu, 2000; Morita, 2000, 2004; Pinheiro, 1999; Tatar, 2005). Nonetheless, online discussion boards and forums allow them to take time to think and express their opinions so they tend to participate more in online discussions than in face-to-face ones (Kamhi-Stein, 2000; Kim, 2011). However, most of these studies examined international undergraduate students (Sotillo, 2000) and/or master's students (Kamhi-Stein, 2000; Kim, 2011; Pilkington & Walker, 2003) rather than international doctoral students.

Above studies have shown the benefits of employing technology to international students during their non-academic (Cemalcilar et al., 2005; Fan, 2008; Kim, 2010) and academic acculturation processes (Bradleya et al., 2010; Kessler et al., 2012; Pilkington & Walker, 2003). Nonetheless, most of these studies looked into international

undergraduate and/or general graduate students but did not particularly examine international doctoral students (Cemalcilar et al., 2005; Kim et al., 2009; Kim, 2010; Kline & Liu, 2005; Reece & Palmgreen, 2000). Doctoral students are disposed to encounter more academic challenges than master's students because the former are required to socialize into their academic disciplines more than undergraduate and master's students do (Girves & Wemmerus, 1988). Moreover, doctoral students are more likely involved in more demanding scholarly activities, such as conducting research, taking a qualifying examination, presenting at academic conferences, and publishing articles in scholarly journals, than master's students do (Girves & Wemmerus, 1988). In addition to centering on international undergraduate and general graduate students, this line of researchers is also likely to examine technology use in ESL or EAP classes (Bakar & Ismail, 2009; Bradley et al., 2010; Kessler et al., 2012) and for class discussions (Pilkington & Walker, 2003) rather than other aspects, such as technology use for understanding lectures and academic articles or for participating in online discussions with scholars outside of the school. Therefore, this present study aims to fill these gaps through exploring how Chinese-speaking international doctoral students use technology to socialize into their particular academic communities.

1.3 Purpose of the Study

The objective of this study is to investigate the role of technology during Chinese-speaking international doctoral students' acculturation to their particular academic communities. It is important to know that the term "Asian students" is in fact not homogenous. Additionally, when the term "Chinese students" is used, there may be a

tendency to think of these students as originating from China. I use the term "Chinese-speaking international doctoral students" to mean students from Taiwan and China.

Participants in this dissertation were chosen from a wider study that investigated international master's and doctoral students from different countries, located at a large research university in the Midwestern United States. This dissertation, hence, only reports on data obtained from the population of Chinese-speaking international doctoral students.

Thousands of international students come to America yearly to pursue the better education and economic conditions (Institution of International Education, 2012-a). Specifically, the number of Asian international students has continuously increased (Institution of International Education, 2012-b, 2013). Chinese-speaking international students are the largest group among the overall international students (Institution of International Education, 2013). International students could not only bring a great deal of financial resources (Brown & Jones, 2007; Pinheiro, 1999) but also enrich local students' and faculty' global perspectives and knowledge (Wan, Chapman, & Biggs, 1992). Nonetheless, upon their arrival, they typically confront a series of acculturative difficulties and obstacles (Currie, 2007; Ellwood & Nakane, 2009; Linda & Wang, 2008; Poyrazli & Lopez, 2007; Yang, 2010). They not only face language barriers but also experience stress caused by cultural dissimilarities (Andrade, 2006). Notably, Asian international graduate students need to adjust to the Western academic culture in general and meanwhile acculturate to their discipline-specific communities (Casanave & Li, 2008).

Thus, the purpose of this study is to examine the role of technology during the process where Chinese-speaking international doctoral students overcome acculturative difficulties and obstacles while adjusting to their academic disciplines.

1.4 Research Questions

This dissertation is guided by the following research questions:

1. How do Chinese-speaking international doctoral students from different academic fields define their academic acculturation?
2. What common and distinct technologies do Chinese-speaking international doctoral students from different academic fields use for academic acculturation and how they utilized these technologies for which academic purposes?
3. In what ways does their use of technology relate to their own definition of successful academic acculturation?
4. How well do they acculturate to their particular academic disciplines?

1.5 Theoretical and Conceptual Frameworks

The two terms, a theoretical framework and a conceptual framework, have been interchangeably utilized by some researchers (Fain, 2014; Parahoo, 2014; Sinclair, 2007). Nevertheless, some researchers think there are differences between the two terms (Imenda, 2014; Rocco & Plakhotnik, 2009). Imenda (2014) indicates that “a conceptual framework is derived from concepts, in-so-far as a theoretical framework is derived from a theory” (p. 189). Hence, in this study, I adopted Vygotsky's (1978) sociocultural theory as the theoretical framework and Lave and Wenger's (Lave & Wenger, 1991; Wenger,

1998) communities of practice and Casanave, Li, and other scholars' academic acculturation (Casanave, 2002; Casanave & Li, 2008) as the conceptual frameworks.

Vygotsky's (1978) sociocultural theory highlights that social interaction fosters learners' cognitive development and tools, such as signs and technologies, that serve as a means of socially interacting with other people. The Zone of Proximal Development (ZPD) (Vygotsky, 1978) further accounts for how learners can more competently cope with difficult tasks through receiving guidance and collaborating with more experienced others. In other words, the difference between what learners can achieve on their own and what they can achieve upon receiving help from more knowledgeable others illustrates some benefits of learning within contexts characterized by social interactions. Since the present study examined how Chinese-speaking international doctoral students socialized into their specific academic communities through interacting with their peers, professors, and scholars in the communities, utilizing Vygotsky's theories is instrumental in the research design and understanding of the research phenomenon.

For the conceptual frameworks, this study employs two theories which are important in gathering, analyzing, and interpreting the data. The first one is Lave and Wenger's Communities of Practice, in particular Legitimate Peripheral Participation (Lave & Wenger, 1991; Wenger, 1999). This framework was used to investigate the role of technology during the process where Chinese-speaking international doctoral students entered their academic communities as novices and then gradually moved toward the center of the communities through peripherally taking part in disciplinary practices. The second one is academic acculturation that was inspired by Casanave, Li and other

scholars, such as Hirvela and Yi , Kuwahara, Prior and Min, Simpson and Matsuda (Casanave, 2002; Casanave & Li, 2008).

Casanave and Li (2008) indicate that

[academic acculturation for all graduate students is a process of] “learning to become a member of a graduate school academic community.....and become familiar with new cultural, literacy, and sociopolitical practices while under the pressure of time, financial hardship, and possibly unclear authority relationships with faculty members” (p. 3).

Due to the dynamic and complicated graduate academic cultures, all students experience a tough transition (Casanave & Li, 2008). Nevertheless, international graduate students who come with the native academic background (e.g., get used to the teacher-centered teaching style) possibly encounter more challenges than domestic graduate students.

After arriving in a new country and studying in a graduate program, they have to immediately adjust to the new language environment, the Western academic culture, and the role of graduate students (Casanave & Li, 2008). In order to become a member of their graduate school academic communities, they need to acquire significant dominant knowledge, participate in their disciplinary practices, negotiate their identities, and take an academically recognizable role in the communities (Casanave & Li, 2008; Heneda, 2009). During the process, they tend to selectively accept and resist the academic communities’ knowledge, practices, and values (Canagarajah, 2004; Casanave, 1995; Duff, 2003). The process of interacting with members of the communities is likely reciprocal rather than unilateral (Duff, 1996, 2002, 2003; Harklau, 2003; He, 2003; Willett, 1995). It is a sophisticated, dynamic, and fluid process (Duff, 1996, 2002, 2003;

Harklau, 2003; He, 2003; Willett, 1995). That is to say, during the process, international doctoral students may be shaped by their academic communities through partaking in particular practices and shape the communities through providing their perspectives and specialties. The present study used this theory to examine how Chinese-speaking international doctoral students acquired their disciplinary knowledge, participated in their communities of practice, and interacted with members of the communities through using technology. To do this, this study adopted qualitative research paradigm, specifically the ethnography and case study, to reveal participants' and the researcher's perspectives on the research issue. This study employed a survey approach to seek suitable participants and participants who were willing to partake in the research. Then, interviews, weekly journals, document collection, and field notes were utilized to gather participants' in-depth information. Next, Merriam's (2009) procedure of data analysis, which heavily drew from Glaser and Strauss' (1967) inductive and comparative approaches, was employed to analyze data.

1.6 Significance of the Study

Through investigating the role of technology during the process of Chinese-speaking international doctoral students' socialization into their specific academic communities, this study made several theoretical and practical contributions.

For the theoretical contributions, this present study extends the line of research on international students' use of various technologies during their academic acculturation and on technology use through participants' perceptions of how technology impacted their acculturation processes. Prior research on technology use by international students'

during their academic acculturation somewhat paid more attention to international undergraduate and/or general international graduate students rather than doctoral students (Cemalcilar et al., 2005; Kim et al., 2009; Kim, 2010; Kline & Liu, 2005; Reece & Palmgreen, 2000). In addition, previous research centered on international students' technology use in ESL or EAP classes (Bakar & Ismail, 2009; Bradley et al., 2010; Kessle et al., 2012) and for class discussions (Pilkington & Walker, 2003). What was omitted is a focus on their technology use for academic purposes in other areas, such as comprehending lectures and academic reading and taking part in scholarly discussions. Hence, the current study extends this line of research through exploring Chinese-speaking international doctoral students' use of technology to socialize into their particular academic disciplines. Another significance of the present study is that it offered a unique perspective on technology use through participants' perceptions of technology rather than through researchers'. Previous studies (see Cemalcilar, Falbo, & Stapleton, 2005; Kim, 2010; Kim, Yun, & Yoon, 2009; Kline & Liu, 2005) have a tendency to examine international students' technology use through researchers' viewpoints of technology. For instance, Cemalcilar, Falbo, and Stapleton (2005) investigated international students' use of computer-mediated communication (CMC) technologies for cross-cultural transition in the early stages. The researchers exclusively explored the students' use of CMC technologies but no other types of technologies. Another example is Kline and Liu's (2005) study which examined Chinese international students' use of CMC technologies for acculturative stress, relationships with their family, and acculturation. Their CMC technologies particularly focused on the telephone and email. A few studies have investigated technology use through international students' own definition of technology

and own selection of technologies. Therefore, this current study contributes to this line of studies through examining Chinese-speaking international doctoral students' viewpoints on their selection of technologies for their academic learning.

In addition to theoretical contributions, the present study also made a number of contributions to international doctoral students, their professors, academic departments, and institutions. First, for international doctoral students, the study offered ideas of technologies they could adopt and ways of utilizing them to help them acculturate to their particular academic disciplines. Second, for their professors, the study discloses Chinese-speaking international doctoral students' difficulties in academic acculturation and provides suggestions about what technologies could be used and how to use them to help their international doctoral students acculturate to their academic disciplines. Third, for international doctoral students' academic departments and institutions, the study offered suggestions for providing workshops to aid their international doctoral students in participating in their academic communities. Overall, this study is vital in addressing challenges that emanate from an increasing trend whereby more and more international doctoral students continue to flock into Western academic spaces from Asia.

1.7 Definitions of Key Terms

1. Academic acculturation in this study is defined as a process where international doctoral students learn to become a member of academic communities through acquiring dominant knowledge, involving in sociopolitical practices, and negotiating own identities in power relationships while being under the pressure of time and financial hardship (Casanave, 2002; Casanave & Li, 2008;

Haneda, 2009). Although the definition highlights various characteristics, such as community membership and aspects of identity, this present study centers more on various elements that crystallize community membership, such as the use of academic language, English proficiency, and disciplinary socialization, through examining the impact of technology use on these aspects of academic acculturation.

2. Academic communities, disciplinary communities, or discipline-specific communities in this study refer to a doctoral student's present doctoral program and disciplinary communities in the U.S. and in global circles.
3. In this dissertation, the common thread that unifies various forms of mechanization which are considered technology is electronic, digital, and computer-based systems. There are two broad categories of technology in this study: tangible and intangible technologies. The former includes cell phones, computers, laptops, hand-held tablets, overhead projectors, and hand-held electronic dictionaries while the latter includes the Internet, any multimedia artifacts, online chat rooms, forums, instant messengers, blogs, social media, and online social networks.
4. Computer-mediated communication (CMC) refers to technologies and software that were utilized by the participants in this study to communicate, transmit information, and share information with other CMC users. There are two types of CMC tools and software: 1) synchronous CMC tools and software (e.g., instant messengers and Skype) which enable a user to communicate with another user in real time, and 2) asynchronous CMC tools and software (e.g. e-

mail, weblogs, and online forums) which allow a user to leave his or her messages online and another user can read the messages at any time.

5. Participation in academic communities of practice refers to acquiring disciplinary dominant knowledge, utilizing disciplinary knowledge and skills to accomplish academic tasks, and partaking in formal and informal academic discussions. Casanave and Li (2008) applied this definition to reading and writing. However, in this present study, I extended the definition to listening and speaking and to participating in academic activities, such as attending or presenting at discipline-specific conferences, seminars, conducting research, and involving in publications.
6. L1 refers to international students' native language.
7. L1 academic culture or background refers to international students' native academic knowledge, skills, practice, ways of thinking, reading, writing, and speaking, and beliefs about education and learning.
8. L2 refers to the language (in the case of this study, English) other than international students' native language and that international students use in a foreign country to help them connect with people in the target culture and learn academic knowledge.
9. L2 academic culture refers to the target academic culture (in the case of this study, the Western academic culture) where international students study higher education in a Western country, such as the United States, England, Austria, or New Zealand. The target academic culture contains its specific academic

knowledge, skills, practice, ways of thinking, reading, writing, and speaking, and beliefs about education and learning.

1.8 Assumptions of the Study

This study is based on a number of assumptions, including the following:

1. This study adopted a survey, interviews, and weekly journals to collect participants' self-reported data. It is assumed that participants honestly answered the survey and interviews' questions and genuinely wrote their weekly journals. In order to address this issue, this study employed an inbuilt triangulation approach where the accuracy of participants' self-reported data was cross-checked against field work and field notes.
2. In this study, I worked on the assumption that cultural socialization takes place during the process of interacting with people. Therefore, this study adopted socio-cultural approach whereby participants are assumed to acculturate to academic spaces through their interactions with others.
3. This study only recruited Chinese-speaking international doctoral students and chose a few participants to take part in the process of qualitative data provision. Thus, it is assumed that the findings could not be generalized to a wider population of international doctoral students and international graduate students from other countries. Nevertheless, I detailed the research design, the research site, the group of participants, and the process of data collection and analysis in chapter 3 so readers could apply the findings of this study to similar populations and research situations.

4. Through a case study approach, this study assumes that studying the experiences of a particular group of Chinese-speaking international doctoral students at a particular institution (a large Midwestern research institution) could produce a rich output of understanding that informs how Chinese-speaking international doctoral students acculturated to the Western academic settings.

Chapter 2: A Review of the Literature

2.1 Introduction

In this chapter, I reviewed the literature that is relevant for understanding the topic of international students' use of technologies and their academic acculturation. This chapter is divided into five sections, including this introduction. The second section reviews theories and empirical studies on academic acculturation. The review in this section highlights various aspects of this acculturation, such as the intersection between language, culture, and academic acculturation. The section also reviews scholarship on different perspectives on academic acculturation, for example, Morita's (2004) and Morita and Kobayashi's (2008) product-oriented, process-oriented, and critical discourse academic acculturation. This review is crucial because the centerpiece of this present study focuses on Chinese-speaking international doctoral students' academic acculturation as they are socialized into the Western academic environment. The third section explores empirical studies pertaining to academic challenges that international students encounter during their academic acculturation. Reviewing scholarship on the challenges that the students confront is important because this leads to understanding how to solve these challenges they face and subsequently help them successfully adjust to the new academic culture. The fourth section reviews research relative to technology use by international students. This section reviews literature on the use of technologies for

academic purposes (Bakar & Ismail, 2009; Bradleya, Lindstroma, & Rystedta, 2010; Braine, 1997; Dekhinet, 2008; Kasper, 2000; Kaur & Hegelheimer, 2005; Kessler, Bikowski, & Boggs, 2012; Kol & Schcolnik, 2008; Shin, 2006; Varley, 2009; Yoon, 2008) and non-academic purposes (Fan, 2008; Lee, 2005; Reece & Palmgreen, 2000). The review of the literature focusing on the use of technologies is significant for this study because the main aim of this study is to establish the effectiveness with which international students employ technologies for productive acculturation to Western academic settings. Figure 2.1 below shows a map of section 2 (academic acculturation), 3 (international students' challenges of acculturation), and 4 (technology use by international students). The fifth section comprises of a conclusion.

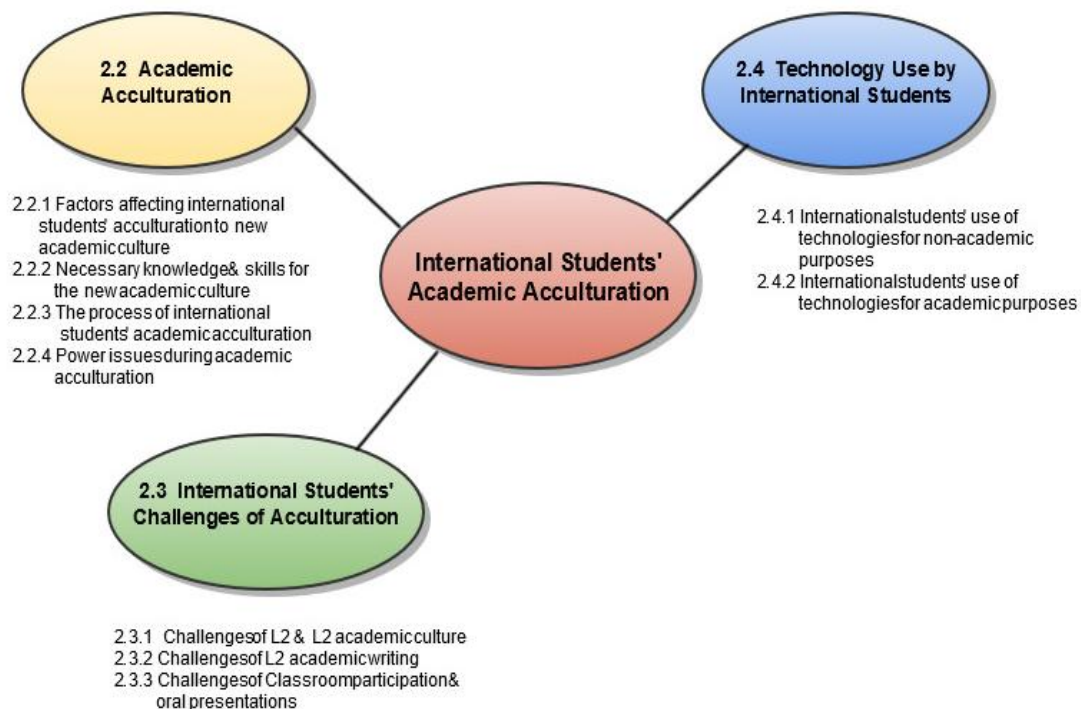


Figure 2.1 A Map of Section 2, 3, and 4 of the Literature Review

2.2 Academic Acculturation

In the literature, academic acculturation has been adopted by researchers to refer to different meanings (Cheng & Fox, 2008; Meyer, 1995). For instance, Cheng and Fox (2008) defined academic acculturation as “the dynamic adoption processes of linguistically and culturally diverse students engaging with the academic study cultures of Canadian English-medium universities” (p. 309). Their definition of academic acculturation was more focused on general academic acculturation rather than discipline-specific academic acculturation. In this current study, academic acculturation is defined as the process by which Chinese-speaking international doctoral students learned to become a member of their academic communities through acquiring dominant knowledge, involving sociopolitical practices, and negotiating own identities in power relationships while being under the pressure of time and financial hardship (Casanave and Li, 2008; Haneda, 2009).

Adjusting to graduate school culture is difficult for both domestic and international students. Nevertheless, international graduate students tend to encounter more challenges than domestic graduate students due to difficulties in socializing into the L2 (English) environment and graduate academic culture (Casanave & Li, 2008). That is, they face double challenges to familiarize themselves with dominant knowledge, negotiate their identities, and participate in their disciplinary communities while acclimatizing to a new language, surroundings, and general academic culture and custom (e.g., the Western writing conventions, expressions of own opinions and thoughts in class, and ways to communicate with faculty members). The double challenges likely make their process of acculturation to graduate-level even more arduous. Many researchers (e.g., Morita, 2004;

Morita & Kobayashi, 2008) have explored international students' academic acculturation.

This line of literature could be categorized into four main groups:

- 1) Factors affecting international students to acculturate to academic culture
- 2) Necessary knowledge and skills for the new academic culture
- 3) The process of international students' academic acculturation
- 4) Power issues during academic acculturation

The present study is situated in a group of studies examining international students' academic acculturation processes.

2.2.1 Factors affecting international students' acculturation to new academic culture.

It is vital for Western instructors, professors, departments, and institutions to realize possible factors that could negatively influence international students as they adjust to a new academic culture. This realization could assist them in providing appropriate and effective support to this group of students. Researchers (e.g., Chirkov, Safdar, De Guzman, & Playford, 2008; McLachlan & Justice, 2009; Yan & Berliner, 2009; Zhang, Mandl, and Wang, 2010) in the first group pertinent to factors affecting international students' academic acculturation have examined possible factors that negatively influence international students' acculturation to new academic culture. Nine factors were discovered in this group of research:

- 1) personalities,
- 2) autonomous motivation to study abroad,
- 3) L2 proficiency and confidence in L2,

- 4) social connections with L1 and L2 groups in the target culture,
- 5) similarities and differences between L1 and L2 educational culture,
- 6) degrees of academic support provided by institutions,
- 7) target language support by institutions,
- 8) the provision of counseling for international students by institutions,
- 9) strategies international students adopt to overcome

First, international students' personalities could affect their sociocultural adjustment in a new environment (Zhang, Mandl, & Wang, 2010). Zhang, Mandl, and Wang (2010), for instance, investigated factors affecting Chinese international students in Germany as they adjusted to the new academic culture. The study found that international students who were open to and intellectually curious about new experiences had a better adjustment to the German academic culture (Zhang et al., 2010). Second, their autonomous motivation to study abroad could impact on their various adjustment outcomes (Chirkov et al., 2008). Chirkov, Safdar, De Guzman, and Playford (2008), for example, examined the impact of international students' self-report motivation and goals to study abroad on their academic adjustment. The results have revealed that their motivation and goals for studying abroad were powerful predictors of their adjustment (Chirkov et al., 2008). Third, their L2 proficiency and confidence in L2 could influence them to communicate with L2 people and meet academic requirements (Barker, Child, Gallois, Jones, & Callan, 1991; Chataway & Berry, 1989; Heggins & Jackson, 2003; McLachlan & Justice, 2009; Swagler & Ellis, 2003; Yan & Berliner, 2009). In Yan and Berliner's (2009) study, for instance, Chinese international master's and doctoral students studying in different academic fields in the U.S. reported that due to their insufficient English ability they had difficulty in

comprehending instructors' lectures, partaking in class discussions, and writing academic papers. McLachlan and Justice (2009) pinpoint that international students' language barrier is a major challenge when they endeavor to negotiate cultural, social, and academic differences. Fourth, degrees of their social contact with L1 and L2 groups could impact on their adaptation to a new academic environment (Barratt & Huba, 1994; Rosenthal, Russell, & Thomson, 2007; Swagler & Ellis, 2003). Swagler and Ellis (2003) examined 25 Taiwanese international master's and doctoral students' academic adaptation in the U.S. and concluded that the participants who had a better adjustment seemed to be the ones who had connections with Taiwanese students in the U.S. and Americans. Interestingly, one of their findings showed that the international students stated that they had the desire to make American friends but did not know how to connect with them and hence felt disappointment (Swagler & Ellis, 2003).

Fifth, similarities and differences between their L1 and L2 educational culture could affect their acculturation to the L2 academic culture (Mehdizadeh & Scott, 2005; McLachlan & Justice, 2009; Yan & Berliner, 2009). For example, in Yan and Berliner's (2009) research, Chinese international students in the U.S. expected guidance on learning from their professors in the way that they had been trained in Chinese academic culture; however, their professors expected students' independence. Sixth, degrees of academic support offered by institutions where international students stay could influence their satisfaction with their academic acculturation processes (Grayson, 2008; Mehdizadeh & Scott, 2005; McLachlan & Justice, 2009; Prescott & Hellsten, 2005; Zhai, 2002). Grayson (2008), for instance, investigated international students' and domestic students' academic experiences and outcomes in Canadian universities. The results have shown

that international students involved themselves in academic activities as domestic students did; however, they received less academic support from the school than domestic students did (Grayson, 2008). Seventh, target language support provided by institutions where international students stay could help them adjust to L2 academic environments (Zhai, 2002). Most international students, for example, in Zhai's (2002) research suggest that a university could provide the connection between international students and domestic students for developing their L2 competence. Eighth, the provision of international student counseling by schools could affect their academic acculturation processes (Zhai, 2002). Zhai (2002) reveals that international students are inclined to suffer from various adjustment problems. If university encourages international students to use counseling service, this could assist them in reducing stress during the process of adjusting a new academic culture (Zhai, 2002). Finally, strategies that international students use to deal with academic problems could impact on their academic adjustment outcomes (Tran, 2008). For instance, Chinese international students in Tran's (2008) study adopted strategies, such as requesting instructors to clarify requirements of writing assignments and asking instructors' feedback during the drafting stage of their writing, to familiarize themselves with disciplinary conventions. Taken together, international students' personalities, the motivation for studying abroad, L2 competence and confidence, and similarities between L1 and L2 are important factors in the acculturative processes. In addition, whether or not they acquire essential academic knowledge and skills as expected by Western instructors and professors could influence their acculturation processes.

2.2.2 Necessary knowledge and skills for the new academic culture.

Instructors and professors in Western academic settings are inclined to have the expectation that international students should have particular kinds of competence in order to adjust to Western academic discourses. Generally speaking, in a Western classroom, students are expected to actively participate in class through oral discussions (Cortazzi & Jin, 1996; Simpson, 2008) and have critical thinking (Kubota, 1999; Vandermensbrugge, 2004). However, Western professors are likely to have different expectations of classroom participation from their international students' expectations (Cortazzi & Jin, 1996; Kubota, 1999; Simpson, 2008). In many cases, international students do not receive the kinds of preparation they need to understand and then adjust to Western academic discourses. Thus, the second group of research on necessary knowledge and skills that international students need possess for the new academic culture focuses on pertinent academic knowledge and linguistic skills international students need to acquire in order to meet their disciplinary requirements (Ferris, 1998; Ferris & Tagg, 1996a & 1996b; Holmes, 1997; Johns, 1997; Kim, 2006; Swales, 1990; Swales & Feak, 1994). Academic literacy skills, especially academic writing skills, are considered as important abilities which international students need to possess (Johns, 1997). More specifically, the ability to write different academic genres is vital for international students (Swales, 1990; Swales & Feak, 1994). In addition, different academic fields have distinctive academic writing conventions (Holmes, 1997) so international students need to learn writing conventions for their particular academic disciplines. For instance, Holmes (1997) found that there were distinctive features in the way the discussion section of natural sciences was written which differed from the way

the same section would be written in social sciences research articles. In addition to academic writing skills, oral and listening skills are also vital for international students. For listening ability, studies have revealed that taking notes is likely a fundamental and essential skill for international students to develop (Ferris & Tagg, 1996; Kim, 2006) because it could help them increase their comprehension of lecturers' lessons and peers' talks. For speaking ability, research has revealed that international students need to develop skills in participating in seminar discussions (Ferris & Tagg, 1996a and 1996b), whole-class discussions (Kim, 2006), and formal presentations (Ferris & Tagg, 1996a and 1996b; Kim, 2006).

2.2.3 The process of international students' academic acculturation.

Given time, some international students are more successful than others in the ways they undertake required activities in order to acculturate to Western academic spaces. Hypothetically, two students from Taiwan may have stayed in the U.S. for a similar duration, but one is more successful than the other in this Western academic setting. Why do they have different academic outcomes? To account for these kinds of differences, the third group of research looks into the process of international students' acculturation to a new academic milieu (Casanave, 1995; Haneda, 2009; Leki, 2001; Morita, 2000; Park, 2009; Prior, 1998; Spack, 1997; Zhou, 2010). Prior (1998) reveals that international graduate students who succeeded in acculturating to their academic disciplines were those whose academic practices aligned with their theses or dissertations. Prior investigated two international students, Mai and Teresa, from their master's study to doctoral learning. The two students had different patterns of participation in their

academic discipline. Mai appeared to work in isolation and engage less in her disciplinary practice (Prior, 1998). Her motivation for studying the master's program was to complete her master's thesis (Prior, 1998). In addition, she took courses based on the requirements of her discipline (Prior, 1998). On the contrary, Teresa actively and continuously engaged herself in the community of practice and took courses aligning with her research (Prior, 1998). The content of her master's thesis also aligned with her intended dissertation (Prior, 1998). Consequently, Teresa had a better adjustment to her academic discipline (Prior, 1998). Casanave (1995) examined the process of international and domestic doctoral students' socialization into their sociological discipline during their first-year study. The students attempted to socialize into their discipline through taking required theory and research method courses, writing academic papers via learning their academic community's discourse conventions, and interacting with their peers, professors, and scholars. However, some of them failed to socialize into their academic discipline and left the doctoral program (Casanave, 1995). Casanave (1995) found two possible causes that could have led to students' failure. The first one is that academic programs and professors overlook the international students' learning needs (Casanave, 1995). The second one is the discrepancy in students' and professors' perceptions of disciplinary training (Casanave, 1995). Unlike Casanave's (1995) study investigating doctoral students' socialization into a doctoral program, Park (2009) examined the process of international undergraduate students' socialization into L2 particular discourse communities and the process of their identity change. The international students in this study struggled to transit from writing in L1 style to accommodating to L2 writing style (Park, 2009). During the process, they negotiated their identity back and forth rather than

in a linear way (Park, 2009). Leki (2001) did not explore international students' identity but their process of adjusting to the Western style of group projects. This study showed that during group discussions international students' opinions were often ignored or resisted by domestic group members because of domestic students' a priori assumption about international students as less capable and contributing group members (Leki, 2001). Consequently, the international students experienced difficulty in adapting to the Western group discussions and held negative attitudes toward group projects (Leki, 2001). Such false assumptions undermine international students' ability to make meaningful contributions through constructing international students as apprentices and domestic students themselves as masters (Leki, 2001). Haneda (2009) investigated the process of three Korean international master students' socialization into their academic discourse. At their beginning of learning in the master's program, they encountered challenges in group work, participation in class discussions, and understanding what professors meant by 'analysis' in their written feedback (Haneda, 2009). During the learning process, they gradually developed strategies to cope with some of the challenges, such as negotiating with their professors to allow them to form a Korean group and participating in class discussions through sharing their prior knowledge and experiences (Haneda, 2009). Unlike Haneda's (2009) research exploring class discussions, Morita (2000) examined the process of international graduate students' socialization into their disciplinary discourse through engaging in oral academic presentations. The participants stated their difficulty in oral academic presentations in terms of psychological, linguistic, and sociocultural aspects. Nonetheless, they were able to develop strategies to deal with challenges, such as rehearsing their presentations, preparing organized handouts, writing

notes for themselves before a presentation, utilizing audiovisual aids, actively collaborating with their supportive group members, and inviting classmates' inputs during a question-and-answer time (Morita, 2000). International graduate students in Zhou's (2010) study also expressed their challenges of adjusting to American academic culture but were able to gradually develop strategies to cope with some of the challenges. For instance, they developed good time management to deal with intensive academic tasks (Zhou, 2010).

2.2.4 Power issues during academic acculturation.

Cultural perceptions of "power," and "authority" differ from communities to communities. When international students migrate to Western academic spaces, they come with their presuppositions about power relationships between professors and students. On one hand, the mismatch in expectation about power and authority can negatively affect academic acculturation. On the other hand, the pressure to adjust one's identity in order to fit into Western academic spaces can be met with resistance by students. This fourth group of research explores international students' academic acculturation but foregrounds power issues during the process (Benesch, 2001; Bizzell, 1992; Canagarajah, 1999; Currie, 1998; Fox, 1994; Park, 2009; Pennycook, 1996). Bizzell (1992), Benesch (2001), Canagarajah (1999), and Fox (1994), for instance, pinpoint that in order to participate in the target academic community international students have to acquire required academic literacy. Nonetheless, during the learning process, some of them tend to resist the dominant Western discourses that often do not allow them to negotiate during the process. Despite their resistance, they still experience

pressure to accept an identity and subjectivity set up by the dominant Western academic discourses (Canagarajah, 1999; Fox, 1994). They face this pressure to give up their L1 academic discourses and adopt the Western ones that possess power and prestige (Canagarajah, 1999; Fox, 1994). Fox (1994), for instance, examined how international students from different cultures learned to write Western-style of academic writing. In Fox's study, an international student, Surya, who was a professional writer in her L1 culture, often received Western professors' comments asking her to improve English writing competence (Fox, 1994). She expressed that "In our [Nepali] writing style,we would not write in such a way that you would see the whole point in one paragraph or one page. We would come up with a lot of background information which would be considered redundant here in this context." (Fox, 1994, p. 66). Another international graduate student from Chile stated that writing academic papers in the Western style was not just learning a technique but changed original ways of thinking and seeing things (Fox, 1994). He expressed that "it's so powerful when you see things from a different perspective—the whole meanings of the world changes.....All my life and everything is going to make sense in a different way...." (Fox, 1994, p. 44). Such disregard of their indigenous identity and academic discourses usually makes some international students resist learning through not complying with rules and conventions that the dominant group established (Benesch, 2001; Canagarajah, 1999; Fox, 1994). For example, in Fox's study, an international student, Joella, was sent to Writing Workshop to fix her L2 writing and said "she's been failing" when Fox asked her background (Fox, 1994, p. 85). She knew some grammatical knowledge but made errors in her papers to show her resistance to the mainstream and standard Western writing style (Fox, 1994). Nevertheless, finally she still

needed to learn the mainstream writing style in order to meet her professors' requirements. Fox (1994) pinpoints that most international students are misjudged by Western professors and universities due to cultural differences in writing style and world view.

Currie (1998) and Pennycook (1996) explored power relationships in a different way. They investigated the issue of plagiarism that Asian international students often encountered in the Western academy. Currie (1998) indicates that plagiarism is ideological viewing the Western concept as the norm and a privilege. This view of plagiarism does not acknowledge that borrowing words from original texts is a process of learning the target language and academic language (Currie, 1998; Pennycook, 1996). This view also ignores writers from different cultures who have different approaches to texts, learning, and memorization (Currie, 1998; Pennycook, 1996). As Fox suggested, international students' L1 writing style and world view should be considered as 'different' rather than 'poor', 'good', or 'problematic'. Fox recommended that L2 writing teachers should teach international students how to write in the Western style and at the same time to learn others' writing style and world view. Park (2009) also examined power relationships during the process of international undergraduate students' transition from L1 writers to L2 writers. Park points out that "becoming a legitimate member of a discourse community is a dynamic process....that learners constantly evolve by assimilating, resisting, and appropriating language use in reference to the norms and values of the discourse community and bring possible change to the community" (p. 107). In an ideal sense, the target discourse community and L2 writers mutually influence and change each other. Nonetheless, the statement raises the question of in which way L2

writers change the target community. Is it possible that certain *fundamental* practices that the target community believes will remain unchanged but have to be complied with? For instance, Western style of academic writing conventions could not be changed but be followed, as Fox urges, to teach international students how to write L2 academic papers to meet the requirements of what the target community believes.

After reviewing this line of studies, comprising of four research groups, covering possible factors influencing international students' academic acculturation, expectations for essential academic knowledge and skills, learning strategies to overcome academic difficulties, and issues of power, it shows that academic acculturation is a complex, multifaceted process with a number of players. Understanding this process requires further examining some of the significant factors that characterize this process. The tribulations these students experience during their acculturation processes warrant further investigation. This present study is situated in the third research group which centers on the process of academic acculturation. It aims to extend this line of research through examining how Chinese-speaking international doctoral students acculturated to their particular academic disciplines and the role of technology during the processes. Through investigating their processes of academic socialization via technologies, this study expected to find out what technologies they utilized and how they employed them to assist them in acculturating to their disciplinary communities.

2.3 International Students' Challenges of Acculturation

Due to different prior exposure to language and academic environments that international students bring with them to Western academic spaces, there is a likelihood

that they would experience various acculturative challenges (Ellwood & Nakane, 2009; Poyrazli & Lopez, 2007; Wang & Li, 2008). Numerous scholars have investigated what challenges international students encounter during the acculturation processes (see Yeh & Inose, 2003). In the literature, three essential groups of research are extensively explored: 1) challenges of L2 and the L2 academic culture (see Poyrazli & Lopez, 2007), 2) challenges of L2 academic writing (see Casanave, 2002), and 3) challenges of classroom participation and oral presentations (see Currie, 2007).

2.3.1 Challenges of L2 and L2 academic culture.

Many studies on international students have revealed that the greatest challenge during their acculturation processes is English proficiency (Poyrazli & Lopez, 2007; Scheyvens, Wild, & Overton, 2003; Trice, 2003; Yeh & Inose, 2003). Their English competence could affect not only their interaction with local people, peers, and faculty members (Le & Gardner, 2010; Trice, 2003; Yeh & Inose, 2003), but also their academic performances (Poyrazli & Lopez, 2007; Scheyvens et al., 2003; Yeh & Inose, 2003). Trice's (2003) research, for example, displayed that international students confronted difficulty in integrating with American students and interacting with their professors, particularly caused by language difficulties. Scheyvens, Wild, and Overton (2003), for instance, discovered that international students' English ability directly influenced their understanding of instructors' lectures, reading, and writing for graduate courses. In addition to their insufficient English proficiency, they, especially Asian international students, encounter the possibility of experiencing more academic difficulties due to their distinct L1 academic culture (Scheyvens et al., 2003; Yeh & Inose, 2003). The Western

academic culture emphasizes students' independence and critical thinking, whereas the Asian academic culture stresses collectivism and dependence (Scheyvens et al., 2003; Yeh & Inose, 2003). The differences possibly exacerbate their academic acculturation (Scheyvens et al., 2003; Yeh & Inose, 2003). Moreover, the factors of their English ability and dissimilar academic culture could result in psychological and acculturative stress (Poyrazli & Lopez, 2007; Poyrazli, Kavanaugh, Baker, & Al-Timimi, 2004; Yeh & Inose, 2003).

2.3.2 Challenges of L2 Academic Writing

Research has shown that international students' L2 competence, previous L2 writing training, and differences between L1 and L2 writing conventions could hinder them from acquiring L2 academic writing (Casanave, 2002; Silva, 1992; Wang & Li, 2008). Their lack of L2 linguistic and rhetorical knowledge likely causes their lower confidence in writing L2 academic papers (Silva, 1992; Wang & Li, 2008). They tend to encounter difficulty in choosing right words to express their perceptions and feelings (Silva, 1992; Wang & Li, 2008). Due to their insufficient L2 and L2 writing knowledge, they attempt to think in L1 while outlining their L2 papers and utilize complicated L2 words and phrases in their L2 writing (Silva, 1992). These difficulties make some of them unable to write extended papers (Silva, 1992). Moreover, some international students only learn to write five-paragraph English essay before coming to the U.S. and do not receive formal training in L2 academic writing while studying in America (Casanave, 2002). Hence, they feel difficult to search and cite relevant scholarly works and to interpret resources (Casanave, 2002). Furthermore, differences between L1 and L2 writing conventions

could impact international students on writing L2 academic papers (Wang & Li, 2008). Asian international students in Wang and Li's (2008) study, for instance, expressed their challenges of having an inability to directly criticize scholars' opinions, and they were unfamiliar with the Western style of topic-oriented writing conventions. The English writing conventions, hence, influenced not only their writing styles but also ways of thinking (Casanave, 2002; Wang & Li, 2008).

In addition to L2 proficiency, L1 writing training, and differences between L1 and L2 writing conventions, discrepancies between international students' and instructors' expectations of good academic writing and writing comments could make them encounter more challenges and feel frustrated during the process of learning L2 academic writing. Leki's (1995) study has shown that ESL students and their instructors had different perceptions of good academic writing. Most of the ESL students considered that interesting topics, organizational concerns, sophisticated language, and good grammar were what their instructors looked for, whereas their instructors actually focused on the content of their writing (Leki, 1995). This misconception caused confusion and frustration during their writing processes (Leki, 1995). In addition, they and their instructors often hold different attitudes toward implicit and explicit writing comments. Instructors believe implicit writing comments could promote students to think and enhance their writing competence. However, such comments possibly perplex international students and make them uncertain of how to revise their papers (Brice, 1995).

2.3.3 Challenges of classroom participation and oral presentations.

The ability for international students to express themselves actively and ask questions is a hallmark of classroom participation in America (Currie, 2007; Ellwood & Nakane, 2009; Ferris & Tagg, 1996a & 1996b). Nonetheless, some international students tend to be silent in Western classrooms and hence are likely perceived as passive learners by professors and native-English-speaking peers (Ellwood & Nakane, 2009). This line of research has disclosed three main factors causing international students to have challenges of participating in class discussions and giving oral presentations. First, the language barrier could inhibit them from freely asking questions and expressing their opinions in discussions (Ellwood & Nakane, 2009; Liu, 2000; Liu & Kuo, 1996; Morita, 2004; Yang, 2010). Research has shown that most international students are interested in the subject matter and have a strong desire to participate in class discussions. However, some of them perceive themselves as less competent English speakers and are afraid to make English mistakes; therefore, they tend to keep silent in class (Ellwood & Nakane, 2009; Morita, 2004; Liu, 2000; Liu & Kuo, 1996). International graduate students in Liu and Kuo's (1996) study expressed that they felt anxious to be called on in class but would speak up if they knew the answers. Some international students adopt strategies to cope with the problem of their silence in class and compensate for their limited English ability. For instance, in Yang's (2010) study, international students in business majors wrote a detailed case analysis, designed professional PowerPoint slides, had more close-ended questions, and left a few minutes for peers to ask questions to compensate for their limited English ability.

The second factor causing international students to have difficulty in participating in class discussions is possible that discussion topics are often inclined to be local issues which many international students are unfamiliar with; hence, they are unable to partake in discussions (Liu, 2000; Morita, 2000; Morita, 2004; Pinheiro, 1999; Tatar, 2005). Due to the lack of background knowledge of discussion topics, some international students feel that they are ignored and marginalized in class (Morita, 2004). Moreover, in most situations, instructors have a tendency to not provide international students clear and sufficient background knowledge of discussion topics, so they have difficulty in understanding their instructors' and domestic peers' talks (Pinheiro, 1999). Furthermore, if topics and discussions are persistently centered on American issues, there is a possibility that international students would gradually lose interest in class discussions (Tatar, 2005). The selection of topics and the provision of background knowledge of the topics could influence international students' participation in class discussions. The absence of their participation in class discussions, thus, is possible because most instructors overlook the importance of carefully selecting these topics (Pinheiro, 1999; Tatar, 2005).

The third factor causing their difficulty in taking part in class discussions is likely cultural differences in styles and perceptions of class discussions. Regarding the styles of class participation, Western conversations tend to be characterized by a quick pace of conversation and turn-taking (Liu, 2000; Morita, 2000, 2004), whereas international students' L1 conversations are likely characterized by a slow pace and dominated by instructors. Due to the Western fast-speed style of discussions, some international students encounter challenges of finding time to jump in class discussions (Ellwood &

Nakane, 2009; Morita, 2000, 2004; Pinheiro, 1999). International students in Tatar's (2005) research expressed that even though they prepared what to say before a class, they sometimes lost chances to partake in discussions.

Moreover, disparate perceptions of class discussions could also influence international students to take part in discussions (Tatar, 2005). Many international students view class discussions as a formal oral presentation where they present their acquired academic knowledge (Tatar, 2005). On the contrary, some Western peers and instructors view class discussions as an informal event in which students freely share their opinions no matter how good or bad these opinions are (Tatar, 2005). Hence, international students appear to think and plan what they should say before speaking up (Morita, 2000). However, after their preparation, they usually miss chances to speak up in class (Tatar, 2005). They attempt to express what they think are meaningful opinions, and thus their silence does not mean they do not have ideas or opinions. Because of the different perspectives on class discussions, some international students feel local students' talks are irrelevant to a class main topic or illogical and non-meaningful (Pinheiro, 1999; Tatar, 2005).

Moreover, Asian culture emphasizes save face and harmony during conversations, whereas the Western culture stresses critical thinking and critique (Liu, 2000). Therefore, Asian international students are disposed to be silent and agree with peers' and instructors' opinions during class discussions (Liu, 2000) even though they do not actually agree in their mind. Nevertheless, their silence in class is often considered as weakness by Western instructors and peers; therefore, they often receive lower grades on class discussions (Currie, 2007). They also feel culture shock and discouraged when Western students criticize what they say during class discussions (Currie, 2007).

Furthermore, Asian international students are inclined to view instructors as the main knowledge resource rather than peers. Accordingly, some international students are disposed to think class discussions waste their time because they want to learn knowledge from instructors (Currie, 2007).

International students' silence in discussions is often simply interpreted by Western instructors and peers as a negative and passive learning behavior (Currie, 2007). Nevertheless, the reasons behind their silence in discussions are more complicated than what Western instructors and students think. Therefore, before making a judgment on international students' silence in discussions, one needs to consider cultural differences of international students' L1 and L2 in styles of class discussions and their perceptions of class discussions (e.g., discussions that should be formal and provide constructive own opinions) in L2 settings. International students might be more willing to partake in class discussions if instructors explicitly explain the Western classroom culture. For example, instructors could explain to international students that they could freely express their opinions or ask questions no matter the opinions and questions are nonsense to them because discussing own opinions and mutually learn from each other are considered a learning process.

On the whole, international students encounter difficulty in adjusting to L2, L2 academic culture, such as independent v.s. dependent learning, L2 academic writing, participation in class discussions, and oral presentations during their acculturation processes. Notably, challenges experienced by these students impact on their four language skills: reading, speaking, listening, and writing. What are some possible ways of alleviating the predicament faced by international students? Could there be a medium

that can mediate classroom experiences for these students? Perhaps technology could play a mediating role that in some ways helps these students overcome academic challenges in these unfamiliar Western academic settings.

2.4 Technology Use by International Students

Technology has been viewed as a beneficial tool for learning a second language (Abdous, Camarena, & Facer, 2009; Bouvet & Close, 2006; Cooledge, 2004; Hew, 2009; McDonald, 2007; Sun, 2010). Research on international students has also shown that technology could assist international students in adjusting to a new society (see Cemalcilar, Falbo, & Stapleton, 2005; Fan, 2008; Kim, 2010; Kim, Yun, & Yoon, 2009; Lee, 2005; Reece & Palmgreen, 2000). This line of research has two major groups of studies: 1) technology use for non-academic purposes and 2) technology use for academic purposes.

2.4.1 International students' use of technologies for non-academic purposes.

Studies have manifested that the use of technology helps international students improve their general English competence (Fan, 2008; Lee, 2005; Reece & Palmgreen, 2000). English proficiency is regarded as a significant factor in successfully acculturating to the Western academic culture (Yeh & Inose, 2003). Nonetheless, international students often suffer various challenges during their acculturation processes due to their insufficient English competence (see Poyrazli & Lopez, 2007; Scheyvens et al., 2003). Researchers have found that international students could enhance their English ability through utilizing media to access English artifacts (Fan, 2008; Lee, 2005; Reece &

Palmgreen, 2000). For instance, international students in Fan's (2008) and Reece and Palmgreen's (2000) research expressed that watching American television helped them improve their English proficiency. Lee (2005) has found that the more international students spent time on American media, the better English skills they possessed. Moreover, the more they spent time on American media, the more they felt satisfied with their acculturation processes (Lee, 2005).

Research has also confirmed that the use of technology could aid international students in relieving acculturative stress (Cemalcilar et al, 2005; Fan, 2008; Kim, 2010; Kim et al., 2009; Kline & Liu, 2005; Ye, 2005, 2006a & b). Studies have revealed that international students are inclined to use CMC technologies to maintain the relationships with their family and L1 friends in their native countries during acculturation processes (Cemalcilar et al, 2005; Fan, 2008; Hodis & Hodis, 2012; Kim et al., 2009; Kim, 2010; Kline & Liu, 2005). This connection could help them reduce the stress of adjusting to a new culture (Cemalcilar et al, 2005; Fan, 2008; Kim et al., 2009; Kim, 2010; Kline & Liu, 2005). Most Asian international students, for example, in Kline and Liu's (2005) and Kim et al.'s (2009) studies, tended to spend a great deal of time on communicating with their family via email. Asian international students in Kline and Liu's (2005) and Kim's (2010) research were disposed to utilize telephones or cell phones to communicate with their parents because their parents were more familiar with phones than the Internet. When communicating with their friends from their native countries, they usually employed instance messengers, such as MSN or QQ (Fan, 2008; Kim et al., 2009). Some international students in Kim's (2010) research expressed that the connection compensated for lonely feeling in a foreign country. International students in Fan's

(2008) study reported that their use of CMC technologies as entertainment helped them escape from heavy study load and relieve their acculturative stress. Researchers of these studies also point out that the connection provides international students with emotional support and strength in a new culture (Cemalcilar et al, 2005; Fan, 2008; Kim et al., 2009; Kim, 2010; Kline & Liu, 2005).

The use of technology could also assist international students in building social networks in a new territory (Cao & Zhang, 2012; Fan, 2008; Hodis & Hodis, 2012; Kim et al., 2009; Kim, 2010). International students have been discovered that they likely encounter problems of making local friends (Zhai, 2002) and tend to isolate themselves from peers and faculty members (Scheyvens et al., 2003; Yan & Berliner, 2009; Zhai, 2002). Research has disclosed that the use of technology could help them make connections with people from identical ethnic groups (Cao & Zhang, 2012; Fan, 2008; Kim, 2010; Kim et al., 2009) and local communities in a new country (Fan, 2008; Hodis & Hodis, 2012; Kim, 2010; Kim et al, 2009). For making connections with people from the same country, in Kim et al.'s research (2009), international students in South Korea developed a friendship with students from the same ethnic group through CMC technologies and utilized the connection to obtain necessary information to effectively manage their daily lives in the new environment. This finding is similar to Cao and Zhang's (2012) study which they investigated international students employed social network sites, such as Facebook and found that this use helped them build and maintain the relationship in online ethnic communities. This relationship further provided them not only emotional support but also practical assistance (Cao & Zhang, 2012). One participant, for instance, said friends in the online ethnic group shared their experiences

of things that they encountered in the new country (Cao & Zhang, 2012). For establishing connections with the target communities, most international students in the U.S. employ Facebook to maintain relationships with local people (Fan, 2008; Kim, 2010) because the social network site is popularly used by Americans (Hodis & Hodis, 2012). In Kim's (2010) study, some international students reported they got to know their new friends better through their friends' postings on Facebook. Similarly, some participants in Fan's (2008) research said that they employed Facebook to keep in touch with friends and lab-mates in the U.S.

2.4.2 International students' use of technologies for academic purposes.

The other group of research explores international students' use of technology for academic purposes. This group of studies can be divided into two major subgroups: 1) international students' use of technology in English as Second Language (ESL) and English for Academic Purposes (EAP) classes and 2) international students' use of technology in their academic discipline disciplines. The second group can be further divided into three sub-groups: 1) the use of technology in an online discussion board or forum, 2) the use of e-mail to communicate with faculty members and peers, and 3) the use of technology to search for academic information.

2.4.2.1 Technology use in ESL and EAP classes.

One group of researchers has investigated the impact of technology use on international students in ESL and EAP classes (Bakar & Ismail, 2009; Bradley, Lindstrom, & Rystedt, 2010; Braine, 1997; Dekhinet, 2008; Kasper, 2000; Kaur & Hegelheimer, 2005; Kessler,

Bikowski, & Boggs, 2012; Kol & Schcolnik, 2008; Shin, 2006; Varley, 2009; Yoon, 2008). Most of these researchers have mainly examined the use of technology to develop international students' English academic writing skills. Researchers have found that integrating technology into ESL and EAP classes likely facilitates student-centered learning (Bakar & Ismail, 2009; Bradley et al., 2005; Braine, 1997; Dekhinet, 2008; Kessler et al., 2012; Kol & Schcolnik, 2008). For instance, Braine (1997) discovered that international students tended to learn L2 writing from peers more in a networked computer ESL class than in a traditional one. Most of the international students in Bakar and Ismail's (2009) research also indicated that blogging allowed them to share their writing and ideas with friends. Bradley et al. (2010) investigated international students' use of wikis in an English for specific purposes course and found that wikis promoted the students to collaboratively construct texts through mutually giving feedback on their L2 writing and ideas. In addition to facilitate student-centered learning, research has also shown that through utilizing Web 2.0 tools, such as blogs and wikis, international students are inclined to write more English messages and longer texts (Bakar & Ismail, 2009; Bradley et al., 2010; Dekhinet, 2008; Kessler et al., 2012; Kol & Schcolnik, 2008). For example, many international students in Bakar and Ismail's (2009) research reported that they were able to write longer texts on blogs than on paper because they could use conversational English to express themselves freely on blogs. Bakar and Ismail found that the international students wrote not only longer texts but also more complex sentences on blogs. Braine (1997) pinpoints that an online environment is less threatening than a class environment so international students in his study had lower anxiety to write and hence produced more online L2 messages. Braine also explained that international students observed their peers

to take risks, such as asking clarification from classmates and teachers, challenging classmates to justify their opinions, and occasionally making mistakes in spelling and grammar, in an online environment. This observation made them be more willing to actively participate in online discussions (Braine, 1997).

Moreover, studies have shown that writing in online environments possibly helps international students improve their L2 writing competence (Bakar & Ismail, 2009; Bradley et al., 2010; Braine, 1997; Kessler et al., 2012; Kol & Scholnik, 2008). For instance, most of the international students in Bakar and Ismail's (2009) study stated that they were able to write better on blogs because they considered a blog as an open space and thus tried to write correct sentence structures and grammar. In addition, they invited friends to read their blogs and received comments from their friends (Bakar & Ismail, 2009). They expressed that the comments assisted them not only in their L2 writing but also in increasing their knowledge about how to raise their self-confidence in presenting their ideas and to offer peers constructive feedback (Bakar & Ismail, 2009). Bakar and Ismail also discovered that most of the participants wrote more organized texts on blogs than on paper. Braine (1997) indicates that a network computer class promotes collaborative learning among peers and hence could enhance international students' writing quality. As in Kessler et al.'s (2012) study, a wiki collaborative writing environment offered international students opportunities to evaluate their own comments for peers and suggest constructive changes. These writing suggestions likely promoted their ability to write better quality of L2 writing. Dekhinet (2008) examined the impact of online feedback given by native-English-speaking tutors on international students' L2 writing on MSN messengers. The results have revealed that through giving implicit and

explicit feedback in back and forth online messages, international students generally raised their awareness of their writing errors (Dekhinet, 2008) and thus helped them improve their L2 writing. Kol and Schcolnik (2008) also obtained similar results. They found that most of EAP international undergraduate students in the study improved their grammatical accuracy in online messages (Kol & Schcolnik, 2008).

In addition to writing in an online environment, research has shown that employing online English corpus or concordance technology could assist international students in developing their L2 and L2 writing ability (Kaur & Hegelheimer, 2005; Varley, 2009; Yoon, 2008). Kaur and Hegelheimer (2005) investigated whether the use of an online dictionary together with an online concordance could aid international students in transferring word knowledge to academic writing tasks. They provided an academic vocabulary list to the participants and designed activities for them to use an online dictionary and concordance (Kaur & Hegelheimer, 2005). They compared the treatment group that was provided an online dictionary and an online concordance with the control group that was offered only an online dictionary (Kaur & Hegelheimer, 2005). The findings have disclosed that international students in the treatment group more correctly applied their word knowledge to other academic writing tasks than international students in the control group did (Kaur & Hegelheimer, 2005). The researchers explained that a dictionary only offers definitions of words, and word knowledge learned from a dictionary is difficult to be transferred to new writing contexts (Kaur & Hegelheimer, 2005). International undergraduate students in Varley's (2009) study utilized a popular concordancing program, Wordsmith Tools, and were aware of the benefits of using it. Most of them reported that they would employ it in the future (Varley, 2009). They

expressed that the concordance helped them learn word usage, particularly on collocation and word clusters, and use learned word usages in other writing contexts (Varley, 2009). They indicated that using the concordance to check words was faster than using a dictionary (Varley, 2009). Yoon (2008) pinpoints that the use of a concordance tends to enhance international students' L2 awareness which possibly influences their approaches to writing and the writing process. Yoon also discovered that their use of a concordance helped them form a habit of checking their writing when composing and hence facilitates independent learning. Moreover, because they could transfer learned word knowledge from the concordance, the quality of their writing increased (Yoon, 2008). This improvement helped them increase their confidence in writing (Yoon, 2008).

In addition to the advantages of using technology to improve L2 academic writing, research has revealed that the integration of an online discussion board or forum in ESL or EAP classes could assist international students in participating in discussions (Sotillo, 2000; Warschauer, 1995). Warschauer (1995) examined the equality of student participation in face-to-face and online discussions. The results have shown that international students participated more in online discussions than in face-to-face ones (Warschauer, 1995). Moreover, they tended to use more formal and complex words and sentence structures in online discussions (Warschauer, 1995). Warschauer (1995) reveals that international students' shyness and their lack of oral competence likely caused their reduced participation in face-to-face discussions as compared to online discussions. Warschauer (1995) suggests that online discussions could be employed first for international students to generate ideas and discuss in a face-to-face situation later. Sotillo (2000) also obtained positive results by comparing international students' use of online

synchronous and asynchronous CMC tools for an ESL academic writing course. The findings have revealed that in both synchronous and asynchronous environments students dominated discussions more than their teacher did (Sotillo, 2000). Sotillo pinpoints that students' interactive discussions likely promote the establishment of a learner community and autonomous learning. The findings have also disclosed that international students had different learning patterns in synchronous and asynchronous environments (Sotillo, 2000). In a synchronous environment, they were inclined to focus on meaning and hence neglected accuracy (Sotillo, 2000). On the contrary, in an asynchronous environment, they had more time to write messages and monitor their spelling and punctuation (Sotillo, 2000).

The above studies have shown that the integration of technology into English writing and speaking promotes academic writing skills (Kessler et al., 2012) and speaking ability (Warschauer, 1995) for international students. Nonetheless, these studies only center on their use of technology in ESL and EAP classes (see Bradley et al., 2010; Sotillo, 2000) rather than in their academic disciplines and outside of class. Some studies (see Kim, 2011; Zhang & Kenny, 2010) examined international students' use of technology in their academic disciplines. These studies are introduced in the following section.

2.4.2.2 Technology use in academic disciplines.

These studies explored international students' use of technology in their academic disciplines (Biesenbach-Lucas, 2005, 2007; Chen, 2006; Hughes, 2013; Kamhi-Stein, 2000; Kim, 2010; Kim, 2011; Kim et al., 2009; Pilkington & Walker, 2003; Sin, Kim, Yang, Park, & Laugheed, 2011; Zhang & Kenny, 2010). This line of research can be

categorized into three groups of studies: 1) the use of an online discussion board or forum, 2) the use of e-mail, and 3) the use of technologies to search for academic information.

The use of an online discussion board or forum.

Researchers (Kamhi-Stein, 2000; Kim, 2011; Pilkington & Walker, 2003; Zhang & Kenny, 2010) explored international students' participation in online discussions in their academic courses. These studies have shown that international students appeared to participate more in online discussions. For instance, in Kim's (2011) research, international students in a master's course voluntarily and actively posted more online messages than their English-native-speaking peers, although they had the requirement of minimum postings. In addition, their postings tended to more accommodate and reflect peers' perspectives than their English-native-speaking peers did (Kim, 2011). In Kamhi-Stein's (2000) study, international students and their instructor equally initiated discussions in a face-to-face master's course. Nevertheless, they initiated and responded more than their instructor did in a web-based discussion board (Kamhi-Stein, 2000). They collaboratively constructed knowledge with their peers and took more responsibility for their learning in the online environment (Kamhi-Stein, 2000). Moreover, the students expressed that online discussions allowed them to hear multiple voices and perceptions, and this promoted a richer learning environment. They also stated that discussing online lowered their cultural and linguistic barriers, which usually existed in face-to-face discussions, and hence reduced their anxiety to express their opinions and ideas (Kamhi-Stein, 2000). Pilkington and Walker (2003) investigated not only international students'

participation in face-to-face and synchronous online discussions but also the roles that they took up in discussions. They designed seven roles and encouraged the students to take up the roles in both types of discussions. The seven roles were “WebCT, exploratory inquiry, task management, encouraging participation, positive feedback, negative feedback, and content building” (Pilkington & Walker, 2003, p. 45-46). The researchers compared three groups: 1) international students in an online course, 2) international students in a course combining face-to-face and online interaction, and 3) native-English-speaking students in the same kind of combination course. The results have disclosed that international students in the online course outperformed the other two groups on essay assignments (Pilkington & Walker, 2003). Furthermore, the researchers explained that international students took up those roles more often in online discussions, and this likely raised the quality of their discussions. Zhang and Kenny (2010) also examined international students’ participation in an online master's course but obtained different results. International students in this study expressed that they had less pressure and embarrassment to communicate with their peers in English in the online environment because the environment allowed them to have more time to read and compose messages (Zhang & Kenny, 2010). Nonetheless, they stated that they had difficulty in understanding their native-English-speaking peers’ postings due to lack of local knowledge (Zhang & Kenny, 2010). Moreover, some of them felt their English writing and speaking competence were inadequate and hence hindered them from posting as many messages as they would like to (Zhang & Kenny, 2010). In addition, the researchers point out that their prior Asian educational background and culture emphasizing harmony and the authority of the teacher-role affected their learning

behavior in online discussions (Zhang & Kenny, 2010). They tended not to argue with their peers and expect their instructors to criticize students' online writing (Zhang & Kenny, 2010). They were also inclined to participate more in online discussions related to course content but participated less in online discussions when they thought these discussion topics were irrelevant to the course (Zhang & Kenny, 2010). The researchers recommended that international students' needs and expectations, principles of designing online courses, and minimum English proficiency could be considered during the process of designing an online course (Zhang & Kenny, 2010). Besides being used for online courses and discussions, technology can be used for one-to-one communication between instructors and peer-to-peer communication. The next section discusses this particular use.

The use of e-mail to communicate with faculty members and peers.

Another group of researchers (Biesenbach-Lucas, 2005, 2007; Chen, 2006, Kim et al., 2009; Kim, 2010) explored international students' use of e-mail to communicate with their faculty members and/or peers. For example, in Kim et al.'s (2009) research, international students in South Korea employed e-mail to obtain academic information from their peers and school administrative assistants. In another study (Kim, 2010), international students utilized instant messenger to communicate with their peers but used e-mail to communicate formal, academic, and official purposes. They reported that e-mail was the primary tool for them to communicate with domestic students (Kim, 2010). The students reported experiencing greater efficiency when employing e-mail to communicate with peers, faculty, and staff than through face-to-face interaction (Kim, 2010). They also

felt less stress to communicate in English through e-mail than face-to-face situation (Kim, 2010). Biesenbach-Lucas (2005) investigated e-mail use by native-English-speaking (NES) and international graduate students to communicate with their Western professors. The NES students' and international students' e-mails showed that NES students initiated to meet their professors on non-regular office hours and requested professors' feedback on their assignments before submission more than international students did (Biesenbach-Lucas, 2005). Some of the international students in this study expressed that they did not know those behaviors were acceptable and thought they were expected to deal with their assignments by themselves (Biesenbach-Lucas, 2005). In 2007, Biesenbach-Lucas (2007) conducted a similar study but focused on examining politeness of NES students' and international students' language in e-mails. The results have revealed that NES were more able to adopt direct and indirect language to produce polite e-mails than international students did. For instance, when requesting for extension of submitting assignments, NES tended to use indirect strategies and the past tense forms twice in an e-mail –e.g., “I was wondering if it would be possible for me to submit...” (Biesenbach-Lucas, 2007, p. 9). On the contrary, international students would write “If possible, could you give more time/extend the deadline...” (Biesenbach-Lucas, 2007, p. 9). Chen (2006) also obtained similar results, but (more specifically) her study investigated a Taiwanese international student in the U.S. for two and a half years as the student transitioned from master's level to doctoral level. At the beginning of the process, the participant's e-mails tended to be unclear, delayed main statements with many irrelevant details, and ineffective utilization of reasons or explanations as supportive statements, and failed to appropriately use polite English to communicate with her

professors (Chen, 2006). However, with the change of her student status from a master's student to a doctoral student, she gradually learned how to appropriately and politely interacted with her Western professors (Chen, 2006). Chen (2006) pinpoints that international students have to be prepared to understand “every discourse practice is socioculturally value-laden and that the appropriateness of every practice is determined by a dominant sociocultural group, not by individual preference (as cited in Fairclough, 1995). Chen recommends that instruction of how to appropriately communicate with authoritative figures via e-mail needs to be taught in L2 classes because rules of appropriate interaction are usually hidden and hard to acquire. In addition to explicit instruction of how to write polite e-mails to professors, most international students do not know some Western academic cultural aspects, such as requesting feedback on assignments before submission and scheduling appointments with professors during non-regular office hours. Those academic practices are usually taken for granted to assume that all students know the academic culture. Explicitly telling international students Western academic practices could reduce their misconception and assist them in having better communication with faculty members. One increasingly popular mode of communication employed by international students in pursuit of academic information is the use of technology.

The use of technologies to search for academic information.

The third group of researchers (Hughes, 2013; Sin et al., 2011) explored international students' use of technology to search for academic information. Sin, Kim, Yang, Park, and Laugheed (2011) adopted a survey to examine what acculturation information

international students sought for. In this study, approximate fifty percent of the participants were international doctoral students and around twenty percent of them were master's students (Sin et al., 2011). These students utilized the following media in descending order of frequency to obtain needed information: online search engines (e.g., Google), official institutional websites (e.g., the international student office's website), general websites, social network sites (e.g., Facebook), blogging tools (e.g., Twitter), and print sources from libraries (Sin et al., 2011). However, the researchers did not state what kinds of educational information most of the international students needed and what technologies they employed to obtain which kinds of educational information. Hughes (2013) adopted qualitative research methods to investigate how international students utilized online information to learn. This study recruited twelve international undergraduate students and thirteen master's international students. Almost all of the master's students studied business majors. The findings have revealed that most of the master's students needed the following online resources to complete their assignments: company information, statistics, background information, academic information, definitions, and legal information (Hughes, 2013). They employed the following technologies in descending order of frequency to receive information related to their assignments: internet search engines (e.g., Google search engine), journal databases, discipline-specific databases, online reference resources, and online library catalog. They reported that they frequently utilized internet search engines because internet search engines contained broad information, supported diverse languages, and were easy to use (Hughes, 2013). They also expressed that they were more familiar with internet search engines than other technologies, such as discipline-specific databases (Hughes, 2013).

Their use of journal databases was limited to few multidisciplinary databases, such as ProQuest and Emerald (Hughes, 2013). Few of them employed discipline-specific databases to obtain needed information (e.g., statistics and company and legal information) (Hughes, 2013). Hughes focused more on international students' use of technology for searching academic information but did not pay attention to their use of technology for developing their academic competence and for socializing into their academic disciplines.

In sum, research on international students' use of technology in their academic disciplines focuses more on the use of online discussion boards or forums to participate in class discussions (see Kim, 2011; Zhang & Kenny, 2010), e-mail to interact with their professors and/or native-English-speaking peers (see Biesenbach-Lucas, 2005, 2007; Chen, 2006), and technologies to seek educational information (see Hughes, 2013; Sin et al., 2011). Moreover, most of the studies examined international undergraduate students and/or master's students (see Hughes, 2013) rather than international doctoral students. Not much research has paid attention to international doctoral students' use of technology to gain discipline-related and research-related knowledge and to participate in their academic communities. Therefore, this current study aims to investigate this research issue.

2.5 Summary

In summary, this review of the literature on international students' academic acculturation, academic challenges, and their use of technology for academic purposes has produced three significant points:

- a. tension exists between the cultural and experiential presuppositions that international students bring to a Western academic space, on one hand, and the expectation by Western instructors and professors with regard to the Western academic culture, English proficiency, and learning strategies that these students are expected to have on the other hand.
- b. In an attempt to lessen the challenges they experience from academic acculturation in Western spaces, international students tend to employ various forms of technology. While the studies reviewed here discuss assistive forms of technology in this acculturative experience, the use of technology in and of itself is not a solution to myriad of challenges that international students face.
- c. This review highlights various uses of technologies by international students studying in Western academic settings, thereby foregrounding possible connections between these uses of technology and conceptualizations of academic success. Notably, "international students" is not homogenous since these students come from different linguistic social backgrounds and academic disciplines.

These three points pinpoint the importance of investigating how international students, such as Chinese-speaking international students, adopt technologies to assist them in socializing into Western academic spaces and subsequently into their particular disciplinary communities. This investigation motivates the research questions that guided this present study. The next chapter discusses the methodology for undertaking this study.

Chapter 3: Methodology

3.1 Introduction

In this chapter, I discussed the main features of the methodology employed in this dissertation. This chapter comprises eleven sections as follows: 3.1 this introduction, 3.2 the theoretical and conceptual frameworks (Vygotsky's (1978) sociocultural theory, Lave and Wenger's (Lave & Wenger, 1991; Wenger, 1998) communities of practices and legitimate peripheral participation, and Casanave, Li, and other scholars' academic acculturation (Casanave, 2002; Casanave & Li, 2008)), 3.3 the research design (which explains case study through ethnographic tools), 3.4 the research site, 3.5 participants, 3.6 the role of the researcher, 3.7 instrumentation and data collection (which elaborates on the survey, interviews, document collection, weekly journals, and field notes), 3.8 data analysis (Merriam's (2009) procedure of data analysis), 3.9 validity and reliability, and 3.10 ethical consideration.

3.2 Theoretical and Conceptual Frameworks

Green (2014) indicates that frameworks are like the map of research. They provide researchers scaffolding to design their studies, develop research questions, select instruments, and interpret findings (Imenda, 2014; Liehr & Smith, 1999; Merriam, 1998; Merriam & Simpson, 2000; Rocco & Plakhotnik, 2009). Some researchers use the two terms, a theoretical framework and a conceptual framework, interchangeably (Fain,

2014; Parahoo, 2014; Sinclair, 2007). Some researchers see differences between them (Imenda, 2014; Rocco & Plakhotnik, 2009). Imenda (2014) explained that “a conceptual framework is derived from concepts, in-so-far as a theoretical framework is derived from a theory” (p. 189). With this mentality, this present study distinguishes a theoretical framework from a conceptual framework. Hence, this study took up Vygotsky's (1978) sociocultural theory as the theoretical framework and Lave and Wenger's (1991 & 1998) communities of practice, and academic acculturation (Casanave, 2002; Casanave & Li, 20008) as the conceptual frameworks to guide this study to design the research, gather and analyze data, and interpret findings.

3.2.1 The theoretical framework.

This study employed Vygotsky's (1978) sociocultural theory as the theoretical framework in exploring how Chinese-speaking international doctoral students socialized into their particular disciplinary communities. Vygotsky's (1978) sociocultural theory emphasizes that social interaction among learners, adults, and peers fosters learning and development. In addition, signs and tools, including words and technologies, serve as a means to socially interact with other people (Vygotsky, 1978). His well-known Zone of Proximal Development (ZPD) further explains how learners can accomplish a difficult task that he or she cannot tackle by himself or herself through giving guidance and collaborating with people who have more experience. In this current study, Chinese-speaking international doctoral students as learners socially interact with their peers, senior graduate students, post-doctoral researchers, professors, and scholars outside of the school (these people are Vygotsky's so-called peers and adults who have more learning

experience) to learn necessary knowledge and skills during their academic acculturation processes. During the learning process, their L1 (Chinese), L2 (English), and technology (which are Vygotsky's so-called signs and tools) serve as a means to help them socially interact with their peers, senior graduate students, post-doctoral researchers, professors, and scholars outside of the school. Through utilizing the signs and tools and coupling with guidance from and/or collaborative learning with peers and more experienced researchers, these Chinese-speaking international doctoral students could be able to accomplish difficult learning tasks. Vygotsky's (1978) sociocultural theory and ZPD stress on the process where learners learn general knowledge and skills through socially interacting with learners who have more experience in learning and instructors, but do not particularly describe the process where learners as apprentices acquire professional knowledge and skills through socially interacting with more experienced researchers and experts in their professional fields. This present study, thus, also adopted Lave and Wenger's communities of practice (Lave & Wenger, 1991; Wenger, 1998) and academic acculturation (see Casanave & Li, 2008) to help me understand the issue of Chinese-speaking international doctoral students' academic acculturation.

3.2.2 The conceptual frameworks.

In addition to Vygotsky's (1978) sociocultural theory as this study's theoretical framework, this study also adopted Lave and Wenger's communities of practice (Lave & Wenger, 1991; Wenger, 1998) and academic acculturation (see Casanave & Li, 2008) as the conceptual frameworks. The fundamental concept of Lave and Wenger's communities of practice (Lave & Wenger, 1991; Wenger, 1998) came from their social theory of

learning which considered learning as a social participation referring to not only "local events of engagement in certain activities with certain people, but to a more encompassing process of being active participants in the practice of social communities" (Wenger, 1998, p. 4). In their initial version of communities of practice, Lave and Wenger (1991) briefly explained that "learners as apprentices" (p. 29) learn to engage in social practice through apprenticeship to obtain knowledge and skills that are recognized by their communities. They, then, gave examples of butchers, midwives, tailors, and quartermasters to show how new-timers engage in situated learning guided by old-timers and attempt to move from peripheral participation to full participation in communities of practice. The process where new-timers peripherally participate in communities of practice before fully participating in communities of practice is Lave & Wenger's so-called legitimate peripheral participation. In other words, the concept of communities of practice (Lave & Wenger, 1991; Wenger, 1998) focuses on relationships between new-timers and old-timers and the process by which new-timers become full participants in the communities. In Lave & Wenger's (1991) initial version, they did not explicitly describe what social learning consisted of and what learning, community, and participation meant. Later, Wenger (1998) delineates those concerns and identifies social participation as the centerpiece of communities of practice. He defined social participation as an "encompassing process of being active participants in the practices of social communities and constructing identities in relation to these communities" (p. 4). The social theory of learning, which accounts for this participation, contains four main components: 1) meaning, 2) practice, 3) community, and 4) identity (see Figure 3.1).

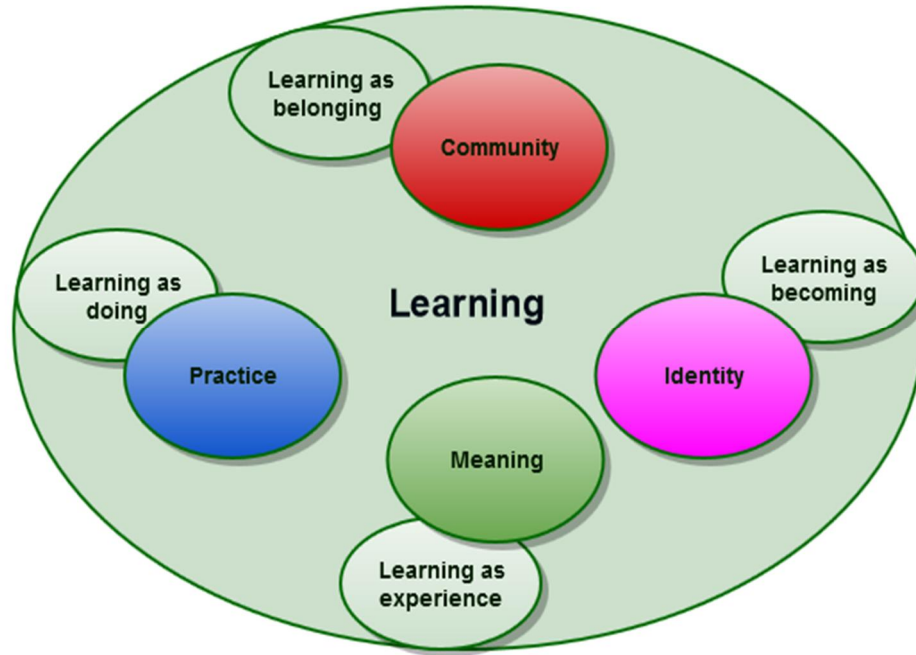


Figure 3.1 Modified from Lave and Wenger's Social Theory of Learning (Wenger, 1998)

Meaning, as depicted in Figure 3.1 above, is equivalent to "learning as experience" (Wenger, 1998, p. 5). The concept of meaning allows researchers to account for variations in people's abilities to understand and function in the world. Community is equivalent to "learning as belonging," in other words, when a community-member participates in the activity of the community, this participation shows competence which is valued by the community. Through the process, members are changing their competence and the communities are also changed by their participation. Practice is equivalent to "learning as doing," that is to say, the acquisition of shared resources "sustain[s] mutual engagement in action" (Wenger, 1998, p. 5). Identity is equivalent to "learning as becoming" (Wenger, 1998, p. 5) which accounts for how people are reshaped by their learning experiences and they gradually form ties with their communities. Since this present study did not explore participants' identity, this component was not

introduced. A comprehensive discussion of identity is outside the scope of this present study. Instead, this study considered community, practice, and meaning in Chinese-speaking international doctoral students' academic acculturative experience. The objective of this acculturation was to gain acceptance into the Western academic culture and their discipline-specific communities. In order to acculturate to the Western academic culture and their discipline-specific communities, they participated in their discipline-specific communities of practice through the guidance from more experienced members and/or experts of the communities.

Employing Lave and Wenger's (Lave & Wenger, 1991; Wenger, 1998) communities of practice, through the concept of legitimate peripheral participation, cohered with the aim of this current study which was to investigate the process in which Chinese-speaking international doctoral students came into their particular academic communities as novices oriented toward becoming experts in their communities. This study explored how these students' academic acculturation processes intersected with their use of technologies. These academic acculturation processes could be understood through the lens of communities of practice whose main features included social participation in practice, multi-membership, and the relations between novices and experienced members of their discipline-specific communities. These features are helpful in analyzing how Chinese-speaking international doctoral students who come into their discipline-specific communities as novices (new-timers) and engage in the process from where they peripherally participate in discipline-specific communities of practice to where they fully participate in the practice and become experts in their communities. Figure 3.2 below shows that in this study the Chinese-speaking international doctoral students as novices

(new-timers) attempted to acquire discipline-specific knowledge and research skills through peripherally participating in discipline-specific communities of practice and then gradually become experts (old-timers) through fully participating in discipline-specific communities of practice. In Figure 3.2, the positions of new-timers and old-timers do not depict the process of moving from the outside of their academic communities by new-timers to the center of the communities. Nonetheless, the positions emphasize their peripheral participation toward full participation in their discipline-specific communities of practice.

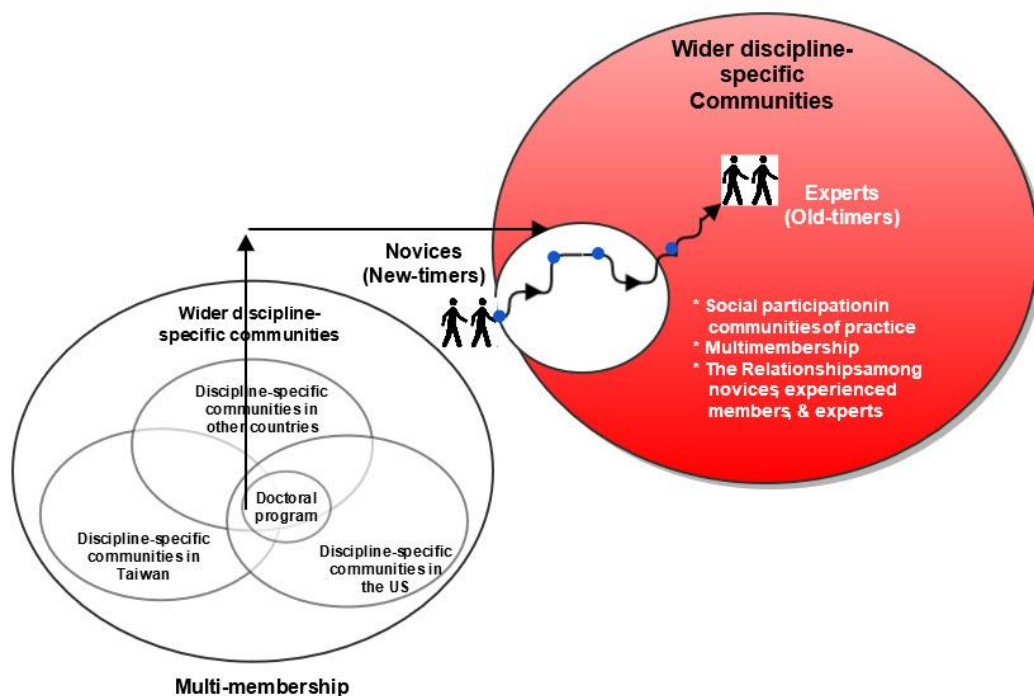


Figure 3.2 The Movements of Chinese-speaking International Doctoral Students from Pheriperal Participation to Full Participation in Their Discipline-specific Communities

Figure 3.2 above also shows Chinese-speaking international doctoral students' multi-membership within different discipline-specific communities. That is, these students are members of more than one community. For example, a Chinese-speaking international

doctoral student could be a member of his or her discipline-specific communities in Taiwan and at the same time a member of his or her discipline-specific communities in the U.S. They are also part of the wider discipline-specific communities. The non-linear arrow in this figure symbolizes movement as these students progress from being novices to become more experienced researchers or experts in their academic fields. Notably, during this movement, these students worked in cooperation with more experienced members and/or experts of their discipline-specific communities in an apprenticeship relationship. The meandering nature of this movement by the students as they progressed toward becoming more experienced researchers or experts in their discipline-specific communities signifies the difficulties that they had to navigate. The blue dots on this non-linear line are indicators of points showing significant progress in the course of this movement. Examples of these indicators include when the students eventually developed a capacity for understanding participatory traditions in class discussions, when students succeeded in presenting their research individually or collaboratively at conferences, and when students achieved publication in scholarly peer-reviewed journals.

The second conceptual framework, academic acculturation, was inspired by the scholarship from the work of Casanave and Li (2008) and other scholars, such as Simpson and Matsuda (2008), Hirvela and Yi (2008), Kuwahara, Prior and Min (2008). This scholarship encompassed anecdotes by domestic and international students and their struggles to learn discipline-specific academic cultures and to attempt to become legitimate members of their academic communities (Casanave, 2002; Casanave & Li, 2008). Casanave and Li (2008) state that graduate academic culture is dynamic and sophisticated and hence both domestic and international students experience difficult

transitions. It is a process of "learning to become a member of a graduate school academic community...and become familiar with new cultural, literacy, and sociopolitical practices while under the pressure of time, financial hardship, and possibly unclear authority relationships with faculty members" (Casanave & Li, 2008, p. 3). Although both domestic and international students face the difficulty in adjusting to the graduate school culture, international students possibly encounter more challenges than domestic students. Upon arriving in a new country and entering a graduate program, they need to immediately socialize into the new language, culture, and the expected role of graduate students (Casanave & Li, 2008). In order to become a member of their discipline-specific communities, they require acquiring significant knowledge, participating in discipline-specific communities of practice, negotiating their identities, and taking an academically recognizable role in those communities (Casanave & Li, 2008; Heneda, 2009). During the acculturation processes, they tend to selectively accept and resist their discipline-specific communities' knowledge, practice, and values (Canagarajah, 2004; Casanave, 1995; Duff, 2003). The process of interacting with other members of the communities is reciprocal rather than unilateral (Duff, 1996, 2002, 2003; Harklau, 2003; He, 2003; Willett, 1995). The process is sophisticated, dynamic, and fluid (Duff, 1996, 2002, 2003; Harklau, 2003; He, 2003; Willett, 1995). In other words, during the academic acculturation processes, the Chinese-speaking international doctoral students in this study were assumed to be shaped by their academic communities through participating in particular practice and meanwhile shaped their communities through providing their unique perspectives. Those scholars' academic acculturation highlights various aspects, such as identity and cognitive development in their discipline-specific knowledge and

research skills. However, this present study focused more on the elements that crystallized community membership, such as English proficiency, use of discipline-specific language and knowledge, and discipline-specific socialization, through investigating the Chinese-speaking international doctoral students' social interactions with their peers, instructors, professors, advisor(s), and scholars in their wider discipline-specific communities during their academic acculturation processes and the impact of technologies during the processes.

3.3 The Research Design

This present study adopted a qualitative research paradigm, specifically the use of ethnographic tools (Green & Bloome, 2004) to understand the process of Chinese-speaking international doctoral students' transition to American academic culture and their discipline-specific communities. In answering the question, "what counts as ethnography?" Green and Bloome (2004) have identified three approaches to ethnography as follows. First, "doing ethnography [which] involves the framing, conceptualizing, conducting, interpreting, writing, and reporting associated with a broad, in-depth, and long-term study of a social or cultural group" (p.4). This approach is the traditional ethnography. Second, "adopting an ethnographic perspective [which means doing] less than a comprehensive ethnography to study particular aspects of everyday life and cultural practices of a social group" (Green & Bloome, 2004, p. 4). The third method, which was used in this study, is "using ethnographic tools [which] refers to the use of methods and techniques usually associated with fieldwork. These methods may or may not be guided by cultural theories or questions about social life of group members"

(Green & Bloome, 2004, p. 4). The ethnographic tools in this study include semi-structured interviews, journals, and field notes. In addition, this study was designed with the following key characteristics: the qualitative research paradigm, case study through ethnographic tools, and emic and etic perspectives.

3.3.1 The Qualitative research paradigm.

This study employed qualitative research paradigm for three main reasons. First, for this study, I recruited a small group of Chinese-speaking international doctoral students. Such minimal recruitment is essential for this study since data obtained disclosed personal experiences and described the acculturation processes at the individual level. This current study examined participants' activities in their specific academic social contexts. Second, this present study centered on the process of how participants influenced and were influenced by their academic social contexts and how they understood their academic social contexts through using technologies. Within the social contexts of academic acculturation, technologies played assistive roles, such as enhancing opportunities for participation in discipline-specific communities of practice, assisting international students in overcoming English barriers, and extending access to academic sources. Third, through various methods of data collection, such as a survey, interviews, weekly journals, and field notes, I obtained in-depth information about participants' use of technologies during their academic acculturation processes. Neuman (1997) has proposed that the foremost purpose of the qualitative paradigm is to gather and report rich description and meaningful details.

3.3.2 Case study through ethnographic tools.

In this present study, I adopted case study and ethnographic tools to address the research questions. The rationale to adopt case study is that this present study explored the sophisticated research issue which investigated Chinese-speaking international doctoral students' academic acculturation processes and their use of technologies during the processes. In order to understand the complex research issue, collecting in-depth information from the participants is necessary. As Yin (2013) indicates, case study is utilized when a researcher desires to “understand complex social phenomena”, and this approach allows the researcher to examine “a contemporary phenomenon (the ‘case’) in depth and within its real-world context” (Yin, 2013, p. 16).

Yin (2013) further explained that research questions in case study are generally developed to ask *how* and *why* questions. This current study, hence, designed research questions based on Yin's suggestion. One of research questions, for example, inquired how well Chinese-speaking international doctoral students acculturated to their particular academic disciplines. Moreover, Yin (2013) pinpoints that the unique strength of the case study is “its ability to deal with a full variety of evidence—documents, artifacts, interviews, and observations” (p. 12). This current study adopted multiple instruments, such as a survey, interviews, journals, document collection, and field note, so the case study approach could help me handle data gathered by different instruments. In addition to the above case study's features, case studies can comprise multiple cases and then carry out cross-case analysis (Yin, 2013). In this present study, an individual participant is viewed as one case because the participants had distinct academic learning backgrounds and studied in different academic disciplines which have unique discipline-

specific culture. Each of them also experienced some dissimilar academic challenges due to their relations with peers, professors, more experienced researchers and advisor(s) and individual doctoral programs' facilities and academic support. After reporting three cases, cross-case analysis was carried out to examine similarities and differences among the three participants (cases).

Besides adopting the case study, this study also employed ethnographic tools (Green & Bloome, 2004) to gain a deeper understanding of the culture where participants operated (Merriam, 2009). Merriam (2009) explained culture as “the beliefs, values, and attitudes that structure the behavior patterns of a specific group of people” (p. 27). In this study, culture refers to the beliefs, values, and attitudes which the participants' discipline-specific communities form. Through adopting ethnographic tools, this present study examined how the Chinese-speaking international doctoral students might be impacted by and influence their discipline-specific culture during their academic acculturation processes.

3.3.3 Emic and etic perspectives.

An emic perspective explores how participants think, perceive, and categorize the world, what their rules for behavior, what meanings are for them, and how they explain things (Kottak, 2008). A researcher who uses the emic perspective, hence, looks for participants' viewpoints and relies on them to explain things and state whether something is important or not (Kottak, 2008). Emic perspectives in this current study derived from Chinese-speaking international doctoral students. Nevertheless, the drawback of the emic perspective is that it could lead a researcher to obtain narrow participants' perspectives on

a research issue. The etic perspective emphasizes what an ethnographer notices and considers significant (Kottak, 2008). This perspective is also called a scientist-oriented approach because an ethnographer attempts to hold objective and comprehensive perspectives on research phenomena (Kottak, 2008). The etic perspective in this study derived from my field notes, interviews, and interpretations of the data. Nonetheless, this approach omits participants' perceptions of a research issue. Each approach has its advantage and drawback. One goal of ethnography is to consider participants' perceptions, views, and beliefs in addition to an ethnographer's observations and conclusions (Kottak, 2008). Hence, employing both emic and etic perspectives could counteract their weaknesses. A combined emic-etic perspective is particularly useful for this present study because Chinese-speaking international doctoral students' self-reports, perspectives, opinions, and experiences intersected with the systematic theory-guided analysis and etic perspectives in order to establish a comprehensive understanding of the participants' academic acculturation processes.

3.4 The Research Site

This study was conducted at one of the largest universities in the Midwestern United States. Such a Western academic space has been described by Scollon and Scollon (2001) as a "utilitarian discourse system" because of its specific characteristics (p.119). These characteristics include:

- 1) anti-rhetorical whereby students' writing appears factual,

- 2) positivist-empirical where students are expected to establish the sense of authority in the ways that they write. In academic spaces, this includes the use of citations.
- 3) deductive meaning that students produce writing that establishes particular relationships between variables or concepts,
- 4) individualistic meaning that "speakers and writers should avoid set phrases, metaphors, proverbs, and clichés, and strive to make their statements fresh and original." (p. 122),
- 5) egalitarian meaning that academic writing takes up an ideology where every participant is perceived as having an equal say, and
- 6) public meaning that students should engage in writing that is seen as a formal public discourse.

However, "constant checks have been placed upon discourse, so that only institutionally authorized discourses may get through the filter and become free speech" (p. 123).

In this current study, the large academic university where the participants studied is characterized as follows. It advertised itself as having a diverse body that was comprised of domestic and international students. According to the research site's statistical reports, this university was ranked the top fifteenth university in the U.S. for enrolling international students. Moreover, the number of international students enrolling in this university keeps increasing each year (the research site's statistical reports). Chinese-speaking international students are the largest population among the overall international students at this university and form a significant portion of students at the doctoral level (the research site's statistical reports). This university has established a particular office

to serve international students by providing services ranging from orientations for incoming students, workshops about cultural practices in the Western classroom, immigration service, and hosting social events for cultural understanding. Overall, this office declares that its vision is to provide "unique international expertise [to provide the institution with] information and access to premier opportunities in a global setting" (document collection and field notes). In addition to these services, this university also provides various amenities which international students can use. These include a recreation and activity board which "provides diverse programs and events that are educational, entertaining, and thought provoking for the students" (document collection and field notes), student teaching training services, libraries, and more recently the establishment of a dedicated research service and support program. This university also offers technological service and support which is comprised of distance education, eLearning, innovational technological pedagogy, educational software for students, classroom management interface where students can view grades, access class content, and interaction with instructors and peers. Doctoral programs at this institution are centralized under the institution's graduate school whose mission is to provide "strategic leadership for graduate education...[foster] quality in graduate education...by providing essential services that support the work of graduate students, faculty, and staff...[This graduate school publicizes its] commitment to effective recruitment, retention, and support systems for all students...[and] the belief that diversity is a critical part of excellence in graduate education. The Graduate School promotes cultural diversity in the community..." (document collection and field notes). In the list of resources for graduate students, the graduate school has identified the office which provides technological

service and support as a useful resource that "delivers information and learning technologies for students...in learning, teaching, research, and administrative settings." (document collection and field notes).

This particular research site gave this present study a unique capability to examine closely the context in which the participants operated as they engaged in academic acculturation. This is because I had a closeness with this institution given my international student status that afforded me an insider perspective. I, therefore, extended familiarity with various spaces in this research site which allowed me to engage with the dynamics of academic acculturation and reflect on acculturative experience. Another reason for selecting this site is that this particular institution professes to have concern for and nurture international students. This university actively promotes global awareness as an essential academic experience through enlisting diverse international students, holding events to assist international students in adjusting to the new culture, and offering study-abroad opportunities (document collection and field notes). For example, in a handbook dedicated to international students, in a section on academic, the institution wrote that "Advisors partner with students at the university to explore educational and professional opportunities, set appropriate goals and decide strategies for accomplishing those goals" (document collection and field notes). The office that serves international students in this research site has assembled on its website a number of useful documents for international students for purposes of orientation. One of these documents is the International Student Handbook which features information on important areas for newcomer international students, including "on-campus housing, cultural differences in the classroom, and driving in the United States" (document collection and field notes). However, nowhere in

the section on academics did this handbook mention the assistive role of technology for international students. This research site offered me the opportunity to investigate socialization of international students through various processes that unpacked students' acculturative experience. These processes entailed analyzing data generated from students' self-reports, official documents, and relevant literature. Notably, from the field notes, it emerged that this university invested a great deal of money in technology infrastructure and instructional technology to provide students and faculty members with a 21st-century high-tech learning environment.

3.5 Participants

Participants in this current research are Chinese-speaking international doctoral students. In this study, the label of "Taiwanese international doctoral students" is synonymous with "Chinese-speaking international doctoral students." The difference is that the former label shows the country of origin and the latter shows language use. Participants in this present study were selected from a wider study investigating the influence of technology use by international master's and doctoral students from different countries on their academic acculturation. Therefore, these participants are a generally coherent group sharing some similarities, such as international doctoral students' experience, native language, and L1 academic culture. They also have dissimilarities, such as different academic disciplinary backgrounds, prior research experience, and use of discipline-specific technologies. Below are the rationale and criteria for selecting participants for this study and a table of demographic descriptions.

3.5.1 Selection of participants: Rationale.

Participants in this study were selected from a wider pool of graduate-level international students from different countries, such as Taiwan, China, Kenya, Indonesia, and South Korea. Given the focus of this study, only Chinese-speaking international doctoral students were selected to respond to the research questions. Selecting suitable participants for a study is significant for understanding a research phenomenon. Bound (2011) has argued that the outcomes of a research project depend on the careful choice of participants. To achieve a careful selection, this current study adopted non-probability sampling which is also called purposeful sampling (Chein, 1981) and is pervasively employed in qualitative research (Merriam, 2009). This type of sampling assumes a researcher wants to explore, understand, and gain insights into a research phenomenon and thus must choose a sample that is most beneficial for the study (Merriam, 2009). Through such an approach, a study would select information-rich cases “from which one can learn a great deal about issues of central importance to the purpose of the inquiry” (Patton, 2002, p. 230). Therefore, the present study mainly selected Taiwanese international doctoral students who could provide rich information about how this particular demographic group utilized technologies to socialize into their academic disciplines.

3.5.2 Selection of participants: Criteria.

There were three requirements for selecting participants for this study. First, participants had to be in a doctoral program in the United States. The reason to select this international graduate population is that Open Door 2001 to 2011 reports show that more

international students come to America to study at the graduate level than at the college level (Institute of International Education, 2001-2013-a). The rationale for selecting international doctoral students rather than master's students is that doctoral students appear to confront more academic challenges than master's students (Girves & Wemmerus, 1988). Unlike a master's program, a doctoral program tends to emphasize that students conduct research, publish papers, and develop professional competence and status in their academic communities (Girves & Wemmerus, 1988). As a matter of fact, in academia, there is a popular saying "publish or perish." Hence, for international students studying in a doctoral program is possibly harder than studying in a master's program. Second, participants needed to be Chinese-speaking international doctoral students. The rationale for selecting this group of students is that Institute of International Education (IIE) 2001 – 2013 report reveals that in comparison to students from other countries, more Chinese-speaking international students came to the U.S. to pursue higher education (IIE, 2001 – 2013-b). In addition, this is the largest group among the overall international students in the research site (Morgan, 2010). Moreover, I am also a Chinese-speaking international doctoral student at the same research site. The Chinese and educational backgrounds could help me understand participants' viewpoints, challenges, motivation, academic behavior, and academic activities that are significant for doctoral students (Kottak, 2008). This shared background with my participants also allowed them to clearly express their experiences and feelings without language and cultural barriers. For instance, data gathering materials, such as interview questions, were written in Simplified and Traditional Chinese. The participants chose a preferred language - Chinese or English - during their interviews. Third, participants needed to be

willing to employ technologies to do academic tasks. The reason is that some students might be resistant to use of technology and hence could be unwilling to utilize technologies for academic tasks. This particular requirement is necessary in order to obtain rich information about how Chinese-speaking international doctoral students used technologies for academic tasks during their acculturation.

Following the filling out of survey responses, and based on a case study approach (Patton, 1990), three participants were chosen. Patton (1990) states that the case study approach is a particular way of gathering, organizing, and analyzing data. This study adopted a case study approach to determine the three focal participants (Cheng-Rui, Zhi-Kai, and Tian-You) from the wider pool of international graduate students. Thus, each participant in this study was treated as one case. The rationale of using the case study approach is that a single case could provide comprehensive and in-depth information about an individual participant's academic acculturation whereas cross cases could offer holistic perspectives on the acculturation processes. Therefore, analyzing both individual cases and synthesizing the data from all three cases is advantageous because this approach provides both depth and breadth in the analysis of data and the significances of these cases. The selected participants are, therefore, in the best position to provide data that answered the research questions. Table 3.1 lists the participants' demographic and background information. All names in this study other than my own are pseudonyms.

Name	Sex	Age Range	Time in the US	Previous Education	Current Academic Discipline	Years in a PhD program	An Instance of Common Use of Technologies for Academic Purposes
Cheng -Rui	M	26~30	~ 6 - 7 years	Material Science MA in the US	Material Science and Engineering	4.5 years (AU2011-SP2016)	Endnote (citation software)
Zhi-Kai	M	26~30	~ 4 - 5 years	Statistics MA in Taiwan	Statistics	4.5 years (AU 2011 - SP2016)	R (statistical software)
Tian-You	M	26~30	~ 1 - 1.5 years	Computer Science MA in Taiwan	Computer Science and Engineering	1.5 years (AU2014 - SP 2016)	Corpus of Contemporary American English (COCA)

Table 3.1 Participants' Demographic and Background Information

The participants' demographic information presenting in the table above reflects some phenomena of international students studying in higher education in the U.S. First, reports of international students in the U.S. produced by Institution of International Education show that there are a high percentage of international students who major in science and engineering academic programs than other academic programs (e.g., education, agriculture, or fine and applied arts) (Institution of International Education, 2016). Second, male international graduate students who study in science and engineering academic programs are more than female international students. Reports of international graduate students produced by the National Science Foundation reveal that in 2015, 38.63 percent of international graduate students in science and engineering majors is females and 61.37 percent is males (National Science Foundation, 2017). This phenomenon could also be seen in the wider pool of participants. In the wider study, participants who studied in science and engineering programs were all males.

All the three participants in this dissertation are from Taiwan. They speak English as a Foreign Language (EFL) in Taiwan but upon coming to the United States they are categorized as English as Second Language (ESL) learners. They also have access to multiple technological devices, such as a laptop, a cell phone, and an office computer. Bound (2011) pinpoints that “The more demographically similar the participants are the better a researcher’s ability to understand the general nature of the experience that can be defined” (p.3). Findings from analyzing data generated from this group were based on a case study approach and not intended to be representative of a larger population of Chinese-speaking international doctoral students. Although this study refers to these participants as "Chinese-speaking", typically in Taiwan people read and write in Traditional Chinese orthography. Interactions between me and these participants are mainly in Traditional Chinese. At the time of data collection, Cheng-Rui and Zhi-Kai finished their qualifying exams, and Tian-You had just started his doctoral program. In addition, during data collection, Tian-You was the only participant who explicitly reported having visited the U.S. to attend an academic conference prior to commencing his doctoral program.

3.6 The Role of the Researcher

In this study, I occupied a particular positionality relevant to the participants, methodology, and the general interest of this study. In a qualitative study, such as this one, a researcher is regarded as performing the role of collecting and analyzing data and hence can affect the results of a study toward a meaningful or meaningless direction (Merriam, 1998). As a researcher, I positioned myself as a Taiwanese international

doctoral student. Banks (1998) further states that one type of cross-cultural researcher is "the indigenous-insider" who "endorses the unique values, perspectives, behavior, beliefs, and knowledge of his or her indigenous community and culture and is perceived by people within the community as a legitimate community member who can speak with authority about it" (p. 8). I am, therefore, an indigenous-insider with a similar background to my participants in terms of Taiwanese educational experience and experience in studying in a doctoral program as an international student in the U.S.. I was educated and socialized into Taiwanese educational style for sixteen years. This educational style is characterized by the following features:

1. Teacher-centered pedagogy where teacher-talk is pervasive in instruction (Chen, 2014; Chen & Bennett, 2012), (refer to Supplement 3-1 for a college-level classroom setting in Taiwan)
2. Chinese as the main language of instruction,
3. Preference by students to consult peers about content questions before consulting teachers more out of reverence than out of fear (Aldridge, Fraser, Taylor, & Chen, 2000),
4. Preference by students to consult teachers about content questions after class rather than during class (Hsu, 2015),
5. This reverence is due to the ideology where the teachers' station is considered as knowledgeable (Chen, 2014) so students tend to not question teachers' knowledge (Lu, 2011),
6. The popular belief that teachers are moral and cultural models for students (Zhang, 2014),

7. Although there has been an increase in the use of technologies in recent years, according to the participants' prior learning experience in Taiwan, technologies were mainly used at higher education levels in the past. At the time when the participants in this study were being educated in Taiwan, technology was not so prevalent in lower-level education.
8. Generally speaking, teachers often adopt textbooks as main teaching materials in higher education (Chen, 2014) and tend to believe knowledge in the textbooks are all correct (Lu, 2011),
9. It is a common practice that most assignments at lower levels of education take the form of short-structured responses (refer to Supplement 3-2)

Moreover, I had been an international student studying in a doctoral program in the U.S. for around six years when this study was undertaken. Hence, my Taiwanese and American educational backgrounds and my experience as an international student could assist me in understanding my participants' 1) experience of their previous and current academic practices and cultures, 2) perspectives on being an international doctoral student in the U.S., 3) socializing into their academic disciplines, and 4) aspirations of becoming an expert in their academic disciplines. Furthermore, I often use technologies to aid me in gaining academic and research knowledge, obtaining professional information (e.g., conferences or teaching strategies), and participating in scholarly discussions. My experience in utilizing technologies helped me understand the data that I considered in this study regarding participants' use of technologies for academic tasks, among other uses. Although my background and experience as a Taiwanese international doctoral student helped me gather and analyze the data, I am an outsider in respect to the

participants' academic disciplines. In other words, Cheng-Rui is in Material Science, Zhi-Kai is in Statistics, and Tian-You is in Computer Science and Engineering; I am in Foreign, Second, and Multilingual Language Education. This outsider role is comparable to what Banks (1998) describes as an indigenous-outsider as follows:

"[an indigenous-outsider is] socialized within his or her indigenous community but has experienced high levels of cultural assimilation into an outsider or oppositional culture. The values, beliefs, perspectives, and knowledge of this individual are identical to those of the outside community. The indigenous-outsider is perceived by indigenous people in the community as an outsider." (p. 8).

Thus, being an indigenous-outsider of the participants' academic communities might constrain me from recognizing and understanding their discipline-based learning behavior, values, perspectives, and knowledge as they strove to participate in their discipline-specific communities. In order to compensate for this drawback, I established a close rapport with my participants and therefore I was able to probe their experience for detailed information that helped me understand their academic disciplines.

3.7 Instrumentation and Data Collection

I employed five principal instruments to gather the data: a survey, interviews, 14-week weekly journals, document collection, and field notes.

3.7.1 The survey.

The survey was used for two purposes. The first purpose was to seek potential participants who met the requirements of this study and also willing to take part in the subsequent process of data provision. Suitable participants were approached via an invitation email. The second purpose was to gather information from the participants, such as background information and the habits of using technologies, which were later treated as part of the data. The survey was developed in consultation with a survey expert (Dr. G.; also see Dillman, 2007) ("Mail and internet surveys: The tailored design method, 2nd edition (2007), by Don A. Dillman). Before distributing the survey, I conducted a pilot study on six international doctoral students: two from China, two from Taiwan, one from Indonesia, and one native English speaker from Kenya.

In order to enhance the validity of the intended survey, the pilot survey was designed in two versions: one (refer to Supplement 3-3) was for respondents who were in the pre-candidacy-exam stage or during the candidacy-exam stage and one (refer to Supplement 3-4) was for respondents who were in the post-candidacy-exam stage. Once students are in the post-candidacy-exam stage, they usually do not take courses anymore. Hence, questions related to taking courses in the survey are irrelevant to students who are in the post-candidacy-exam stage. Due to this concern, the survey was designed in the two versions.

In the pre-candidacy-exam survey, for example, one item asked "I use technology (e.g., e-mail or Facebook) to discuss academic issues, courses, or assignments with professors in school", whereas in the post-candidacy-exam survey the item was modified into "I use technology (e.g., e-mail or Facebook) to discuss research or academic issues with

professors in school". In addition, the two versions were written in three languages - Simplified Chinese, Traditional Chinese, and English - to enhance respondents' comprehension of the questions. During the pilot stage, I invited the two students from China to answer and give feedback based on the simplified Chinese version of the survey, two students from Taiwan to answer and give feedback based on the Traditional Chinese version, and two students from the other countries to answer and give feedback based on the English version. Their feedback aided in the revision of survey questions to make these questions more relevant and comprehensible. Moreover, they were timed when answering questions to set an effective time-frame for respondents of the survey. Completing the survey took a respondent around fifteen minutes.

Each of the two survey versions contained two main sections: 1) background information and 2) technology use for academic purposes. Questions in the first section, background information, asked respondents' background information, English proficiency levels, the comfort of using technology, and their technology use for academic purposes. Questions in this section were the same in both versions, but the wording of some questions in the second section was slightly different so that the questions could address pre-candidacy and post-candidacy international doctoral students. The second section, technology use for academic purposes, asked respondents what technologies they employed to do which academic activities and tasks. Most of the questions were close-ended and used Likert rating scales to measure respondents' answers. There were a few open-ended questions. For the purposes of this present study, the surveys were designed to capture participants' self-report with regard to their use of technologies in various academic contexts, an identification of specific technologies

employed by participants for academic purposes, and representation of participants' preferences for using specific technologies for particular academic tasks.

3.7.2 Interviews.

I employed interview to collect in-depth data. The study focused on participants' perceptions of technologies and their use of technologies to do academic tasks during their academic acculturation processes. Academic acculturation can take international students several years (Berry, 2005, 2006). Interview is regarded as a valid and efficient method of understanding participants' perspectives (Maxwell, 2005). In addition, interview allows a researcher to gather participants' information in a short time and allows a researcher to obtain participants' historical information (Creswell, 1994). Furthermore, interview enables a researcher to collect information that cannot be directly observed (Merriam, 2009). Employing interview, hence, could enhance me to understand participants' past experiences of academic learning and technology use before studying their doctoral programs, academic challenges they encountered during their doctoral study, and how they utilized technologies for academic purposes in and outside of class. Due to these advantages, interview is an appropriate method for data gathering in this study.

I employed a semi-structured interview format (Merriam, 2009) to elicit participants' original thoughts and reactions to research phenomena in their unique ways. Open-ended questions are often used in this type of interview (Merriam, 2009). Since this present study centralized participants' experiences of technology use to socialize into their particular academic disciplines, a semi-structured interview is an appropriate way to elicit

Chinese-speaking international doctoral students' thoughts and reactions on this research issue. Interviews in this study were generally designed to encourage participants to reflect on their use of technology in their academic acculturative experience.

Generally, I conducted an initial interview (see Supplement 3-5), bi-weekly interviews during 14 weeks (seven interviews) (see Supplement 3-6), and the last interview (see Supplement 3-7) with each participant. I selected the participants based on respondents' responses to their survey

During the initial interview, participants responded to questions about their background information, habits of technology use, and their learning experiences in their native (L1) academic setting. At this interview, participants also gave their definitions of technologies and successful academic acculturation. During the 14 weeks of journaling academic tasks, participants took part in seven interviews where they reflected on and clarified journal-based information. During the last interview, participants responded to questions about their use of technologies to do academic tasks in and outside of class, and overall feelings of socialization into their academic disciplines in the U.S. The length of the initial and last interviews were around one and a half hours each. The length of bi-weekly interviews was around thirty minutes each. In order to make participants feel comfortable to talk, all interviews were conducted in Chinese. Moreover, all interviews were digitally recorded with appropriate permission. Generally, interviews were instrumental in this study as a method of eliciting participants' self-reports. These reports provided evidence for their academic acculturation.

3.7.3 14-week weekly journals.

For the purpose of this study, participants were required to dutifully record and reflect on their use of technology for the duration of one semester (14 weeks). The 14-week weekly journals (see Supplement 3-8) included a brief thank you message, the purpose of the weekly journals and bi-weekly interviews, descriptions of software that the participants might employ to do academic tasks, and a sample of the weekly report form. In order to make the participants feel at ease with doing weekly reports of their technology use, the weekly journals were designed in three different language versions (Traditional Chinese, Simplified Chinese, and English). Participants could choose to write their journals electronically or on paper. Frequent reporting by participants allowed for a steady record which reflected the regularity with which particular technologies were used. The journal genre is advantageous for this kind of recording because it enabled participants to reflect on their uses of technology, rationalize this uses, and to record self-reports of advantages and disadvantages of various technologies. On a whole, all participants were able to successfully complete the 14-week weekly journals requirement of this study.

3.7.4 Document collection.

Document collection in the qualitative research includes gathering written, digital, visual, and physical materials related to the conducted research (Merriam, 2009). Document collection could constitute of ready-made materials existing in the research setting and research-generated documents produced by the researcher or given by

participants after the research has begun (Merriam, 2009). In this current study, gathered documents included:

1. some Chinese-speaking international doctoral students' syllabi of courses that they took;
2. writing samples, such as conference papers and their writing assignments and papers;
3. PDF files of some scholarly materials the participants read and electronically annotated;
4. photographic images of participants' print-out of scholarly materials with hand-written annotation and notes;
5. photographic images of a classroom setting depicting the use of technologies for session recording;
6. screenshots of search engines and websites the participants often visited;
7. Word files and PDF documents of disciplinary specific information related to international students and program requirements for doctoral students;
8. Word files and PDF documents from different non-disciplinary departments focusing on assisting international students;
9. Word files about how the institution provided general information about technologies for academic purposes;
10. participants' online dialogue with peers, professors, and scholars outside of the school; and
11. a graduate school handbook and international student handbook

These documents are instrumental in this present study because they gave department-specific and discipline-specific indicators of academic acculturation. That is, they were useful in cross-checking participants' self-reports about academic acculturation and in confirming how concepts from the scholarship were applied to the research setting. They are also beneficial to this study because they contextualized data from participants' self-reports, that is, they are useful in establishing an understanding of the nature of the research setting.

3.7.5 Field notes.

Brodsky (2008) indicates that "In fieldnotes, qualitative researchers record in-depth descriptive details of people (including themselves), places, things, and events, as well as reflections on data, patterns, and the process of research" (p. 341). Doing field notes is also an ongoing analytic process and should record researcher's bias, perspectives, possible mistakes, reflections, and responses to participants and fieldwork (Brodsky, 2008). Therefore, for this present study, field notes included my reflections on the instruments of data collection, annotations and notes on electronic files in the document collection, field notes in the form of visual representation of the research site, and visual representation of technologies used by the participants. Field notes contributed to this study in a number of ways. First, through field notes I was able to capture immediate etic perspectives on various concepts and features of the research site. Second, field notes are instrumental as a cue for recalling specific research phenomena and developments. Third, field notes are useful for cross-checking emic and etic perspectives. On most occasions, this cross-checking was done in Chinese.

Overall, this study employed the survey, interviews, 14-week weekly journals, document collection, and field notes. Table 3.2 shows four research questions and the specific data gathering instruments used to collect data to address each of these research questions.

Research Questions	A Survey	Interviews	Documents	14-week Weekly Journals	Field Notes
1. How did Chinese-speaking international doctoral students from different academic fields define successful academic acculturation?		V			V
2. What common and distinct technologies did Chinese-speaking international doctoral students from different academic fields use for academic acculturation?	V	V	V	V	V
3. In what ways did their use of technologies relate to their own definition of successful academic acculturation?	V	V		V	V
4. How well did they acculturate to their particular academic disciplines?		V	V	V	V

Table 3.2 Question-based Instruments of Data Collection

Notably, this study employed various instruments of data collection for triangulation to increase the validity of research findings. This is one of four types of triangulation (methods triangulation) that Denzin (1978) and Patton (1999) proposed. The purpose of adopting this type of triangulation is to make sure whether research findings are

consistent via cross-checking data that are collected through distinct data collection methods (Denzin, 1978; Patton, 1999). In addition, each instrument reveals different aspects of research phenomena (Berg, 2001). Furthermore, the use of a variety of research methods controls for bias and other limitations of specific research methods (Maxwell, 2005). This study, therefore, utilized multiple instruments to gather the data to be certain the consistency of research findings, compensate for individual instrument's drawbacks, and reduce bias. Through using several instruments could also provide more holistic research phenomena of the three Chinese-speaking international doctoral students' academic acculturation processes.

3.8 Data Analysis

The current study employed Merriam's (2009) procedure of data analysis that was heavily drawn on Glaser and Strauss's (1967) inductive and comparative approaches. Merriam (2009) proposes several steps that help qualitative researchers analyze their data and that include open coding, analytical coding, looking at patterns and generating categories, sorting evidence for the categories, and generating themes (see Figure 3.3). In this study, these steps were employed to analyze data generated from the surveys, interviews, weekly journals, related documents, and field notes. Data gathered through each instrument were treated equally and all analyzed via Merriam's (2009) data procedure. Regarding naming categories, Merriam (2009) suggests that naming categories could come from existing literature, participants' terms, and the researcher's own terms reflecting what the researcher sees in the data. Therefore, this study utilized terms from existing literature on communities of practice and academic acculturation

(e.g., participation, interaction, new-timers' challenges) in combination with my own terms (e.g., learning in L2 culture, and teaching methods and materials) to name the categories.

3.8.1 The procedure of data analysis for individual case reports.

Patton (1990) points out that doing field notes while collecting data is also part of data analysis: "In the course of gathering data, ideas about possible analysis will occur. Those ideas constitute the beginning of analysis; they are part of the record of field notes." (p. 377). Thus, in the course of data collection, I wrote field notes to record comments, thoughts, and insights into the collected data, including potential themes or categories that emerged from the data. Table 3.3 shows the procedure of data analysis for each instrument. Therefore, this present study started data analysis from the beginning of data collection. Merriam (2009) indicates that:

“qualitative research is not a linear, step-by-step process. Data collection and analysis is a simultaneous activity in qualitative research. Analysis begins with the first interview, the first observation, the first document read. Emerging insights, hunches, and tentative hypotheses direct the next phase of data collection, which in turn leads to the refinement or reformulation of questions, and so on.” (p. 165).

After interviewing, data were transcribed and the recording file was instrumental in refining or reforming interview questions for the following interview. During the process of coding data, I employed qualitative data analysis software, ATLAST.ti, to analyze the data. One of its features is that it can generate the frequency of a word. Hence, in the course of coding data, I utilized this function to create some categories. Meanwhile, since some low-frequency words might still be crucial and need to be considered, I also

directly looked at the gathered data to see emerging themes. Table 3.3 shows the step by step procedure of data analysis based on particular data gathering instruments.

Instru ment	Data Analysis Procedure
A survey	<ol style="list-style-type: none"> 1. Asked the participants in their first bi-weekly interview to clarify some of their responses (emic perspectives) 2. Transcribed the interview data 3. Employed Merriam's (2009) data analysis procedure after importing survey and interview data into ATLAST.ti
14-week weekly Journals	<ol style="list-style-type: none"> 1. A weekly journal was used to compose interview questions for the next time bi-weekly interview (emic perspectives) 2. Employed Merriam's (2009) data analysis procedure after importing 14-weekly weekly journals into ATLAST.ti
Interviews	<ol style="list-style-type: none"> 1. Transcribed the interview data and took field notes 2. Employed Merriam's (2009) data analysis procedure after importing all interview data into ATLAST.ti
Documents	Employed Merriam's (2009) data analysis procedure after importing documents into ATLAST.ti
Field Notes	Employed Merriam's (2009) data analysis procedure after importing field notes into ATLAST.ti

Table 3.3 Data Analysis Procedure for Each Instrument

After open coding, as presented in Table 3.3, the next step was analytical coding or axial coding (Merriam, 2009). Following this, data were examined for patterns and recurrences to produce emergent themes and to generate tentative categories. These preliminary categories were further fine-tuned leading to categories and sub-categories, and were ultimately instrumental in the interpretive process (Merriam, 2009). Given the different modalities of data involved in this study (texts, PDFs, Word documents, photos, screenshots, and one instance of a video file), I employed Merriam's analytical procedure in a robust way that allowed for examination of various media as follows: the software interface for data analysis was ATLAS.ti. This was the place where data were imported,

housed, organized, and subjected to analytic treatment as per Merriam's (2009) procedure.

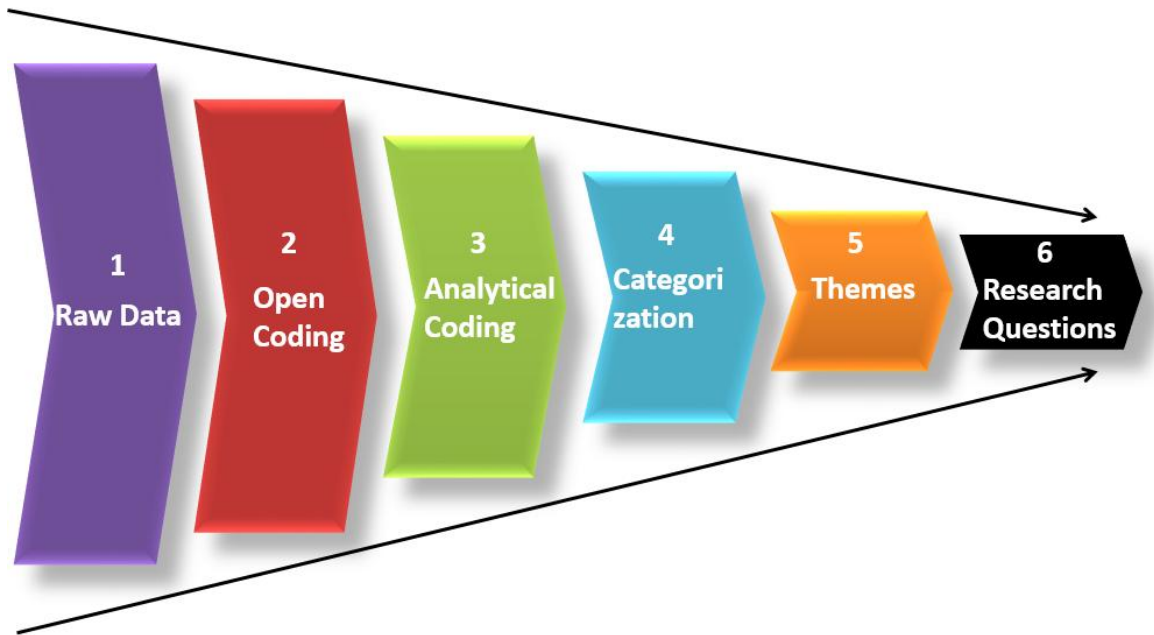


Figure 3.3 A Depiction of Key Steps in Merriam's (2009) Data Analysis Procedure

The raw data in Figure 3.3 above comprised of texts, PDFs, Word documents, photos, screenshots, and one instance of a video file for the three focal participants in this study. The two lines above and below with arrowheads pointing toward the research questions were indicative of the process of constantly focusing the data on responding to the research questions. This focusing was outlined by Merriam's (2009) data analysis procedure as follows. A researcher begins by considering the entire data corpus (raw data), for instance, working through the entire transcript. This is followed by further consideration of data through open coding where the researcher begins to develop categories based on the raw data. These categories are merged in subsequent processes and further named and renamed into categories to more precisely reflect what is in the

data. After these processes, a researcher would then sort evidence into emerging categories that respond to the research questions. Overall, Merriam (2009) proposes that a researcher operates from a deductive stance through this general procedure of focusing the raw data in a way that ultimately addresses the research questions (as depicted by Figure 3.3). Given the raw data contained textual and visual data, the visual data (photos, screenshots, and a video file) were subjective to this procedure after being imported into ATLAS.ti. More specifically, these data included photos of Apps (software), technologies (hardware), screenshots of homepages and search engines, and a video file. After importing into ATLAS.ti, these data were described to highlight the following aspects:

- 1) What were the participants' definitions of successful academic acculturation?
- 2) What were software and technologies the participants utilized for academic purposes?
- 3) How did the participants get acquainted with software and technologies they used for academic purposes?
- 4) What were some key ways the participants used these software and technologies to do academic tasks?
- 5) What was the frequency of using these software and technologies?
- 6) What were the affordances of these software and technologies for the participants?
- 7) How did the participants socially interact with their peers, professors, research team members, advisor(s), and scholars in their wider discipline-specific communities?

8) What were communities of practice the participants engaged in during their academic acculturation processes?

Answers to these questions were, therefore, useful in generating descriptions of visual data from which I undertook open coding, analytical coding, grouping, categorization, and generation of themes in response to the research questions (see Figure 3.3).

3.8.2 The procedure of data analysis for the cross-case report.

Cross-case analysis in this study also followed Merriam's (2009) data analysis procedure. Raw data were the aggregation of the three single data. After the data were imported into ATLAS.ti., during the coding process, the data were examined for differences and similarities among the three participants to produce emergent themes and to generate tentative categories. These initial categories were further modified leading to categories, sub-categories, and were finally helpful to answer the research questions. More specifically, the following aspects were highlighted during the process of data analysis:

- 1) What were common and distinct the three Chinese-speaking international doctoral students' definitions of successful academic acculturation?
- 2) What were identical and different technologies the three participants utilized for academic purposes and how did they employ the technologies to do academic tasks during their academic acculturation processes?
- 3) What were relations between their use of technologies and definitions of successful academic acculturation, and what were similarities and differences among the relations?
- 4) How well did they socialize into their particular discipline-specific communities?

3.8.3 The evaluation approach of individual participant's academic acculturation.

In order to answer research question four (How well did the participants acculturate to their particular academic disciplines?), I developed an evaluation approach. In this evaluation approach, I utilized indicators of successful academic acculturation from four main sources:

- 1) individual participants' definitions of successful academic acculturation,
- 2) collected data on individual participants,
- 3) expectations and requirements of individual participants' doctoral programs, and
- 4) the scholarship of local and international students' socialization into graduate school

In the literature on international graduate students' academic acculturation, most studies examined the processes rather than the assessment of these students' academic acculturation. These studies investigated international students' socialization into graduate programs through taking discipline-based courses (Morita, 2009), writing a master's thesis or a dissertation (Hedgcock, 2008; Li, 2008), or mentor and mentee relationships (Simpson & Matsuda, 2008). Moreover, most studies (e.g., Gardner & Barnes, 2007; Gardner, Hayes, & Neider, 2007; Golde, 1998) on domestic graduate students also concentrated on the processes of students' socialization into their graduate programs rather than evaluating their socialization. These studies did not undertake an explicit evaluation approach to determine success in graduate students' academic acculturation. This present study, however, applied an evaluation approach to determine the participants' academic acculturation success.

In order to develop the evaluation approach, I drew on the concept of the graduate student socialization framework developed by Stein and Weidman's (Stein & Weidman, 1989; Weidman, Twale, & Stein, 2001). In 1989, Stein and Weidman proposed the framework graduate and professional student socialization which extended their previous undergraduate socialization model (Weidman, 1989). They indicate that graduate students' socialization into their professional fields consists of sequential processes whereby newcomers:

- 1) enroll in "the educational institution with values, beliefs, and attitudes about self and professional practices", (Stein & Weidman, 1989, p. 14)
- 2) are influenced by faculty, peers, professional organizations, professional practice, family, and friends,
- 3) assess the salient "normative pressures exerted by faculty and peers" for achieving personal and professional goals, (Stein & Weidman, 1989, p. 14)
- 4) assume, change, or maintain "those values, aspirations, identity and personal goals that were held at the onset of the socializing experience" (Stein & Weidman, 1989, p. 14).

In brief, this framework of graduate and professional student socialization emphasizes student background, personal communities (e.g., family, friends, and employers), and the institutional culture which includes academic programs, peer climate, and professional communities (Stein & Weidman, 1989; Weidman, Twale, & Stein, 2001). Weidman and Stein (2003) conducted the empirical study through utilizing this framework to investigate socialization of domestic doctoral students in sociology and in educational foundations programs. The research findings supported this framework confirming the

significance of social interactions among students and faculty and of a supportive climate created by faculty. Since this framework has been proved by Weidman and Stein's (2003) study through examining doctoral students' socialization, I, therefore, adopted this framework to devise the evaluation of doctoral student socialization. Nevertheless, this framework does not consider socialization into Western academic settings for international students. Thus, I incorporated research (e.g., Li & Collins, 2014; Morita, 2009; Robinson-Pant, 2009; Sato & Hodge, 2009) on international students' study in Western graduate programs as one of the sources to develop my evaluation approach of international doctoral student socialization.

In Stein and Weidman's framework, student background characteristics contain age, gender, "knowledge and beliefs about the professions and self on impact of educational experience" (Stein & Weidman, 1989, p. 12). To determine student background characteristics, I utilized an individual participant's definition of successful academic acculturation, which is an individual participant's understanding and expectations of the profession the participant is pursuing. I also adopted indicators of successful academic acculturation that emerged from an individual participant's data, which is self-educational experience during the participant's academic acculturation processes. To determine institutional culture, I employed expectations and requirements of an individual participant's doctoral program which was described on the participant's doctoral program's website and related departmental materials. Nevertheless, an individual participant's understanding and expectations of the profession that the participant is pursuing and own experience of academic acculturation processes are limited to an individual participant's understanding and experience. If participants'

academic acculturation is solely evaluated through these indicators, the result might have a bias. The participants might positively report some of their acculturation experience or might be unable to see some essential academic acculturation aspects due to their own limited understanding of the Western academic culture and the culture of their discipline-specific communities. For the same reason, if an individual participant's academic acculturation is merely evaluated through his doctoral program's requirements and expectations, the result might be overestimated. A doctoral program tends to only request their students to meet the fundamental requirements to exit the program but does not stress the engagement in scholarly activities in wider discipline-specific communities. The scholarly activities could include attending and presenting own research at conferences, socially interacting with scholars in formal and informal occasions, and publishing own research in discipline-based journals. Hence, my evaluation approach of doctoral students' academic acculturation incorporated indicators of successful academic acculturation that emerged from the scholarship of domestic (Gardner, 2007; Golde, 1998; Grives & Wemmerus, 1988) and international students' (Li, 2008; Li & Collins, 2014; Morita, 2009; Sato & Hodge, 2009) socialization into graduate school.

Figure 3.4 shows that some of the indicators from the four sources overlap (the gray area) and some (non-gray areas) do not. The equal size of the four circles does not signify that each category contains the same amount of academic acculturation aspects. However, the purpose of this diagram is to show that some indicators of successful academic acculturation from one source imbricate some indicators from another source.

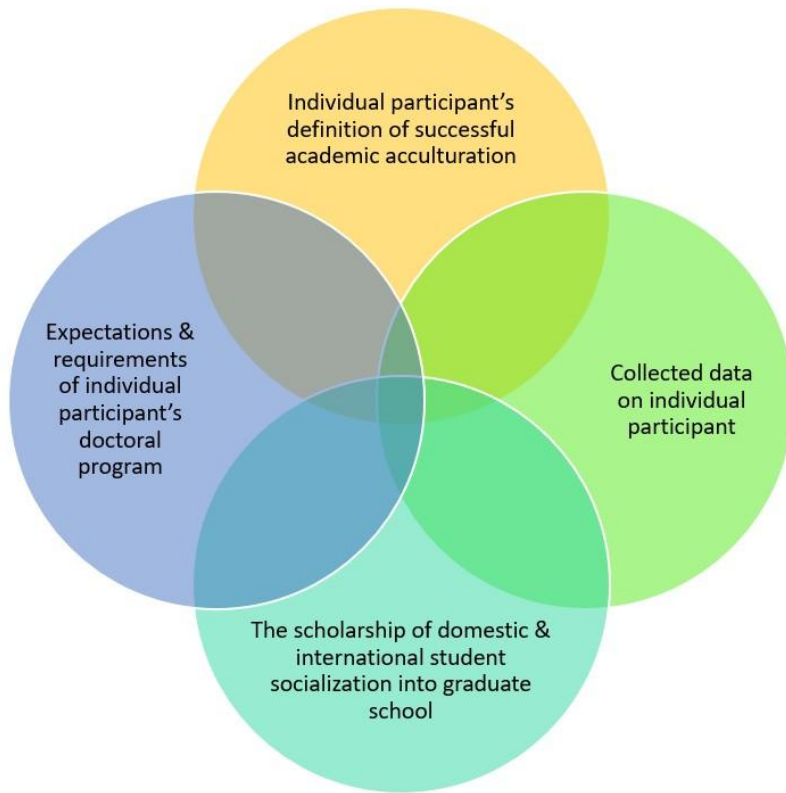


Figure 3.4 The Indicators of Successful Academic Acculturation from the Four Sources

The number of indicators varied according to each participant's situation. These indicators were drawn from the participants' definitions of successful academic acculturation, from collected data on each participant, and from an individual participant's department. Nonetheless, this study identified 25 indicators of successful academic acculturation from the scholarship. I provided below some examples of how I utilized scholarly works to draw out five indicators of successful academic acculturation.

Example 1

The 1st indicator: Knows how/ has the ability to have (online and/or face-to-face formal and informal) conversations with scholars, including peers, colleagues, professors, and other scholars in own discipline-specific communities

“Participating in Conversations

The term conversation is now commonly used to describe the activity of participating in the oral and written textual practices of specialized communities... expand that earlier focus on written discourse conventions to include the oral interactions that graduate students have in classes, seminars, meetings with advisors, and consultations with classmates and colleagues..." (Casanave, 2008, p. 19)

"I had been too timid to accept at my first conference presentation two years earlier...(p. 97)...this presentation...thought I now had the opportunity to bumble in full view of people who could gently point out my errors, and in the guidance of a mentor who could mitigate the "damage." The most educative part for me came when a well-known scholar in composition and rhetoric (whom I will refer to as "Dr. Smith") visited our booth and asked about our project. I recall launching into a spiel I had prepared on the plane to San Francisco only to find that Dr. Smith already knew everything I was telling her, and that I was not really answering the question she had asked, at least not to her satisfaction. A bit rattled, I attempted a few more explanations, none of which satisfied Dr. Smith's curiosity...Eventually, Paul [his advisor] stepped in, and I watched him as he carefully attempted to address Dr. Smith's concerns...watching Paul interact with Dr. Smith taught me much about the importance and collaborative nature of academic dialogue and helped me more rationally examine my academic "performance" anxiety. Dr. Smith's questions, I realized, were not intended to dismantle me. Rather they were simply inquisitive and constructive – they were meant to engage my ideas and further the knowledge-making process I had entered into with my colleagues...(p. 98)" (Simpson & Matsuda, 2008, p. 97-98).

"Over time and in different conversational spaces (classrooms, faculty offices, the copy room, the corridor outside of our TA cubicles), I noticed certain refrains that gradually coalesced into coherent, operational messages. One such message was that writing in graduate school wasn't just a pedagogical exercise or a private transaction between student and professor: The process was designed to stimulate the professional conversations in which scholars engage through their publications, editorial activities, and conference presentations. I was slow to catch on, but I eventually captured the principle that a chief goal of graduate school apprenticeship was to produce public writing that would contribute to a body of knowledge and perhaps even influence the course of a professional conversation." (Hedgcock, 2008, p. 36)

"Notably, gaining access to oral practices was difficult for Kota not only inside but also outside the classroom; participating in social gatherings with fellow doctoral students using 'everyday language' was as challenging for Kota as participating in class discussions using 'academic language'. Also, his marginal membership in the two contexts appeared to impact each other. (Morita, 2009, p. 456)

Example 2

The 2nd indicator: Knows old timers' expectations and has the ability to use effective strategies to satisfy those expectations

“I came to understand that apprenticeship would involve building content knowledge and displaying it by writing skillfully. Successful apprenticeship would necessitate (a) figuring out the expectations of “old-timers”—initially, my professors (the experts and gatekeepers) — and (b) discovering effective strategies for satisfying those expectations.” (Hedgcock, 2008, p. 36)

Example 3

The 3rd indicator: Has a healthy and sustainable advisor-advisee relationship

“We conclude this chapter by reflecting on the long-term nature of the mentoring relationship and by sharing some thoughts on how to make the relationship healthy and sustainable.” (Simpson & Matsuda, 2008, p.91)

“When discussing the concept of choosing an advisor, many remarked that choosing an advisor who was around was important, and choosing someone who, in Michael’s words, is ‘not always gone on vacation or not always involved into many committee meetings that they just can’t spend time with their students.’...these students expect, and almost demand, a certain quality of relationship with their advisors. Many of the students discussed that having support from their advisor was often more important than having someone who is a specialist in their area of study.” (Gardner, 2007, p. 735-736)

“Reasons for Departure of Science Students...Advisor Mismatch. Two students described personality clashes with their advisor. Both of these students selected their advisor without having worked with them in advance, and one did so despite the advice of other students...Both of these students had difficult relationships within their advisor...” (Golde, 1998, p. 57-58)

“The role of the advisor is critical at the doctoral level...Her or she serves as a role model and becomes the primary socializing agent in the department. Typically, the adviser establishes the standards of performance and the behavior norms for his or her advisee...A student’s academic success and his or her increased involvement in the program probably increase the likelihood that faculty members will work with that student...the set of student/faculty relationship variables is powerful enough to indirectly predict doctoral degree.” (Girves & Wemmerus, 1988, p. 185)

Example 4

The 4th indicator: Has a good relationship with faculty

“Faculty support

‘I guess what I would advise is not necessarily to look for the expert, but to look for the person who’s been supportive’ (Gloria, history, fifth year). The connections and relationships made with faculty were frequently remarked upon by the students, as much of their experience centers around their research. Overall, this group of students seemed relatively satisfied with the majority of the faculty and the relationships they had with them. They felt that, in general, they were able to approach most faculties with questions, problems, or even just to chat.”(Gardner, 2007, p. 735)

“...A multivariate analysis provides support for the framework, affirming the importance of social interaction among both students and faculty as well as collegiality among faculty for creating a supportive climate for doctoral study that also has the potential to provide a strong foundation for subsequent academic and/or research careers by stimulating students’ research and scholarly productivity...” (Weidman & Stein, 2003, p. 641)

“There are four general tasks of transition and initial socialization into graduate student life and the future career common to most doctoral students...The fourth task is integrating oneself into the department. Students must determine whether this particular department is a good fit for them. Relationships with faculty, staff, and peers play a critical role here. The key question students are asking is: “Do I belong here?” (Golde, 1998, p. 56)

“The student’s relationship with the faculty and the department characteristics are important at both the master’s and doctoral levels.” (Girves & Wemmerus, 1988, p. 186)

Example 5

The 5th indicator: Has a good relationship with peers

“There are four general tasks of transition and initial socialization into graduate student life and the future career common to most doctoral students...The fourth task is integrating oneself into the department. Students must determine whether this particular department is a good fit for them. Relationships with faculty, staff, and peers play a critical role here. The key question students are asking is: ‘Do I belong here?’...” (Golde, 1998, p. 56)

“Peer support

‘I need support from other students’ (Claudia, history, fifth year)...These comments were spread equally across both programs and peer support was mentioned overall

much more frequently than the concept of faculty support. These students look to one another for support, friendship...for guidance in their programs through ‘the graduate student grapevine.’ ...These students felt that their connections with other graduate students were what got them through the beginning of their program...” (Gardner, 2007, p. 736)

“For the vast majority of the students in the study, therefore, the central source of support was other students in their program. Indeed, support from other students was mentioned far more frequently than support from advisors or faculty members, a finding generally not discussed in the existing literature. Students seek out one another for advice, guidance, and mentoring.” (Gardner, 2010, p. 70)

Indicators from the scholarship of doctoral students’ academic acculturation	Interpersonal relationships with peers, professors, & advisor
	1. Has the ability to have (online and/or face-to-face formal and informal) conversations with scholars (Casanave, 2008; Hedgcock, 2008; Simpson & Matsuda, 2008; Morita, 2009), including peers, colleagues, professors, and other scholars in own discipline-specific communities
	2. Knows old timers’ expectations and has the ability to use effective strategies to satisfy those expectations (Hedgcock, 2008)
	3. Has a healthy and sustainable advisor-advisee relationship (Gardner, 2007; Golde, 1998; Girves & Wemmerus, 1988; Simpson & Matsuda, 2008)
	4. Has a good relationship with the faculty (Gardner, 2007; Golde, 1998; Girves & Wemmerus, 1988; Weidman & Stein, 2003)
	5. Has a good relationship with peers (Gardner, 2007 & 2010; Golde, 1998)
	A participant’s academic performance in his academic field
	6. Has the ability to write as an insider and write for a wider audience (Hedgcock, 2008; Li, 2008)
	7. Has the ability to write different writing genres for different academic purposes in English (Hedgcock, 2008) (e.g., class assignments, lab reports, conference proposals, qualifying exam(s), a candidacy exam, a dissertation, and journal articles)
	8. Has the ability to use disciplinary language, terms, and concepts in speaking and writing (Casanave, 2008)
	9. Has the ability to thoughtfully and critically read scholarly texts (Casanave, 2008; Hedgcock, 2008; Li, 2008)
	10. Has the ability to use strategies to purposefully read academic texts (Hedgcock, 2008) (e.g., read texts as sources of discipline-based knowledge and as models to recognize, analyze, reproduce, selectively reshape textual conversations)

Continued

Table 3.4 The Indicators of Academic Acculturation from the Scholarship

Table 3.4 continued

A participant's academic performance in his academic field	
11.	Has the ability to have an argumentative voice and make scholarly arguments (Li, 2008)
12.	Has critical thinking and synthesis competence (Gardner, Hayes, & Neider, 2007; Li, 2008)
13.	Has the ability to independently conduct research and/or experiments (Gardner, 2007 & 2010; Girves & Wemmerus, 1988)
14.	Receives awards related to academic performance (Mendoza, 2007)
15.	Involves in professional activities (Li & Collins, 2014; Gardner & Barnes, 2007; Weidman, Twale, & Stein, 2001) (e.g., attend conferences, seminars, workshops, and scholarly talks)
16.	Acquires disciplinary core knowledge (Casanave, 2008)
17.	Knows key figures in the field (Casanave, 2008; Hedgcock, 2008)
18.	Knows which academic camp(s) he aligns with (Casanave, 2008; Hedgcock, 2008; Li, 2008)
19.	Knows ways of constructing knowledge (Casanave, 2008) (e.g., knows how to interpret research and experimental data)
20.	Knows scholars' arguments when listening to scholars' talks (Simpson & Matsuda, 2008)
21.	Understands disciplinary culture (Gardner, 2007; Hirt & Muffo, 1998)
22.	Has the ability to use English to do academic English speaking, reading, listening, and writing without difficulties (Sato & Hodge, 2009)
23.	Understands course materials in English (Morita, 2009)
24.	Understands and has the ability to participate in class discussions in English (Morita, 2009)
25.	Understands the Western academic culture (Jones, 1999; Li & Collin, 2014; Robinson-Pant, 2009), such as the emphasis on the student-centered teaching, the ability to communicate and construct knowledge, critical thinking, independence, and class participation through oral discussions

In order to assess the participants' academic acculturation according to each indicator from the four categories, I adopted satisfied (S), slightly satisfied (SS), dissatisfied (DS),

Not Prominence (NP), and Not Applicable (NA). More specifically, S means a participant met the overall requirement and performed well; SS means the participant met the requirement but did not perform well; DS means the participant did not meet the requirement; NP means data do not show the prominence of this indicator; NA means the indicator was not applicable according to a participant’s situation. In addition to evaluating the participants’ academic acculturation through this manner, I also utilized a 1% to 100% scale (see Table 3.5) and descriptive explanations to offer detailed information about how well the participants achieved these indicators. It is expected that evaluating their academic acculturation through this method could provide a more holistic view of the participants’ academic acculturation.

Percentage Range	Likert Scale
1 – 20 %	Very poor
21 – 40%	Poor
41 – 60%	Moderate
61 – 80%	Good
81 – 100%	Very Good

Table 3. 5 The Percentage Scale to Evaluate the Participants’ Academic Acculturation

Category	Indicators of Successful Academic Acculturation	S, SS, DS, NA, NP
A participant’s definition of successful academic acculturation	1.	
	2.	
	3.	
	4.	
Indicators from collected data on a participant	5.	
	6.	
	7.	

Continued

Table 3.6 An Example of the Table Used to Evaluate an Participant’s Academic Acculturation

Table 3.6 continued

Category	Indicators of Successful Academic Acculturation	S, SS, DS, NA, NP
Expectations and requirements of participant's academic department	8.	
	9.	
	10.	
	11.	
	12.	
Indicators from the scholarship of doctoral students' academic acculturation	Interpersonal relationships with peers, professors, & advisor	
	13.	
	14.	
	15.	
	16.	
	17.	
	An participant's academic performance in his academic field	
	18.	
	19.	
	20.	
	21.	
	22.	
	23.	
	24.	
	25.	
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3.9 Validity and Reliability

Validity and reliability are used to measure whether a study's results are trustworthy or not (Merriam, 1998). Validity includes internal and external validity. Internal validity considers whether researchers really measure what they are purporting to measure and what the findings reflect (Merriam, 1998). Merriam (1998) suggests six ways to increase a study's internal validity: 1) triangulation, 2) member checks, 3) long-term observation, 4) peer examination, 5) participants' involvement, and 6) researcher's bias. This current study employed multiple instruments, such as a survey, interviews, weekly journals, document collection, and field notes, to collect data from the participants and the research site for triangulation. This present study also utilized member checks; for instance, I asked participants to clarify their uncertain and ambiguous answers during the process of data collection and analysis. In the course of writing up analysis and findings, I asked the participants to double check interpretations and their meanings. I also invited a bilingual speaker who is proficient in both Chinese and English to double check whether the translated excerpts from the participants' data clearly conveyed the original meanings. Most of the raw data, such as interview transcriptions, were written in Chinese and imported into ATLAS.ti in this language for two reasons.

1. Translating data from one language to another language could lose some meanings of the original data, especially when data are not translated by a researcher but by translators who may not know the research context (Phelan & Parkman, 1995; Temple, 1997; Temple & Young, 2004; Twinn, 1997, 1998; Xian, 2008). For this present study, data were only translated and analyzed by myself and the translation was cross-checked by a bilingual speaker.

2. Translating data into another language has the potential of inaccurately conveying meaning from the original data (Twinn, 1997; Xian, 2008) because the process of translation involves not only translating across two languages but also interpreting two different cultures. Xian (2008) advises translators to transfer meanings of data rather than verbatim translating the data and to provide supplementary explanations for cultural and knowledge gaps.

In spite of this strategy, some challenges remain during the process of translation. First, sometimes it is difficult to find an appropriate word in the target language to represent the meaning of the word in the source language, especially when there is no apparent equivalent word in the target language (Twinn, 1997, 1998). For instance, a word, such as 烏賊車 (wu zei che; a squid car or scooter, refer to Supplement 3-9), means that a car or a scooter emits black exhaust like a squid which releases a dark pigment. Second, different grammatical styles between two languages, such as Chinese and English, could make the translation become more difficult (Twinn, 1997, 1998). The third challenge is the straightforward translation, that is, the same word in the translation may have different interpretations by readers from the source and target cultures (Xian, 2008). Xian (2008) gave an example of the word "saint" which referred to Confucius for Chinese readers whereas it referred to "a holy person, an archangel (such as St. Paul or St. Peter), or one of God's chosen people" for Western readers (p. 238). In considering all these, I translated participants' interview responses to capture their tone and oral styles instead of merely pursuing grammatical accurate translation.

In addition to translation, another strategy for ensuring validity and reliability in this present study is to seek other researchers' advice during the process of data analysis and

report. That is, I employed "peer examination" (Merriam, 1998). With regard to researcher's bias, each researcher has his or her own beliefs, values, and worldviews (Merriam, 1998). Hence, Merriam (1998) suggests that a researcher should attempt to be as clear and non-judgmental as possible and report findings as accurately and honestly as possible.

This present study followed these suggestions by Merriam (1998) in order to engage with researcher's bias. I, therefore, acknowledge that my interpretation of collected data cannot be completely objective and neutral. In order to compensate for this weakness, I utilized five different instruments to gather data collection – a survey, interviews, document collection, weekly journals, and field notes – and the member check technique to increase the validity and credibility of this study (Creswell, 1994). Overall, this study applied various strategies, including adopting multiple instruments, member checks, peer examination, and double-checking the translation with a bilingual speaker in order to ensure the validity of this study.

In addition to internal validity, external validity considers whether findings of a study could be applied to other situations (Merriam, 1998). This current study adopted a qualitative research paradigm which did not attempt to generalize research findings to other or a wider population. It is, therefore, up to a reader to decide whether to apply findings of a study to particular situations (Firestone, 1993 cited in Merriam, 1998). A researcher should provide readers sufficient detailed description of the research context (Merriam, 1998). Accordingly, for this present study, I attempted to describe the research context in a detailed manner so that a reader could appreciate whether and how to apply research findings to their own situations.

Another factor that determines the trustworthiness of a study is reliability. This refers to the extent to which the same results would be obtained if a study is duplicated (Merriam, 1998). Merriam (1998) pinpoints the problem of applying the concept of reliability to qualitative research because such research often involves human behavior which is never static and such research does not seek a single reality. Lincoln and Guba (1985) suggest seeing reliability as a way to examine whether findings of a study are consistent with the gathered data. Hence, for this current study, I attempted to align the findings with the collected data.

3.10 Ethical Considerations

Heath and Street (2008) and Merriam (2009) have argued that for qualitative research ethical dilemmas likely appear during the process of data collection, analysis, and the distribution of findings. In this current study, before gathering the data, the participants were invited to take part in the study and given a consent form which described the purpose of the study, the procedure of data collection, their rights as participants, benefits and risks, and the extent of anonymity and confidentiality. During the process of data gathering, participants' real names in all data were replaced with pseudonyms. Moreover, the participants understood that if they did not feel comfortable to answer some of the questions, they had the option of withdrawing. There were no penalties or ramifications if they decided to withdraw at any point in this study. The presentation of data strives to maintain participants' voices through the faithful representation of their sentiments and an attempt to portray their voices through transcriptions. This was corroborated through member checks.

For data analysis, Merriam (1998) has proposed that this process may have other ethical issues because a researcher is a primary person who decides what data are important and who analyzes data through his or her own particular theoretical perspectives and bias. In order to compensate for this drawback, this study employed triangulation as explained above. In addition to data analysis, reporting a case study which depicts a case or a participant in detail could make the case or the participant become easily identifiable. To avoid this problem, data in this study were de-identified to the extent possible. As for the issue of distributing research findings, Merriam (1998) pinpoints that exposing a case through any means of publications could violate participants' privacy. In order to prevent this violation, participants gave appropriate consent.

In the following three chapters (Chapter 4, 5, and 6), I presented, analyzed, and discussed the three participants (Cheng-Rui, Zhi-Kai, and Tian-Yu) individually through the format of a case study. Each case study was organized through answering the four research questions. Each case report contained six major sections: 1) learning background which presented a participant's previous and current learning backgrounds, 2) definition of academic acculturation which described a participant's perceptions of conditions constituting successful academic acculturation, 3) academic difficulties which disclosed a participant's academic challenges during his acculturation processes, 4) use of technologies for academic acculturation which introduced what technologies a participant used and how he utilized them to undertake which academic tasks, 5) the relationship between a participant's use of technologies and his definition of successful academic acculturation which analyzed how a participant's use of technologies impacted on his

academic acculturation processes, 6) the evaluation of a participant's academic acculturation to his academic discipline, and 7) summary.

Chapter 4: Cheng-Rui's Case Report

4.1 Cheng-Rui's Learning Background

Cheng-Rui's learning background mainly comprises three stages: L1 learning context at the college level and L2 learning context at both the master's and doctoral levels (see Table 4.2). Before entering his current doctoral program, he studied in the same Material Science and Engineering (MSE) field at a university in Taiwan. From his college years, he was motivated to study abroad. Hence, he involved in a science fair as a significant step in preparing for studying in a master's program in the US. This science fair project was to conduct an experiment, and he opted to present the written results in English as shown in "I was thinking that I would study a master's degree overseas... so I insisted on writing the report and the poster in English" (interview transcript, July, 2015). One notable impediment was that he lacked training in English academic writing. He said "No one taught me how to write it. I just looked at previous students' writing formats" (interview transcript, July, 2015). This challenge persisted throughout his master's level and was felt as he transitioned to the doctoral level. In reference to his master's level, he said:

"I didn't take classes about how to write English academic papers. The program emphasized more on speaking... They offered spoken English courses but not English writing" (interview transcript, July, 2015).

L2 learning context: Master's level.

In terms of academic transition, it is noteworthy that Cheng-Rui studied for one and a half years in an MSE master's program which is similar to his program focused on the doctoral level. Both master's and doctoral programs were in the U.S. Studying in this context presented some challenges. For instance, the master's program in the U.S. presented linguistic challenges in reading, writing, and paper presentation. In reflecting about his master's program, the repetition of "difficulty" and "difficult" emphasizes his challenge of transitioning from L1 to L2 English as follows:

“The difficulty was that I understood reading but I needed to use my own words to write up my ideas. It was really difficult. I had to digest reading, organize my ideas, and then write my ideas in my own words. It was very difficult. Thus, at the beginning, I often copied entire passages I thought were important from the original text to my writing. I didn't know how to make them become my own words and then logically write them into my papers. The second problem was that I copied too many [passages] and finally found that I was unable to paraphrase them. Thus, I directly quoted them if I could. If not, I just directly copied them into my writing. My professors used Turnitin software [to detect plagiarism]. I remember my first paper got 34 % [of his writing had been plagiarized]. 34% was very very high.” (interview transcript, March, 2015)

His reading and writing challenges were further exacerbated by the expectations from his master's program to not plagiarize leading to monitoring of language use through Turnitin software.

L2 learning context: Ph.D. level.

Interview data, field notes, information from the college and departmental website, and assembled field documents, such as policies, coursework, and general information, reveal several characteristics of his current MSE program. Table 4.1 particularly highlights some characteristics of the MSE doctoral program:

Features of the MS Doctoral Program
Provided newly admitted international students useful information, such as preparation for studying in the U.S., housing, finances, a graduate student orientation, registration of courses, and contact information of a graduate studies coordinator in the department.
Regularly invited domestic and international scholars to give talks
Had high reputation in the international MSE communities and hence created opportunities to have local and international research collaborations
Possessed great technological infrastructure for research and instructional purposes
Had higher proportion of domestic students
Recruited the faculty with a high reputation in MSE communities
Had a requirement for students to take and pass MSE core courses and maintained a minimum GPA 3.0 above
Had a requirement for students to be an instructional assistant for six-credit hours. The purpose was to develop students' "intellectual leadership which involves more than the generation of knowledge through research, but also its transfer through effective communication" (MSE website).
Had a requirement for students to complete the doctoral program around five years. After one to two years, students could take the candidacy exam. Then, around one year after the exam, students were required to complete the dissertation overview. Around six to one year after the overview, students needed to complete the dissertation. In other words, the department expected students to have the ability to independently undertake research and complete their doctoral study within a certain time period.
Emphasized the originality of students' academic works. For example, students' written and oral doctoral candidacy exam needed to be "free of plagiarism and all other forms of academic misconduct" (MSE website).

Table 4.1 Characteristics of Cheng-Rui's Doctoral MSE's Program

In his interview data, two notable characteristics of his current program were the program's high reputation in the international MSE communities and well-equipped technologies:

"My program has a high reputation in the international academy and first-class experimental facilities so many international scholars would contact us to ask the possibility of collaboratively conducting research. For instance, scholars from China had projects with my professors. Then, I'd do research with them... We also have many visiting scholars coming here to exchange research and experimental experience. Tomorrow, there'll be two visiting scholars from Japan. In the past, we had visiting scholars from Austria, China, Brazil, and Nigeria... My prior master's program had only two American students. But, my doctoral program is

more multicultural and also has many resources. I feel very privileged."
(interview transcript, March, 2015)

Moreover, he reported that his present advisor was eminent and hence attracted numerous domestic and interactional scholars to come to give talks and have collaborative research projects. The favorable reputation of his doctoral program, the academic renown of his advisor, and the availability of resources added up to the high esteem of the program which in turn shaped his acculturation in MSE academic communities.

Based on his interview data, the following characteristics of his L1 and L2 learning contexts presented in Table 4.2 both Taiwan and the U.S. were generated across the college, master's, and doctoral levels. The characteristics of his previous and current learning contexts could impact on his acculturation to the Western academic culture and the MSE communities.

	L1 learning context: the College Level	L2 learning context: the Master's Level	L2 Learning context: the Ph.D. Level
Classroom Context	1. Students to meet attendance expectations and subsequently graduate.	1. Students to gain experimental skills and timeliness.	1. Students successfully undertook independent research, completed candidacy exam and dissertation, and gave a public talk about the dissertation research.
	2. The main language in the classroom was Chinese.	2. The main language in the class was English.	2. The main language in and outside of the class was English.
	3. Limited student-to-student and student-to-teacher class interactions.	3. Few student-to-student and student-to-teacher class interactions.	3. Abundant student-to-student and student-to-professor interactions.
	4. Mid-term and final examinations were adopted to evaluate learning.	4. Various approaches (e.g., exams, assignments, and presentations) to evaluate students' learning.	4. Various approaches (e.g., exams, assignments, presentations, a candidacy exam, and a dissertation) to evaluate students' learning.
Pedagogy and Interaction	5. Most teachers adopted teacher-centered styles.	5. Instructional styles tended toward traditional methods	5. Professors adopted interactive teaching methods, integrating slides and videos.
Language of Instruction	6. Most teaching and learning materials were written in English.	6. All teaching and learning materials were written in English.	6. All teaching and learning materials were written in English.
	7. Few assignments written in Chinese.	7. Different types of assignments, such as math questions, short papers, and class presentations, written in English.	7. Different types of assignments, such as math questions, short papers, and class presentations, written in English.

Continued

Table 4.2 Cheng-Rui's L1 and L2 Learning Contexts

Table 4.2 continued

	L1 learning context: the College Level	L2 learning context: the Master's Level	L2 Learning context: the Ph.D. Level
Technological Infrastructure	8. Limited technological infrastructure. Teachers often wrote the teaching content on a chalkboard but occasionally utilized an overhead projector with transparencies.	8. Limited technological infrastructure. The school lacked internet connectivity.	8. Well-equipped technological infrastructure and support for instruction and research (see Supplement 4-1 & 4-2). a. Teaching materials were uploaded to Carmen [an online class management program] before class. b. Each class was digitally recorded and uploaded to Carmen after class (see Supplement 4-3).
Cheng-Rui's Learning Habits	9. Quietly listened to lectures and took notes by hand. 10. Wrote notes in English by hand 11. Rarely previewed and reviewed teaching materials except for preparing for mid-term and final exams. 12. Participated in collaborative learning groups to prepare for exams. 13. Underlined unfamiliar English words on teaching materials and then utilized his laptop to look them up in Taiwan online Yahoo Chinese-English dictionary (after going back to his dormitory). 14. Rarely attended co-curricular activities. 15. On one occasion, the publication took the form of a poster presentation at a science fair.	9. Asked questions after class or during office hours. 10. Wrote notes in English by hand 11. Reviewed what professors taught via writing different types of assignments. 12. Data do not show the prominence of group learning. 13. Employed his laptop and Google search engine to understand unfamiliar concepts and terms while writing assignments (at home). 14. Data do not show the prominence of his participation in co-curricular activities. 15. Minimal opportunities to publish research results in scholarly journals.	9. Participated in class discussions. 10. Wrote notes in English by hand 11. Reviewed teaching content after class via writing assignments and sometimes watching teaching videos. 12. Sometimes utilized communication apps (e.g., WeChat, Facebook, cell phone calls, and cell phone texts) to discuss assignments and research with peers. 13. Learned unfamiliar concepts through downloading previewing, and reviewing slides and teaching videos. 14. Attended MSE conferences, seminars, and visiting scholars' talks. 15. Tended to publish his research results in scholarly journals.

On the whole, Cheng-Rui's learning experience in college in Taiwan and in the master's and the doctoral program in the U.S. offer some valuable insights about his academic acculturation. Firstly, given that his college-and-Master-level learning was in the same field as his current doctoral program, he was likely experiencing some transfer in the course of his acculturation. More specifically, teaching content in college and the master's program were related to MSE so he was likely able to transfer some MSE knowledge and terminologies that he learned in previous learning contexts to his present doctoral learning. Secondly, the difference between his previous and present exposure is that the former (college and the master's program) tended to employ traditional teacher-centered pedagogy while the latter (the doctoral program) utilized the student-centered instruction. This particular difference would have ramifications on the nature of class interactions between teachers and students and on their role relationships. Under the traditional teacher-centered pedagogy, a teacher's role ideologically positions the teacher as a provider of direction and impetus for learning and students as followers of the teacher's direction. On the contrary, under the student-centered pedagogy, a teacher is perceived as a facilitator of learning and students as independent learners with the responsibility for their learning. His data also reveal that his learning was inclined to meet teachers' requirements, such as examinations and assignments, in college and master's program, whereas in the doctoral program, his learning was apt to actively participate in required and non-required academic activities (e.g., conferences, seminars, and publications) in order to fulfill his own expectation: success in the MSE field. This change also demonstrates that he took up the Western ideology of *an independent learner* at the doctoral level. Thirdly, he studied exam content together with peers at college in

Taiwan which indicates his participation in peer-to-peer support network in the collective learning environment. Conversely, in his present Western academic context, field notes reveal a pervasive ideology of independence and competitiveness among the student body. His tendency for peer-to-peer support network endured in his doctoral study. Survey and interview data reveal his use of technologies, such as cell phone texts and calls, WeChat, and Facebook, to achieve the peer-to-peer support infrastructure, for example, when he needed to discuss academic and research issues. This use of technologies afforded him peer-to-peer support in his acculturation processes. Fourthly, a difference between his prior and current academic socialization lay in the use of instructional technologies. In his college and master's program, he was not exposed to hi-tech environments, whereas his present doctoral program had well-equipped technologies for instruction and research. In spite of this difference, his multiple data do not reveal difficulties in adjusting to his present doctoral program with well-equipped technologies. Fifthly, the absence of training in English academic reading and writing in his college and master's study might possibly affect his acculturation to the current doctoral program that highly emphasized English academic reading and writing. In terms of his listening and speaking, additional data show that he did not receive formal training in English listening and speaking in college and the master's program. However, informal practices, such as listening to lectures and presenting in class in the master's program, likely helped him transit to the present doctoral program. Taken together, his prior academic learning experience might impact him on socializing into the current doctoral program and MSE communities.

4.2 Cheng-Rui's Definition of Successful Academic Acculturation

As mentioned in the section of his learning background, Cheng-Rui studied an MSE master's program in the U.S. for one and half years. In other words, he started to accommodate to the Western MSE academic culture when studying in the master's program. For him, being able to discuss and present MSE related research at conferences are significant indicators of successful academic acculturation. In an interview, he explicitly discussed these determinants:

"I think success in the field means to be able to communicate with others about research, present at conferences and receive good feedback from the audience, and receive awards. Also, my advisor is satisfied with my work performance." (interview transcript, June, 2015)

He further offered the following self-evaluation about his conceptualization of his own academic success:

"From 0 to 10, I feel I've 9 in terms of communication with colleagues and my advisor. So far I've adjusted well. I'm able to discuss topics related to MSE and my research. For example, when I communicate with others or attend a conference, there's a new topic. I'm able to understand what they said through their presentations or conversations... After attending conferences for several years, I feel I've 7 out of 10 in terms of receiving good feedback from conference audiences. I compare myself to the same year of another doctor students. I could know how well I'm through comparing what another fourth year of doctoral students have done and what I've done. But, if I compare with students in the entire US, I feel I've only 5. Once I received an award for my presentation in a conference that was held in the [research site]. That was in February, 2015 [his fourth year of Ph.D. study]." (interview transcript, June, 2015)

In terms of external evaluation, specifically, being evaluated by his advisor, he reported that:

"I totally don't know whether my advisor is satisfied with my work or not. He always said good, good, good. For instance, he said my work is always well organized. But, I really do not know how good my work is. In comparison with his other students over a period of 10 years, I don't think I'm really outstanding. For this current conference presentation, he didn't even look at my slides. After my presentation and his meeting [at the conference], he asked me what questions

the audience asked. I told him and then he just said good. He's always busy. After he asked me, many people wanted to talk to him. He's always surrounded by many people. I even didn't have time to discuss my presentation or my dissertation with him." (interview transcript, June, 2015)

Data from his interviews show other instances where his answers implied a sense of success, for example, when he talked about the publication:

"In my early Ph.D. years, I knew publication was very important for me even though my program and advisor don't require students to publish. Most of my seniors didn't have publications when they graduated. My advisor also doesn't care about it. I personally think an absence of publications while graduating is very unsettling... I'm writing a journal paper. My goal is to publish at least three journal articles above: three articles and one literature review. That would be four." (interview transcript, July, 2015)

In defining academic success, he highlighted "the field" as representing the MSE context within which he wanted to succeed. His answer contains an inventory of academic activities which amount to a checklist or preconditions for successful academic acculturation: 1) communication, 2) presenting at conferences, 3) receiving positive feedback, 4) receiving awards for research and academic performance, and 5) advisor's satisfaction. In his self-evaluation, some of these preconditions for success emerge. Noticeably, in this self-evaluation, he employed a ten-point scale leading to a precise assessment of his rate of academic success, "I feel I've 9 in terms of communication...I feel I've 7 out of 10 in terms of receiving good feedback... I feel I've only 5 [in terms of the comparative standing with other students in the U.S.]". Incidentally, none of the five preconditions is about academic publication. Yet, he highlighted this as an indicator of successful academic acculturation. These above data show that Cheng-Rui was aware of the necessity of academic publication when he said "I'm writing a journal paper. My goal

is to publish at least three journal articles above." This awareness is contrasted with his advisor's lack of concern as seen in "My advisor also doesn't care about it."

When he shifted this assessment to reflect on how his advisor would rate him, his assessment was less precise as he said "I totally don't know whether my advisor is satisfied with my work or not... I really don't know how good my work is... I don't think I'm really outstanding." A key reason that emerges for this lack of precision in successful academic acculturation is unclear guidance by his advisor. This is corroborated by "He always said good, good, good.... he didn't even look at my slides... I told him and then he just said good." These data appear to conflict with his previous statement where he reported that the good reputation of MSE and his advisor were advantageous. He noted that his advisor had no time and was too popular to guide him effectively, for instance, "He's always busy. After he asked me, many people wanted to talk to him. He's always surrounded by many people. I even didn't have time to discuss my presentation or my dissertation with him." His self-report about his advisor was characterized by a litany of complaints as follows: 1) inattention, "For this current conference presentation, he didn't even look at my slides", 2) limited guidance, "After my presentation and his meeting [at the conference], he asked me what questions the audience asked. I told him and then he just said good" and 3) alienation, "He's always surrounded by many people. I even didn't have time to discuss my presentation or my dissertation with him."

Taken together, data from Cheng-Rui's self-evaluation on successful academic acculturation and his interaction with his advisor reveal a discrepancy between his five preconditions for academic success and the low-quality interaction with his advisor as reported in this particular instance. Overall, he defined successful academic acculturation

as the process where he gradually acquired MSE knowledge, developed expertise, and a capacity to be involved in intellectual and scholarly discussions while gaining recognition in the MSE communities. In addition to yielding this definition, these data give evidence of difficulties Cheng-Rui confronted during his academic acculturation processes.

4.3 Cheng-Rui's Academic Difficulties

From various data sources, he reported three main areas of difficulties in his academic acculturation processes. These were the lack of support from his advisor and difficulties in English academic reading and writing. Whereas he highlighted other difficulties, these three predominated in the data. Although English academic reading, writing, listening, and speaking are inseparable, in order to clearly analyze and discuss English academic difficulties he encountered during his acculturation processes, his English academic difficulties in reading and writing are reviewed separately from listening and speaking in this section.

4.3.1 Difficulty in getting support from his advisor.

As mentioned in the section of his learning backgrounds, his advisor was renowned and accomplished in the MSE discipline, but too busy to give him sufficient support. This observation recurred in the data, such as:

"During my first year of Ph.D., I had found my seniors had difficulty in meeting the advisor. At that time, I was generally optimistic. However, after encountering the challenge for several times [the challenge of meeting his advisor regularly], I realized I need to rely on myself, and I shouldn't expect him to help me. When facing difficulties in conducting experiments, I rarely asked him. What I asked him about was research directions and budgetary advice. For technical problems, such as how to do certain parts of an experiment, I rarely rarely asked him." (interview transcript, September, 2015)

He also mentioned several occasions that show his advisor could not offer him enough support in the way of expedient guidance. On one occasion, he wanted his advisor to look at his dissertation writing as follows:

"My advisor absolutely doesn't look at my articles because it takes him lots of time to read and give feedback. I gave him my first journal article [which is the first chapter of the dissertation]. I thought at least I could have his suggestions. I knew he wouldn't read it so I printed it out and put it in front of him. I thought at least he would look at it a little bit. Then, he directly asked me whether I found someone to proofread it first. I said "Not yet". Then, he suddenly looked reluctant to read it. I tried to mitigate the atmosphere so I further explained "It is not the final one" which meant that I wanted him to look at it first and then I would revise based on his suggestions. Then, he said "Oh! After you finish it [the final version], you bring it to me." If he doesn't read it, how could I come out with the final version? It's a chicken and egg situation." (interview transcript, June, 2015)

On another occasion, he found that his later experimental results repudiated his previous experimental analysis which he had erroneously presented at several conferences but no one, including his advisor, had detected this error:

"During a group meeting [He had a regular meeting as a member of his advisor's research team. Whenever a student was going to present at a conference he or she would first need to present at the group meeting.] When I reported my data and analysis, he [his advisor] just said: "good, good, good". Not only him but also the audiences at conferences didn't question my data and analysis." (interview transcript, July, 2015)

He described how he tried to resolve this matter with his advisor. In this description, he highlighted how he coped with the challenge of convincing his busy advisor to give him guidance. He described a strategic use of the PowerPoint presentation which emanated from his frustration in getting his advisor to engage with his written text:

"I know he is unwilling to look at it so I just directly copied the paragraph to PowerPoint. When he read until that slide, he said: "hm...I'll read this later." He just skipped that slide. I asked "Can you read it now?" So, he went back to the slide to read it. Then, we discussed it a little bit. Before this, whenever he saw any lengthy prose, he would skip it. After he read that prose, I didn't have any further areas I needed him to read. I hope I'll not need to ask him to read anymore text in my

dissertation. It really takes a lot of time to have him to read my writing. What I can do now is to do my best to make it [his dissertation] better and then give it to the post-doc to review. Actually, the post-doc may not understand what I did. He cannot be compared to my advisor. In terms of professional knowledge, my professor would know best. I'm the second and then the post-doc, but my advisor doesn't want to read it. The post-doc just revised words, grammar, or the structure of writing." (interview transcript, July, 2015)

Cheng-Rui's interaction with his advisor is characterized by a growing frustration over the lack of adequate guidance on his dissertation. His main needs were guidance on both English written accuracy and disciplinary content related to his dissertation research. Nevertheless, his complaint is that his advisor was giving him insufficient support and unwilling to address his English writing academic need. The following data demonstrate this strained relationship:

"I finished my first chapter and then sent it to him [his advisor]. No any response again. Every time I met him and asked him to look at my paper. Then, he said no. It's hopeless. What I exactly need is his help for my writing! He doesn't want to read it! No way out!" (interview transcript, January, 2016)

In the course of our conversation, he did not want to talk more about this situation with his advisor. These above data reveal several difficulties encountered by Cheng-Rui in his interactions with his advisor. These include clashing academic expectations, cumulative frustration, unmet-prerequisite needs in language use and disciplinary conceptual guidance, and disconnected advisor-advisee mentoring relations in unfamiliar Western MSE academic communities. Specific instances within these data show the extent of these difficulties. He developed a strategy of self-reliance to deal with the clashing academic expectation which is seen in "I realized I need to rely on myself, and I shouldn't expect him to help me. When facing difficulties in conducting experiments, I rarely asked him." Additionally, he and his advisor had different expectations of writing final drafts whereby his advisor insisted upon the post-doc as a go-between for assistance in English

writing accuracy, and he preferred direct engagement with his advisor. This clashing expectation is evidenced by "he directly asked me whether I found someone to proofread it first or not. I said "Not yet". Then, he suddenly looked reluctant to read it. ... If he doesn't read it, how could I come out with the final version."

These clashing expectations are prevalent in his interview data indicating his festering frustration. Out of helplessness, he devised some strategies to deal with his disappointment given what he considered as inadequate guidance. For instance, when confronting with technical problems in conducting experiments, he "rarely rarely asked" his advisor for help. The repetition of "rarely" puts emphasis on his deliberated decision to deal with this matter in this way. Another strategy is to directly persist on seeking help despite the awkwardness of such persistence. For example, when his advisor said "I'll read this later" and skipped a slide containing Cheng-Rui's lengthy text, he asked "Can you read it now?" The direct nature of this question shows that he really wanted his advisor as an expert in the field to read and give confirmation. Further, his advisor's refusal to read his writing exacerbates his frustration as seen in "If he doesn't read it, how could I come out with the final version. It's a chicken and egg situation." The chicken-egg metaphor indicates his confusion about a way forward and heightens his dissatisfaction with this lack of guidance. This growing dissatisfaction is captured in his expression of hopelessness and entrapment in "Every time I met him and asked him to look at my paper. Then, he said no. It's hopeless... He doesn't want to read it! No way out! "

Although the MSE department expected their doctoral students to be able to undertake independent research (as described in this early section of his departmental

characteristics), without an expert's guidance during the entire learning process, any novice researcher would be unable to learn vital disciplinary knowledge and research skills and become an independent researcher with well competence. In Cheng-Rui's case, he was compelled to be an independent researcher from the beginning until the present, but it is uncertain whether he acquired significant disciplinary knowledge and research skills, which casts further doubt as to whether he met disciplinary communities' expectations of knowledge and research skills. This sense of doubt foregrounds his another challenge, that is, unmet-prerequisite needs in language use and disciplinary conceptual guidance. As an ELL speaker of English, Cheng-Rui was concurrently navigating the new language and academic culture as seen in "he directly asked me whether I found someone to proofread it first or not. I said "Not yet". Then, he suddenly looked reluctant to read it." An implicit expectation by his advisor was his writing be proofread by the post-doc. Aware of this expectation, he resolved to work harder on his writing before giving it to the post-doc. The focus was on English writing accuracy, including syntax, grammar, and structure. He said "What I can do now is to do my best to make it [his dissertation] better and then give it to the post-doc to review... The post-doc just revised words, grammar, or the structure of writing." One line that succinctly expressed his plea for help in L2 English academic writing is "What I exactly need is his [his advisor] help for my writing!" The use of "need" and "help" indicate that he required a basic and necessary intervention for his survival in his academic acculturation processes, and this intervention should come in the form of vital SOS assistance by his advisor. In general, his unanswered plea for help with his writing (among other challenges) shows a disconnected advisor-advisee mentoring relationship in the

unfamiliar Western MSE academic context. From the very beginning, he reported he sensed of optimism which conflicted with his current frustration. Upon entering the unfamiliar MSE academic context, he observed other students who were ahead of him and noted how they had difficulty in meeting their advisor (who was also Cheng-Rui's advisor) as seen in "During my first year of Ph.D., I had found my seniors had difficulty in meeting the advisor. At that time, I was generally optimistic." Overtime, his advisor took up senior administrative responsibilities necessitating for students to schedule appointments through his secretary. In a subsequent interview, he further reported: "If we need to meet him, we need to make an appointment with his secretary" (interview transcript, March, 2015). Taken together, these data show a significant challenge for Cheng-Rui's academic acculturation processes and underscore the need for an infrastructure of support through a pleasant advisor-advisee relationship.

4.3.2 Difficulty in academic reading and writing.

In addition to the difficulties in interacting with his advisor, he also faced challenges in academic reading and writing in English. These are the main academic difficulties he encountered when compared with the challenges that he experienced in listening and speaking. Among multiple data, one notable point is that he mentioned his difficulty in writing the literature review for his dissertation due to the lack of suitable note-taking strategies while reading academic texts and further the lack of systematically organizing notes:

"This is my big problem. I read an article and found the author mentioned another researcher's work. Then, I would immediately look for and read the researcher's work. Then, in the second researcher's article, he mentioned another researcher's work so I searched for and read his/her work right away. During the process of

reading one text and then jumping to read other texts, I gradually lost myself and forgot what I wanted to look for and get from those research works...I don't have a good habit of reading academic texts." (interview transcript, June, 2015). The above data reveal that he was unable to adopt a purposeful reading strategy to follow the thread of arguments and hence inefficiently participated in scholarly conversations. This is because he was unable to see where an argument started and how it developed. Instead, he got distracted by other citations and references and then finally lost his original sight of the argument. In a related manner, he did not initially have the agency to control technology to achieve his reading objectives so he read one PDF and then got derailed into reading another PDF and subsequently lost his focus. This also highlights the non-linear nature of online reading which complicates his academic reading process in English (L2). In other words, he needed to cope with the understanding of academic disciplinary concepts, language competence in L2 English, and non-linearity of online reading processes.

After we discussed several possible strategies of reading, note taking, and arranging notes, over time he self-reported that he was able to systematically take and organize notes while reading, identify the centerpiece of arguments, synthesize these, and subsequently present this information in a tabular format housed with Microsoft Word (see Supplement 4-4). The Supplement 4-4 shows that he assembled his notes and recorded what he thought to be important about the articles he was reading. More specifically, he employed the paraphrase strategy when making notes about the first article, *Aqueous corrosion of 1100 aluminum and of aluminum-nickel alloys*, and reproduced the abstract of the second article, *Resistance of Aluminum to corrosion in solutions containing various anions and cations*, and used the red color font to highlight what he thought was key information. The majority of data on his reading notes took the

form of reproducing the abstracts of the articles he was reading through copy-paste-and-screenshot. Although he self-reported that his strategies entailed systematically organizing notes while reading, identifying the centerpiece of arguments, synthesizing these and subsequently presenting information in a table, the notes he produced as evidence of this did not show these strategies. Instead, he reproduced 51 abstracts of the articles which he claimed he had read and changed font color in some of them to visualize areas that he thought was significant information in the abstracts. For each article, he also supplied reference information, such as authors, title, year of publication, and page number. This discrepancy between what he said and what he actually did reveal that he might have difficulties in acculturation to the disciplinary expectation of academic reading because he mainly reproduced the articles' abstracts and did not show evidence of having engaged with the articles in its entirety. This discrepancy further points to his difficulties in paraphrasing and synthesizing skills.

Additional data also reveal that he did not read enough articles related to his research and did not have good reading strategies to enable him to write a literature review.

Through using past tense, he reflexively revisited his prior understandings of academic articles that he read before hinting at possibilities for improvement:

"I didn't read a lot of texts before. When reading an article, I usually only skimmed its introduction and diagrams to decide whether it was useful or not. Next, I save it on my laptop. Because at that time [when reading articles], I had not yet started to write literature review so I didn't take notes. I just knew that which articles could help me design experiments and explain results. At that time, I just knew this researcher and other researchers did related studies. I just saw few branches of a big tree, but I hadn't seen other branches and the entire tree."
(interview transcript, June, 2015)

He also stated that he had trouble with getting the gist of a text while reading:

"I gave myself 6 [6 out of 10] for my reading competence. I'm not good at getting important points from a text. For example, when I read a text, I'm supposed to be

able to get the important points the author made, but I feel reading to get the important points of a text is my weakness." (interview transcript, January, 2016)

The above data demonstrate several interconnected concepts on Cheng-Rui's challenges in academic reading and writing. In his reflections on previous reading and writing strategies, he listed his problematic approaches to reading and writing as follows: "I didn't read a lot of texts before... I usually only skimmed its introduction and diagrams ... [when reading articles]... I didn't take notes." A key reason for his difficulty in writing a literature review is the lack of adopting proper reading strategies to help him write. This difficulty was exacerbated by his lack of a panoramic view while reading texts which were conveyed in the symbolism of a tree and branches, "I just saw few branches of a big tree but I hadn't seen other branches and the entire tree." The ramification of not having a broader or panoramic view (that is, only seeing branches but not seeing the entire tree) is an inability to engage knowledgeably in wider scholarly conversations. Although he did adopt a purposeful reading strategy to help him write the procedure of an experiment and experimental results as seen in "I just knew that which articles could help me design experiments and explain results", he did not properly adopt this strategy to consider broader concepts in the scholarly conversations. These data also show his growing capacity to clearly articulate his reading difficulties. For instance, he gave himself six out of ten points for his "reading competence", he reported that "I'm not good at getting important points from a text." , and he summed up his weakness saying "I feel reading to get the important points of a text is my weakness." As this has already been established, his inability to engage in broader scholarly conversations in the MSE discipline is related to his problem of getting the gist of a text. In spite of some progress, such as reflecting on

his previous problematic reading approaches and articulating his specific reading challenges, some reading difficulties persisted.

Beside his reading difficulties, data reveal that he struggled and still continued struggling with English academic writing. A sample of his writing sourced through the document collection shows evidence of difficulties in structuring writing, inadequacy in disciplinary concepts, the lack of clarity, and general English accuracy. More specifically, he presented to his advisor the following opening paragraph of a 330-word, three-paragraph long conference proposal (see Supplement 4-5).

"Localized corrosion of aluminum alloys has been widely studied as a major cause of fatigue and crack in many applications, which also deteriorate the mechanical properties of materials significantly. In order to provide a precise pit growth prediction under various environmental conditions (temperature, pH, and chloride concentration), a comprehensive investigation is necessary to model pit growth kinetics. However, pit growth could be underestimated without considering uniform corrosion. In fact, uniform corrosion could be considerable in certain environment associate with pitting. Therefore, this work aims to modify pit growth model by involving uniform corrosion of aluminum alloys, and to study mechanisms of uniform corrosion in various environment." (document artifact from field work)

In his feedback, Cheng-Rui's advisor restructured this conference proposal beginning with:

"Pitting corrosion and uniform dissolution of aluminum alloys 2024-T3, 7075-T6 and 6061-T6 were characterized quantitatively using optical profilometry after free corrosion exposures in 1.0 M NaCl solutions as a function of pH, temperature and exposure time." (document artifact from field work)

This opening sentence foregrounds information that Cheng-Rui had originally presented in the last paragraph of his abstract and introduces a disciplinary concept, "optical profilometry", which he did not write in his abstract. In addition to restructuring and giving an illustrative opening paragraph of the proposal, his advisor also provided the following feedback:

"Results showed . . . pick three key and interesting results . . .

One on environment

One on alloy composition or metallurgy

One on the relative depths of uniform corrosion and pitting corrosion.

In this presentation, details of the experimental method and the results will be presented and the implication of these results on corrosion damage accumulation pit depth modeling will be addressed." (document artifact from field work)

Cumulatively, his advisor employed various strategies in giving him feedback:

- a. restructuring the proposal,
- b. providing MSE terminology that was missed out,
- c. rewriting the entire first paragraph offering non-directive and illustrative feedback on how the opening paragraph should look like,
- d. offering directive feedback by writing "pick three key and interesting results" and identifying for Cheng-Rui what these three key results should be (that is, environment, alloy composition or metallurgy, and information on corrosion and pitting corrosion), and
- e. providing subtractive feedback, that is, omitting some points that he had included.

These written interactions between him and his advisor reveal that he struggled with the internalization of MSE academic writing practices. Further data show that despite his advisor's effort to offer writing feedback, such as rewriting his whole paragraphs, he sometimes felt frustrated by this rewriting. He reported that "After he sent me the revised version, I found he didn't just revise but rewrote the entire document. That made me feel more or less frustrated" (interview transcript, March, 2015). In reflecting on his frustration, he commented that in comparison to others in his cohort group his writing was not the worst: "My writing is not the worst kind of writing that would give him a headache" (interview transcript, March, 2015). Throughout these interactions, he showed

an awareness of his difficulties in MSE writing. These data complicate the previously argued position that his advisor had no time to give any feedback or positive intervention. The data also reveal unintended tensions that could arise from giving and taking up feedback. For example, he appeared not to understand why his advisor used this rewriting strategy in "I found he didn't just revise but rewrote the entire document" which led to frustration instead of modeling writing. The core of this frustration lies a miscommunication in intentionally in that he did not know how rewriting and modeling work in his advisor's feedback, whereas his advisor might be intending to rewrite paragraphs as models for him to emulate. Without such clarification in writing feedback, he might feel confused and frustrated during his academic acculturation processes.

Further interview data disclose evidence that he was aware that he was confused and frustrated. He discussed how his academic writing background, specifically his master's study, contributed to his woes saying:

"I only remember one time a course project where I had to write a literature review. It was very painful. I had to read many scholarly papers and organized their main ideas. I found the main idea, but I didn't know how to write it. After reading many ideas, I needed to synthesize them through using my own words. It's very difficult and I didn't do well. I chose non-thesis so I didn't write a thesis for my master's degree." (interview transcript, July, 2015)

The use of phrases, such as "I found the main idea, but I didn't know how to write it" captures his confusion while "It was very painful" and "It's very difficult and I didn't do well", captures his frustration. He further expressed his regret for missing the opportunity to engage with English academic writing when he said "I only remember one time a course project where I had to write a literature review" and "I chose non-thesis so I didn't write a thesis for my master's degree." Having only one course where he wrote a

literature review and not doing a thesis for his master's degree led to the lack of exposure to extensive MSE English academic writing. This regret further captures when he said:

"During my first and second years of Ph.D., I almost didn't write any long papers. At that time, I just did experiments and then created PowerPoint slides to report the results to my advisor... It's until recently [he was referring to the stage when writing his dissertation] that I've had the chance to write longer papers and literature reviews." (interview transcript, June, 2015)

His regret over this belated exposure to MSE English academic writing is captured in "I almost didn't write any long papers... I just did experiments. ... It's until recently that I've the chance to write longer papers and literature reviews." These various instances, where he regretted prior insufficient exposure to academic writing, demonstrate the enduring effects of previous experiences on one's academic acculturation processes. The effects of his lack of exposure to academic writing accumulated over the duration of his master's program and continued to influence the quality of his writing at the doctoral level. Given such limited exposure, Cheng-Rui found the difficulty in navigating a complicated academic genre, such as his dissertation. In addition, he is an international student who speaks English non-natively. This linguistic and cultural fact made his academic acculturation processes more difficult.

4.4 Cheng-Rui's Use of Technologies for Academic Acculturation

One way in which Cheng-Rui lessened the difficulties during his academic acculturation processes is through the use of various forms of technologies. Table 4.3 visualizes academic search engines, an online encyclopedia, online storage, online lexical resources, citation software, course management software, presentation software, online networking, and online social interactional technologies. His self-reported frequency of use over 14 weeks (which is partial data) gives an indication of some significant

technologies that he employed for academic purposes. The self-reported specific uses of technologies further indicate particular ways in which technologies were central to his day-to-day activities in the course of his academic acculturation processes.

Broad Categories of Technologies	Specific Technologies Used	Approximate Frequency /14 weeks	Uses
Academic search engines	Google Scholar	52	<ol style="list-style-type: none"> 1) Searched for papers he came across in conferences 2) Checked citations for citation conventions and further readings 3) Searched for papers to solve research-based problems, such as confirming experimental procedures and finding clear ways to report data 4) Searched for scholarly sources to include in his dissertation and journal-article writing
	Web of Science (an academic search engine)	2	➤ Searched for scholarly sources
	School library search engine	10	<ol style="list-style-type: none"> 1) Downloaded scholarly papers 2) Used e-library to download a needed handbook
	School library databases	1	➤ Downloaded ASTM standards (American Society for Testing and Materials Standards) which were an industrial demonstration standard that was used for experimental data analysis
	Google Search Engine	9	<ol style="list-style-type: none"> 1) Searched speakers and scholars he met at conferences 2) Checked abbreviations of journals
Online Encyclopedia	Wikipedia	1	➤ Searched for chemical properties of various chemicals.
Online Storage	Dropbox	43	<ol style="list-style-type: none"> 1) Shared papers and documents on different electronic devices (PC, Mac, and iPhone) 2) Synchronized files in lab's computer with files on his laptop at home 3) Shared documents with his advisor 4) Backuped his presentation files

Continued

Table 4.3 Cheng-Rui's Self-reported 14week Weekly Journals of His Technology Use for Academic Purposes

Table 4.3 continued

Broad Categories of Technologies	Specific Technologies Used	Approximate Frequency /14 weeks	Uses
Online Lexical Resources	Taiwan Yahoo online Chinese-English dictionary	30	➤ Looked up unfamiliar English vocabulary
	Dictionary App (dictionary.com, English dictionary)	2	➤ Looked up unfamiliar English vocabulary
Citation Software	EndNote (download and web versions)	42	1) Synchronized all his references in Endnote's library with references in Cloud's library 2) Edited references 3) Cited references
Course Management Software	Carmen (the course management)	8	1) Checked and downloaded lecture notes and homework 2) Submitted homework 3) Checked course grades
Presentation Software	Microsoft PowerPoint	6	1) Prepared for presentation slides for conferences 2) Prepared for meeting slides for his advisor
Online Social Interaction Software	LinkedIn	3	1) Searched for speakers and people met in conferences 2) Searched for a company recruiter
	Facebook	3	1) Communicated with scholars whom he met in conferences 2) Searched for a company recruiter and messaged friends about a job opening
	E-mail	3	1) Sent his resume to someone for internal referral 2) Communicated with a company's technician about equipment issues

4.4.1 Academic search engines.

Data from his 14-week weekly journals show that his use of technologies for academic purposes is mainly characterized by the use of academic search engines, online submission storage, citation software, online lexical resources, and online social interaction channels. The school library search engine and databases were provided by the university for used by graduate students, whereas Google Scholar, Web of Science, and Google came out of his personal effort in engaging in academic research. Given the frequency of use in his 14-week weekly journals, he employed the school provided search engines at a significantly lower count than self-sourced search engines. In itself, Google search engine is not an academic search engine; however, he utilized it for academic purposes, such as locating scholars with whom he interacted at conferences. Although Wikipedia is not an academic search engine, he also employed this encyclopedic resource for accessing information, such as finding chemical properties.

In multiple interview data (the survey interview, the first interview, bi-weekly interviews, and follow-up interviews), he reported various ways of using academic search engines. With regard to Google Scholar, he said:

"When I attended a conference and heard some scholars' names or attended scholars' presentations and heard scholars mentioned in connection to my research, I'd type their names and keywords into my laptop right away. After the conference, I'd use Google and Google Scholar to search for their names, papers, and more information." (interview transcript, April, 2015)

In a further clarification, he explained that:

"During a talk, if I heard something I'm interested in, I'd then use my laptop to Google them. After searching, I'd leave webpages or articles on my laptop. After the conference, I'd go back to scan through them." (interview transcript, June, 2015)

In addition to using search engines at conferences, he described how he employed Google Scholar to troubleshoot problems he confronted while conducting research:

"This [Searching for papers via Google Scholar] is for research when I face some problems and I want to see whether previous scholars had the same issues or had some solutions I could refer to. If I face general problems, I'll ask my group members. However, if the problems are too complex, I'll try to find papers to solve the problems because they may not know how to deal with the problems. My advisor may also not know the details because I'm the one who knows the research the best." (interview transcript, April, 2015)

Furthermore, he also employed Google Scholar to locate scholarly sources that were cited by significant researchers:

"It's [referring to a print-out article] an important paper for my dissertation. It has many references. So, I searched for the most important works cited in the reference list via Google Scholar and then read them. For those references which have my check marks, I found them and read them. [Cheng-Rui showed me his print-out with his notes. See Supplement 4-6]" (interview transcript, May, 2015)

Besides utilizing Google Scholar to locate scholarly works, he also employed it to

confirm citation conventions. In this instance, there is a combined use of technologies

that is he utilized Google Scholar and EndNote to complement their various capabilities:

"For some special references, such as very old and foreign books, I'd manually edit those references to correct them. The reason is that after I found those references via Google Scholar and I imported them into EndNote [citation software that can generate citations and references for users after users import papers into EndNote], EndNote seems unable to recognize those references. For that kind of special references, I'd use Google Scholar to find them, import them to my EndNote account, and then manually edit them." (interview transcript, January, 2016)

In addition to confirming convention citations, he utilized information generated by

Google Scholar's web pages, such as citation counts, year of publication, journals, and

authors. These influenced his determination of what counted as "good" scholarly works:

"I look at citation numbers to decide which papers I want to read. When I search for papers via Google scholar, it automatically shows citation counts. So, what I often read is those papers with high citation counts. Those papers with high citation counts are not published too long ago. Then, I look at which journal papers were published and who the authors are. Then, I'd know whether the papers are good or not. I usually search until I've covered all hits on the first 10 web pages on Google search and no more. After 10 web pages, I'd lose my patience." (interview transcript, May, 2015)

Data from both interviews and his 14-week weekly journals show Google Scholar is the

preeminent academic search engine of choice for him. Notwithstanding, data reveal that

he also used other academic search engines, such as the school library search engine, Web of Science, and Google, albeit to a lesser degree. He reported that even though his preference was to use Google Scholar first, he deviated to the school library search engine because through this search engine he could download PDF articles. As a student, he enjoyed the institutional subscription benefit that this search engine came with:

"I usually use Google Scholar first and then the school library search engine. If I cannot find papers on Google Scholar, I'll use the school library search engine and databases. I don't know what Google Scholar's problems are. This may be related to the school library. If the school subscribes to the journal and I search for an article via Google Scholar, the link of the article would directly lead me to a download page. Then, I could download it. But, sometimes I've to go to the school library search engine to find that journal and then download that article. I don't know why Google Scholar sometimes couldn't provide PDFs. Those journals may be very special. This week I also looked for ASTM standards that are an industrial standard. I cannot find it via Google. The school's databases have it. It costs money to subscribe." (interview transcript, May, 2015)

Another academic search engine he utilized is Web of Science. He only utilized it for a couple of weeks because at the time he needed a function that Google Scholar could not provide:

"The reason I use Web of Science is that I'm utilizing EndNote [citation software that allows users to organize readings and generate citations and bibliographies]. It's much easier to use Web of Science to import articles' citation information to my EndNote. Google Scholar doesn't have that function so I need to type the citation information into my EndNote account. If I use EndNote more frequently, I may not develop a habit of using Google Scholar to find papers." (interview transcript, May, 2015)

After the Google company improved the function of importing citation information to EndNote, he switched back to Google Scholar:

"Google Scholar is very easy to use now. I don't use Web of Science anymore. I've already removed its link from My Favorite [a short-cut folder listed in the toolbar of the Internet Explore browser for users to save links to websites they often browse.] There's no paper that Google Scholar cannot find. Before there were some papers that I couldn't find via Google Scholar. Now, this problem doesn't exist. Also, Google Scholar allows me to import citation information to my EndNote account so I don't use Web of Science now." (interview transcript, January, 2016)

He also supplemented the use of these academic search engines through employing Google to research on disciplinary knowledge and concepts:

"Yes. Google! Google is the tool I must use. For example, if there's a new and unfamiliar concept, I'd Google it to see more explanations of the concept... I just use Google to preview teaching materials that I download from Carmen before a class. That's all." (interview transcript, March, 2015)

His use of technologies spans inside and outside of the classroom. Notably, when attending conferences, he used Google and Google Scholar to search for names of scholarly personalities, research areas, and MSE disciplinary concepts as shown in "After the conference, I'd use Google and Google Scholar to search for their names, papers, and more information." Knowing this information situated him as being familiar with MSE scholars and scholarship, and it also enhanced his participation in MSE academic communities. He devised various strategies to search for new MSE information and employed technological hardware, such as his laptop, and software, such as Google search engine. This is evident when he said "During a talk, if I heard something I'm interested in, I'd then use my laptop to Google them... I'd leave web pages or articles on my laptop and after the conference, I'd go back to scan through them." His strategies also entail conferring with his peers as seen in "If I face general problems, I'll ask my group members." When this approach failed to yield an answer, he escalated the issue through the use of technologies that is "if the problems are too complex, I'll try to find papers to solve the problems."

In terms of academic search engines, data from his 14-week weekly journals reveal that he heavily relied on Google Scholar as the main academic search engine. This is confirmed by 52 frequency-of-use count within 14 weeks which is by far the largest frequency-of-use count in Table 4.3. In the column on the use of technologies, the words

"searched" and "checked" were repeatedly used to describe his actions with Google Scholar. For example, the descriptions "searched for papers he came across in conferences," and "checked citations for citation conventions and further readings" account for the 52 frequency-of-use count with regard to the use of Google Scholar. Although this high frequency shows Cheng-Rui's preference for Google Scholar, his use of technologies was not guided by loyalty but by what he thought was expediency. When he discovered that Web of Science was more useful than Google Scholar in importing citation information into his EndNote account, he opted to use the former and explained that "It's much easier to use Web of Science to import articles' citation information into my web version of EndNote. Google Scholar doesn't have that function". Further, when he recognized the limitation of Google Scholar in "Google Scholar doesn't have that function so I need to type the citation information into my EndNote account ", he switched to Web of Science and reverted to Google Scholar after this limitation had been addressed by Google company. This switching back and forth indicates his agency in using technologies for academic purposes and his awareness of the functionality of various technologies. The action words in "Google Scholar is very easy to use now. I don't use Web of Science anymore. I've already removed its link from My Favorite" disclose that he exercised deliberate choice in switching across technologies. Recognizing that Google Scholar could serve his need for citation export, he took agentive action to realign himself with Google Scholar and dis-align himself from Web of Science. This robust use of technologies positioned him as an active user of technologies for academic acculturation. In various instances, his descriptions of technology use, for example, "I'd use Google Scholar to find them, import them to my

EndNote account, and then manually edit them" visualize his agency in employing technological affordances for his academic acculturation. In other words, his descriptions of his technology use illustrate his agentic appropriation of the instrumentality of technology which was entrenched in his academic acculturation processes. When he said that "Google Scholar doesn't have that function so I need to type the citation information into my EndNote account", having an EndNote account gave him the identity of an EndNote account user and demonstrated a commitment to using this EndNote account for his MSE academic pursuits.

Although Cheng-Rui devised various strategies where technology was at the center of his academic participation, these strategies have some significant limitations as follows: First, he had the habit of only reading no more than 10 web pages that Google Scholar generates as seen in "I usually search until I've covered all hits on the first 10 web pages on Google search and no more." One webpage might have a limited number of relevant scholarly works, such that reading hits on only 10 web pages might not allow him to find a larger quantity of relevant scholarly works. Second, he used citation counts to decide whether an article was important or not and whether he wanted to read it or not which is evidenced by "I look at citation counts to decide which papers I want to read... So, what I often read is those papers with high citation counts." This method of evaluating the importance of articles is not entirely reliable because it is prone to missing newly-published yet-to-be-cited scholarly works. It is also subject to the citation information of an academic article that Google Scholar provided whereas another academic search engine might have more citation counts for the identical academic article. Third, the above data sets also disclose that Cheng-Rui mainly utilized Google Scholar to search for

scholarly works (and the school library search engine and databases were only used to download PDF of scholarly works which Google Scholar did not provide). This search behavior might limit his research perspectives to academic articles that Google Scholar indexed whereas another academic search engine might index academic articles that Google Scholar did not offer.

Lastly, data also point to endure challenges in Cheng-Rui's MSE academic acculturation processes. For instance, when he said "My advisor may also not know the details because I'm the one who knows the research the best", this indicates a continuing lack of sufficient communication between him and his advisor where his advisor was unaware of the details of his research. Additionally, when he mentioned about losing his patience while searching web pages on Google Scholar in "After 10 web pages, I'd lose my patience", this loss of patience indicates an on-going struggle to cope with his difficulties in MSE research processes. A scrutiny of wider data in the general corpus in this study reveals that he also utilized other academic search engines, such as Engineering Village, Knovel aluminum alloy database, and Corr Defense (see Supplement 4-7). These were, however, rarely mentioned when he recounted his own use of academic search engines. In spite of these challenges and this omission, his enthusiasm about the role of technology in his academic acculturation processes is evident in "Yes. Google! Google is the tool I must use." His confident tone here combined with evidence of the rampant use of Google Scholar to position himself as an active user of technology as he acculturated to MSE communities.

4.4.2 Citation software - EndNote.

In addition to Google Scholar, another technological software that Cheng-Rui often used is the citation software, EndNote. Data from his 14-week weekly journals and interviews reveal that he always utilized EndNote to organize readings and generate in-text citations and bibliographies. More specifically, he employed a downloaded and a web version of EndNote citation software. He described his use of EndNote as follows eventually establishing his preference to EndNote over RefWorks:

"It [EndNote] actually has many functions. When seeing an article online, I can import it into EndNote. Then, the article's title, authors, year, and related citation information will be stored in the library of my EndNote account. When I want to cite the article, I can just search for authors or keywords in the library. Then, EndNote will locate it and generate citation information in my text and the reference list. I can also adjust the format of citation information to meet the requirements of a writing citation style. We've many citation styles. Different journals have different requirements. Without using EndNote, I'll be crazy. I always use EndNote while writing...The school doesn't offer EndNote license. The school library suggests RefWorks but I feel it's difficult to use." (interview transcript, March, 2015)

EndNote provided him with a versatile functionality so that he also employed it in his reading process and found it "very convenient": "I always use EndNote to organize my readings. It is very convenient and saves my time to write citations and bibliographies" (interview transcript, April, 2015).

These data show that he heavily utilized EndNote during reading and writing processes, and utilizing it offered him several benefits. First, it allowed him to store citation information in one place as shown in "the article's title, authors, year, and related citation information will be stored in the library of my EndNote account." He was, therefore, able to systematically organize all of his citations. Second, EndNote provided easy access to and generated citation information as shown in "When I want to cite the article, I can just search authors or keywords in the library and then EndNote will locate

it and generate citation information in my text and the reference list" which made his academic writing processes more efficient. Third, EndNote helped him cope with different citation styles that MSE discipline required as proved by "We've many citation styles. Different journals have different requirements. Without using EndNote, I'll be crazy." Overall, the contribution of Endnote to his acculturation process is significant in that it alleviated various challenges by enabling storage, access, and location of articles in addition to providing him with experiences in utilizing different citation styles.

These data also reveal that Chen-Rui positioned himself as a knowledgeable user of EndNote, for instance, he knew that EndNote "has many functions", he could import articles into it, and that it could store information, such as "title, authors, year, and related citation information". He presented himself as an active user, saying "When I want to cite the article, I can just search authors or keywords in the library...I can also adjust the format of citation information". The use of "we" is significant because he positioned himself as a part of MSE communities, a knowledgeable member who was aware of the various citation styles in "We've many citation styles. Different journals have different requirements..." Given that his MSE academic activities involved numerous citations, he knew that not using citation software was tantamount to being "crazy". His data account for the high frequency of using EndNote, as shown in Table 4.3, which he reported as being easier to use than RefWorks. Overall, as evidenced by "I always use EndNote while writing," and "I always use EndNote to organize my readings," the data anchor EndNote citation software in his reading and writing academic acculturation processes.

4.4.3 Online lexical resources.

In addition to EndNote and the other technologies, Cheng-Rui reported employing online lexical resources, such as Taiwan Yahoo online Chinese-English dictionary (see Supplement 4-8) and Dictionary App (It is also called English dictionary, see Supplement 4-9), for language-related needs. These mainly include using his laptop to look up unfamiliar English vocabulary. According to his 14-week weekly journals, his frequency count for the Taiwan Yahoo online Chinese-English dictionary has a much higher frequency count than the English dictionary, meaning most of his online dictionary activities include cross-linguistic meaning making. Survey data show that when writing academic papers, he often utilized Google search engine and the Taiwan Yahoo online Chinese-English dictionary to check English words, usage, and grammar. Interview data reveal that his use of the Taiwan Yahoo online Chinese-English dictionary was formed by his previous habit of using online dictionaries:

"During my Master's study, when reading academic papers, I would look words up in a dictionary. I used the same online dictionary, Taiwan online Yahoo Chinese-English dictionary." (interview transcript, July, 2015)

Over time, he developed a facility for using the Taiwan Yahoo online Chinese-English dictionary which he described as being much easier than other online lexical resources, such as Corpus of Contemporary American English (COCA):

"When writing academic papers, I'd use Taiwan Yahoo online Chinese-English dictionary. It's not very good, but I can quickly understand the meanings and then read the context of an article to understand what the author wanted to say. I used COCA before. I feel it has too many entries. I don't want to find out an answer from the big data. I don't have time to do that. I sometimes use Google to search for synonyms because Taiwan Yahoo dictionary doesn't have synonyms. So, when I want to find synonyms, I use Google. COCA is very inconvenient. I only use COCA one time for a couple of months." (interview transcript, March, 2015)

With regard to using Dictionary.com, he said "I used it before but I'm lazy to use it. It's very fast to find out the meaning of a word via using Taiwan online Yahoo dictionary.

I'm just lazy to use an English-English dictionary" (interview transcript, April, 2015). He reflected on specific language related needs based on his usage of the Taiwan Yahoo online Chinese-English dictionary. These languages related needs include checking for unfamiliar words, collocations, and prepositions:

"I often use the online Taiwan Yahoo dictionary while writing. When I'm unsure whether I can use an English word in a certain way, I'd check the dictionary. Another situation is that if I don't know an English word, I check the dictionary. ...My method is to find a research paper which focuses on an area related to my research interest. Then, I look at how s/he wrote his/her paper, such as structure, words, and usage, so I'd know how to write my paper. That is why I said sometimes I know English words, but I don't know their collocations, such as *to*, *for*, *in*, and *or* those prepositions. Then, I'd check the dictionary. Another situation is that I read this paper and some words I don't know. Then, I'd look them up. " (interview transcript, May, 2015)

Interview data also show that he tapped into his interpersonal network through asking "Americans in my lab" when he needed clarification about English grammar. When this effort failed to yield clarity, he reverted to online lexical resources (e.g., Google search engine) where he entered particular grammatical search-terms and browsed various links for answers:

"They [American group members] often tell me various versions of answers so I'm confused about which one is correct. Then, they ultimately would say "yeah, English is complicated." Sometimes their answers are wrong so I went online to look for correct answers." (interview transcript, March, 2015)

He navigated different technological hardware depending on expedience and convenience. In the absence of his laptop, which was his preferred hardware, his cell phone came in handy. He sometimes alerted to opportunities to learn new words and concepts in and out of class, such as in group meetings, through employing his cell phone and the relevant App:

"During a group meeting, I used Dictionary App [see Supplement 4-9] in my cell phone to check an unfamiliar word. At that time, there was no computer around me so I used my cell phone to check the word. My advisor was talking about something and he repeatedly mentioned the word. It's an important word so I

looked it up. In fact, I rarely used the App on my cell phone, but I just used it for that time." (interview transcript, May, 2015)

These above data show that he reflected on his use of online lexical resources to address his language needs by recalling his master's study where he would "look words up" using the "Taiwan online Yahoo Chinese-English dictionary." The use of technologies for academic purposes was, therefore, not a new phenomenon in his academic socialization. Data also disclose a preferential use of technologies and of language. For example, he preferred Google search engine to COCA when he said "I used COCA before. I feel it has too many entries... So, when I want to find synonyms, I use Google. COCA is very inconvenient." He also preferred online lexical resources that presented information in Chinese. For instance, "I often use Taiwan Yahoo dictionary while writing."

Notably, when he used this dictionary to search for English words and "their collocations, such as *to*, *for*, *in*, and *or* those propositions", his native language came into play. For example, in Supplement 4-8, when he searched for "look for" in the Taiwan online Yahoo Chinese-English dictionary, the meaning 尋找 (*xún zhǎo*) came up in his native Chinese language but he also got synonyms, such as "seek for, seek after, search for, search after" in English. In addition, the dictionary offered him examples of usage, such as "I'm looking for my dictionary...我在找字典 (*wǒ zài zhǎo zì diǎn*)...". Moreover, the dictionary provided American pronunciation of "look for". His preference for the Taiwan online Yahoo Chinese-English dictionary is because he "can quickly understand the meanings" since they were written in Chinese. This preference for Chinese is perhaps what drove him away from COCA and Dictionary App (Dictionary.com) whose content was entirely in English. COCA, in particular, features numerous examples of English language use. For example, Supplement 4-10 features the first 20 entries out of 18,843

entries for the usage of the phrase "look for". He said "I used COCA before. I feel it has too many entries. I don't want to find out an answer from the big data. I don't have time to do that." Whereas he was very definitive in declaring that he had no time to use COCA, he did not provide what it was that he was using this time for. This gap shows his preference for the Chinese-oriented online lexical resources. Over-dependence on Chinese-based and avoidance of English-based online lexical resources could impede his English learning and decelerate his acculturation to the English-dominant Western academic space that characterized his MSE program. As a Chinese-speaking international doctoral student, Cheng-Rui concurrently navigated unfamiliar MSE disciplinary concepts and English L2 dominant instructional context of MSE program. Taken together, these two aspects made his academic acculturation processes more difficult.

4.4.4 Online social interactional software.

"For me, a social network is very important...Very important! Very import!" (interview transcript, July, 2015). These words by Cheng-Rui illustrate the highly significant role that online social interaction software played in his academic acculturation. The high incidence of social-networking-related data categories together with sentiments, such as in the statement above, combine with his habitual usage of technologies for social networking purposes to make the case that this particular use of technologies is the most important one for him. Oddly, his self-report in the 14-week weekly journals (see Table 4.3) reveals that the frequency-use count of online social interaction software, such as Facebook and LinkedIn, is not very significant. This self-report is contradicted by his own emphasis in interviews where he detailed various uses

of different social interactional technologies for his networking in the MSE communities. In this regard, data show that he employed WeChat, Facebook, Facebook Messenger, Skype, cell phone texts, email, LinkedIn, and Glassdoor, for various reasons including maintaining relationships with peers, professors, and post-docs in his current lab, building relationships with scholars outside of the lab, gaining exposure to online posts focusing on MSE disciplinary knowledge, and receiving information on current trends and developments in the MSE world. The following data show that he employed different online social interactional software to communicate with different groups:

"I use WeChat to discuss research with peers because our lab has many students from China. For Facebook, our lab has a Facebook group. But, I don't often use it. It's more like networking than sharing information because many MSE graduated students are in this Facebook group. It's not used to discuss research but networking. There're few interactions in the group. It's like a bulletin board... It's not very active. I also use Facebook Messenger and cell phone texts to discuss with American students. Only WeChat is mainly used with students from China. For students from other countries, I use cell phone texts, email, or Facebook. For this group of students, I use email more often because it's more formal. It's informal when using those Apps." (interview transcript, March, 2015)

This data set also reveals that his choice of online social interactional software was dependent on the popularity of software among the particular groups of people rather than on his own preference evidenced by "I use WeChat to discuss research with peers because our lab has many students from China... I also use Facebook Messenger and cell phone texts to discuss with American students...". In the same way, his use of Facebook was influenced by Taiwanese students' preference for this technology (interview transcript, March, 2015). This data set also discloses that he distinguished whether online social interactional software was for formal or informal use. Making this distinction was dependent on the nature of the interface that the software had rather than the content of communication as seen in "I use WeChat to discuss research with peers... It's informal

when using those Apps". Some of the main features of WeChat include utilizing Chinese as the main communication language, sharing information in a group, discussing via instant messages, recording videos, and capturing images. Notably, nationality is a significant factor in his use of technologies for social networking. More specifically, for students from China and America, he employed particularized informal online social interactional software as shown in "I also use Facebook Messenger and cell phone texts to discuss with American students...Only WeChat is mainly used with students from China...". Additional data also show that he employed Facebook when interacting with students and post-docs from Taiwan (interview transcript, March, 2015). However, when communicating with students from other countries, he used email as seen in "For this group of students, I use email more often because it's more formal". A close scrutiny data on his online behavior reveal that when using online social interactional software for sharing MSE information, he held back and waited for others to post information in the online groups. Even though he was a group member, he did not actively share information with other members. His use of "occasionally look," and "read" underscore his passivity in some online groups when he said "I'm part of some Facebook groups. One discusses topics on batteries and another discusses topics related to MSE. I'd occasionally look at their posts", "Some members [of a WeChat group] would share articles or ask members to be internal referrals for jobs. I'd read their posts because those are related to my research," and "My LinkedIn sends me emails when someone post and answer questions. I'd skim through those emails to see what they are discussing, but after reading those emails, I deleted them" (interview transcript, July, 2015). This passivity might indicate that he positioned himself as a novice who waited for experts or others to

guide him as seen in "I'd read their posts," and "I'd skim through those emails to see what they are discussing". This passivity had the potential to deter rapid academic acculturation because it might lead to an inability for him to develop an informed and confident voice within these discussions with other MSE students and scholars.

He also reported communicating with professors and scholars outside of the school, using email which he considered to be a "more official" online social interactional technology:

"I always use email to communicate with visiting scholars because email is more official. Dropbox is not official. It's used to share files and doesn't have records like email. Email is able to show what files I sent and what files people sent to me." (interview transcript, January, 2016)

Data reveal that he employed email communication with established scholars to achieve a number of objectives, including basic communication, retaining records of communication, and doing a follow-up after conferences. Generally, he utilized this mode of communication to build relationships with scholars in MSE communities, especially those who were not in his institution:

"Recently, I attended a conference and met some professors. Then, I want to contact them via email because at the conference we discussed a problem, and I'd like to do a follow-up. I'll send my data to them to tell them the results of my research and we can keep in touch. I more often use email to communicate with professors not in my university." (interview transcript, March, 2015)

His use of email as a formal mode of communication signals that he was aware of the hierarchy in the MSE communities. MSE community members who were perceived as being of a higher rung included professors and visiting scholars. He employed technologies to build horizontal relationships, such as using Facebook to maintain relationships with students from his institution and other institutions whom he met at MSE conferences:

"One student is a student at Michigan State University. The other student is a chemistry student in the same school as me. I met both of them in a conference. I didn't know them before. After the conference, I added them in my Facebook. Then, we ate dinner together and discussed what research each of us is doing, how our advisors are, and so on." (interview transcript, June, 2015)

When he said "added them in my Facebook," this addition signifies a building of interpersonal relationship house within Facebook technology. In other words, he added the student from Michigan State University and the other student from his institution into an already existing group in his Facebook account. In the same data set, he illustrated the multifunctional uses of Facebook saying "Facebook groups are more for social networking rather than for sharing information. Occasionally, someone posts something. Then, there is no any post for two to three days. After one week, there is one post" (interview transcript, June, 2015). In this statement, "networking" is put in opposition to "sharing information". These two mean informal "interpersonal relationships" and "MSE discipline-based knowledge" respectively. These two opposing uses of Facebook indicate that using online social interactional software can be a complex activity with some ideological tensions. In other words, there is an implied question about the two uses of Facebook in Cheng-Rui's group: "more for social networking" or "for sharing information".

In further data, he reported using LinkedIn and Glassdoor, two online social interactional software for a number of reasons, including participating in discussions with industry-based groups that were related to MSE, forwarding topical issues of interest from discussion groups to his email, constructing his academic identity through enhancing his visibility in MSE discussion groups, and getting answers to some academic-based questions. He reported:

"LinkedIn has many discussion groups. For example, we're doing corrosion, that is, proof-rust. In the corrosion, there're many users of LinkedIn open some discussion groups. Many people would post some questions there and some volunteers would answer those questions. Then, by answering questions, you could build up your visibility in the group which is to build up your reputation. Most of the members are probably working in industries." (interview transcript, March, 2015)

Notably, his participation in LinkedIn was largely through reading group members' posts (see examples of posts in Supplement 4-11) rather than offering direct contributions to these discussions. He used LinkedIn-based information regularly evidenced by

"I still use LinkedIn's function of automatically sending emails to inform me who posts or answers what questions. Today, I just read an email from LinkedIn. If the topic is what I'm interested in, I would read them. I regularly read those LinkedIn emails." (interview transcript, September, 2015)

Overall, the uses of online social interactional software highlighted here are of the paramount importance for his academic acculturation processes and this importance is echoed in "For me, the social network is very important...Very important! Very import!"

Taken together, Cheng-Rui actively adopted various technologies to enhance his efforts in fulfilling MSE academic requirements in order to achieve his professional goals. Some of these efforts include overcoming language and academic barriers, enhancing MSE disciplinary knowledge, and establishing a social network in the immediate (the MSE doctoral program) and wider (general membership in the MSE academic discipline) MSE communities. However, some of his habits of technology use, for instance, his dependence on only Taiwan Yahoo online Chinese-English dictionary among other tendencies might impede his academic and English development. Furthermore, he seemed to be unaware of possible shortcomings of his technology use for academic purposes which had ramifications on his academic acculturative processes.

4.5 The Relation between Cheng-Rui's Use of Technologies and His Definition of Successful Academic Acculturation

In the section of "Definition of successful academic acculturation", Cheng-Rui indicated that successful academic acculturation entailed the gradual acquisition of MSE knowledge, development of expertise, a capacity for discipline-based intellectual and scholarly participation, and recognition by others within MSE communities. This success was determined by the following conditions: 1) able to understand and communicate with others about MSE related research and his studies, 2) participating in MSE conferences, 3) obtaining awards, 4) publishing research results, and 5) deriving his advisor's satisfaction with his academic performance.

With regard to the first condition for successful academic acculturation, his use of academic search engines to locate MSE scholarly works is instrumental in giving him exposure to MSE disciplinary knowledge and in grounding his research within the discipline. This technology use further helped him understand and discuss MSE related research with others. This is proven by "I feel so far I've adjusted well. I'm able to discuss topics that are related to MSE and my research. For example, when I communicate with others or attend a conference, there's a new topic. I'm able to understand what they said through their presentations or conversations" and "After the conference, I'd use Google and Google Scholar to search for their [scholars'] names, papers, and more information." He also pinpointed how using online environments and search engines contributed to fostering communication:

"I feel I can express my ideas much clearer through using technologies than the face-to-face method. If we're discussing the newest concept that I don't know, in an online environment, I've more time to search for online sources, such as related articles and looking words up in a dictionary, to help me understand it and more

time to organize my thoughts to lucidly express what I want to say." (interview transcript, March, 2015)

The above data show that the use of technologies afforded Cheng-Rui more time and resources to understand new concepts as seen in "more time to search for online sources...help me understand it and more time to organize my thoughts to lucidly express what I want to say". In face-to-face interactions, as an L2 English learner, Cheng-Rui might have difficulty in utilizing contextualization cues, especially a new concept within the topic corrosion and new terms, such as galvanic, pitting, intergranular, and filiform corrosion, to describe this concept, to help him understand the process of corrosion. An online environment provided a buffer to allow him to have more time to learn new concepts and to organize his articulation. It also offered abundant online sources so that he could quickly learn new concepts.

His second and fourth conditions of successful academic acculturation require fundamental MSE disciplinary knowledge, research perspectives and skills, and English proficiency to participate in MSE conferences and publications. Hence, his use of MSE departmental technological infrastructure, personal technological devices (e.g., his laptop and cell phone), academic search engines, EndNote, Taiwan Yahoo online Chinese-English dictionary, PowerPoint, Microsoft Word, and online social interactional technologies directly and indirectly assisted him in meeting these two conditions. Lab-based research hardware and software which were a part of the departmental technological infrastructure enabled him to conduct experiments, remotely automatically control his experiments, and analyze data. MSE classroom instructional technologies, such as a video recording device, a computer, a projector, and course management software, facilitated his out-of-class learning. For instance, he reported that he

downloaded instructors' slides and videos from the course management software to preview and review teaching content. His laptop helped him in writing and doing academic tasks, in employing the internet to search online academic information, and in accessing various apps, software, and online programs. For instance, his use of academic search engines supported his learning of MSE disciplinary knowledge, procedures of experiments, and scholars' contributions. His use of EndNote enabled him to organize academic readings and generate citations and references. His use of Taiwan Yahoo online Chinese-English dictionary aided him in gaining lexical competence which was necessary when writing conference proposals, his dissertation, and MSE related research papers. His use of PowerPoint afforded him clarity and sequence in the presentation of his research results through incorporating diagrams, images, and videos. His use of Microsoft Word enabled him to not only write conference proposals and his dissertation but also systematically organize his notes for academic articles. Online social interactional technologies, such as LinkedIn, Facebook, and email, assisted him in keeping up with the current trends in the MSE communities so that he could know what research was and was not conducted and how his research could contribute to the MSE field.

The third and fifth conditions of successful academic acculturation depend on the outcomes of his overall academic learning and research performance. In an interview, he reported that he received an award for his conference poster. This award demonstrates that he had, to a certain degree, acculturated to the MSE communities. Regarding the fifth condition, it seems that he was unsure whether he met his advisor's expectations as shown in "He [his advisor] always said good, good, good. For instance, he said that my work is always well organized. But, I really don't know how good my work is."

Although the above data analysis shows that Cheng-Rui's use of technologies had positive relations with his academic acculturation, data also reveal that he still struggled with English academic reading and writing and interaction with his advisor. In addition, he reported that he had adjusted well to his doctoral program which was his immediate MSE community; however, data display that he might remain in the position of a novice who still needed experienced scholars (including his advisor, a famous MSE expert) to share MSE information and guide him, especially because he is an L2 English researcher navigating the Western academic space characterized by an unfamiliar language, culture, and academic practices. However, he did not benefit from this much-needed guidance mainly because of his advisor's busy schedule. The use of technologies could not replace the expertise he would obtain from his advisor's guidance.

Overall these technologies, which he employed to accomplish academic tasks and goals, include academic search engines (e.g., Google Scholar, the school library search engine and databases, and Google), online lexical resources (e.g., Taiwan Yahoo online Chinese-English dictionary and web pages about English grammar derived from Google search engine), course management software (e.g., Carmen), PowerPoint, and online social interactional technologies (e.g., email, Facebook, and LinkedIn). On a whole, the relationship between the use of these technologies and academic acculturation is positive in that they took on an assistive role in enhancing Cheng-Rui's acculturation processes, such as reading, writing, and participation in MSE communities. Notwithstanding this assistance, Cheng-Rui still needed the guidance of experts, such as his advisor, to navigate the demands of disciplinary expectations for publication and gradually gain recognition by others in the wider MSE communities.

4.6 The Evaluation of Cheng-Rui’s Acculturation to the MSE Discipline

In order to evaluate how well Cheng-Rui had acculturated to the MSE discipline, I adopted the self-developed evaluation approach (see Table 4.4), the percentage scale, and descriptive descriptions (see the detailed evaluation of the participants’ academic acculturation in the section on data analysis in Chapter 3).

Category	Indicators of Successful Academic Acculturation	S, SS, DS, NP, NA
Cheng-Rui’s definition of successful academic acculturation	1. Had the ability to discuss MSE-related research with others, especially researchers and experts in the MSE field	S
	2. Presented own research at MSE conferences and received positive feedback from audiences	S
	3. Received research awards for research and academic performance	S
	4. Derived satisfaction from advisor with research and academic performance	DS
Indicators from collected data on Cheng-Rui	5. Had a productive relationship with advisor	DS
	6. Continuously engaged in MSE scholarship	S
	7. Had the capacity to clearly present research in English using disciplinary language	SS
	8. Had the ability to establish a network within MSE communities	S
	9. Had the ability to employ varied technologies as assistive tools during acculturative processes	SS
	10. Possessed good academic English competence	SS
Expectations and requirements of the academic department (Material Science and Engineering)	11. Timeliness (e.g., The program required students to take a candidacy exam after 1 or 2 years, to complete a dissertation overview 1 year after the candidacy exam, and to complete the doctoral program within around 5 years)	S
	12. Obtained high standard of discipline-specific core knowledge (e.g., The program required students to take and pass MSE core courses and maintain minimum GPA above 3.0)	S

continued

Table 4.4 The Evaluation of Cheng-Rui’s Academic Acculturation

Table 4.4 continued

Category	Indicators of Successful Academic Acculturation	S, SS, DS, NP, NA
	13. Intellectual participation through various avenues in communities (e.g., to be an instructional assistant for six-credit hours in order to develop intellectual leadership by involving scholarship through research and transferring learned knowledge and skills via effective communication)	S
	14. Originality of work (e.g., Students' written and oral doctoral candidacy exam needs to be "free of plagiarism" (MSE website))	S
	15. Disciplinary conventions/ High quality of graduate work (e.g., Complete the dissertation and pass the oral defense)	S
Indicators from the scholarship of doctoral students' academic acculturation	Interpersonal relationships with peers, professors, & advisor	
	16. Had the ability to have (online and/or face-to-face formal and informal) conversations with scholars (Casanave, 2008; Hedgcock, 2008; Simpson & Matsuda, 2008; Morita, 2009), including peers, colleagues, professors, and other scholars in MSE communities	SS
	17. Knew old timers' expectations and had the ability to use effective strategies to satisfy those expectations (Hedgcock, 2008)	DS
	18. Had a healthy and sustainable advisor-advisee relationship (Gardner, 2007; Golde, 1998; Girves & Wemmerus, 1988; Simpson & Matsuda, 2008)	DS
	19. Had a good relationship with the faculty (Gardner, 2007; Golde, 1998; Girves & Wemmerus, 1988; Weidman & Stein, 2003)	SS
	Cheng-Rui's academic performance in MSE	
	21. Had the ability to write as an insider and write for a wider audience (Hedgcock, 2008; Li, 2008)	SS
	22. Had the ability to write different writing genres for different academic purposes in English (Hedgcock, 2008) (e.g., class assignments, lab reports, conference proposals, qualifying exam(s), a candidacy exam, a dissertation, and journal articles)	SS

Continued

Table 4.4 continued

Category	Indicators of Successful Academic Acculturation	S, SS, DS, NP, NA
	23. Had the ability to use disciplinary language, terms, and concepts in speaking and writing (Casanave, 2008)	SS
	24. Had the ability to thoughtfully and critically read scholarly texts (Casanave, 2008; Hedgcock, 2008; Li, 2008)	SS
	25. Had the ability to use strategies to purposefully read academic texts (Hedgcock, 2008) (e.g., read texts as sources of discipline-based knowledge and as models to recognize, analyze, reproduce, selectively reshape textual conversations)	SS
	26. Had the ability to have an argumentative voice and make scholarly arguments (Li, 2008)	SS
	27. Had critical thinking and synthesis competence (Gardner, Hayes, & Neider, 2007; Li, 2008)	SS
	28. Had the ability to independently conduct research and/or experiments (Gardner, 2007; Girves & Wemmerus, 1988)	S
	29. Received awards related to academic performance (Mendoza, 2007)	S
	30. Involved in professional activities (Li & Collins, 2014; Gardner & Barnes, 2007; Weidman, Twale, & Stein, 2001) (e.g., attend conferences, seminars, workshops, and scholarly talks)	S
	31. Acquired disciplinary core knowledge (Casanave, 2008)	S
	32. Knew key figures in the field (Casanave, 2008; Hedgcock, 2008)	S
	33. Knew which academic camp(s) he aligned with (Casanave, 2008; Hedgcock, 2008; Li, 2008)	S
	34. Knew ways of constructing knowledge (Casanave, 2008) (e.g., knew how to interpret research and experimental data)	SS
	35. Knew scholars' arguments when listening to scholars' talks (Simpson & Matsuda, 2008)	NP
	36. Understood disciplinary culture (Gardner, 2007; Hirt & Muffo, 1998) (e.g., the important elements in a conference proposal and a journal article, the emphasis on innovation, problem-solving competence, and collaboration)	SS

Continued

Table 4.4 continued

Category	Indicators of Successful Academic Acculturation	S, SS, DS, NP, NA
	Understanding of the Western academic culture and academic English competence	
	37. Had the ability to use English to do academic speaking, reading, listening, and writing in English without difficulties (Sato & Hodge, 2009)	SS
	38. Understood course materials in English (Morita, 2009)	SS
	39. Understood and was able to participate in class discussions in English (Morita, 2009)	SS
	40. Understood the Western academic culture (Jones, 1999; Li & Collin, 2014; Robinson-Pant, 2009), such as the emphasis on the student-centered teaching, the ability to communicate and construct knowledge, critical thinking, independence, and class participation through oral discussions.	S

Among the 40 indicators of successful academic acculturation from Cheng-Rui’s definition of successful academic acculturation, collected data, the expectations and requirements of the MSE doctoral program, and the scholarship of graduate student socialization, Cheng-Rui obtained S 18 times (45%), SS 17 times (42.5%), DS 4 times (10%), and NP 1 time (2.5%). This result (achieving 18 indicators in the satisfied level among the 40 indicators; 45%) indicates that overall his acculturation to the Western academic culture and the MSE discipline are moderate.

Under the category of his own definition of successful academic acculturation, for the 1st to 4th indicators, multiple data disclose that he was able to discuss MSE-related research with other scholars in MSE communities. He also kept attending and presenting his research at MSE conferences. At one of the conferences where he presented, he received an award for his research and presentation. In spite of Cheng-Rui’s effort to

acculturate to the Western academic culture and the doctoral program, he was unsure whether his advisor was satisfied with his research and academic performance.

Under the category of indicators collected data on Cheng-Rui, for the 5th indicator, multiple data disclose that he did not have a productive relationship with his advisor. As mentioned in the section of Cheng-Rui's academic difficulties, he encountered the challenge of receiving sufficient support from his advisor for his dissertation writing. This phenomenon frustrated him, and he later gave up seeking advice on his dissertation from his advisor. Concerning the 6th and 8th indicators, data show that he continued to engage in the MSE scholarship by attending seminars, presenting at MSE conferences, and attempting to publish his dissertation in MSE peer-reviewed journals. Moreover, multiple data reveal that he understood the significance of networking and hence made efforts to establish and maintain relationships with scholars in MSE communities through online and face-to-face modes. For instance, when attending conferences, he would socially interact with scholars and exchange contact information to maintain the relationship with them. Additionally, when his doctoral department invited domestic and international scholars to give talks, Cheng-Rui would attend the talks. In an interview (interview transcript, January, 2016), he reported that attending the scholars' talks helped him establish and maintain relationships with the scholars in the MSE field. In addition to face-to-face interactions, he also used online social interactional software (e.g., Facebook, LinkedIn, and Glassdoor) to build up and cement relationships with scholars in the MSE academy and workers in MSE industries. Nonetheless, data show that he tended to passively interact with scholars in online environments by merely reading scholars' posts rather than taking an active role to share information or discuss MSE-related topics.

Regarding the 7th indicator (the ability to clearly present research in English through using discipline-based language), Cheng-Rui might be able to adopt MSE discipline-specific language that he was familiar with. However, due to the lack of suggestions from his advisor, as an expert of the MSE field, for his conference papers, presentations, dissertation, and journal articles that he attempted to publish, Cheng-Rui might not be proficient in using discipline-based language. Concerning the 10th indicator (possessing good academic English competence), he developed the basic competence to present his research in written and oral English but might not reach the proficient level. As mentioned in previous sections, he encountered difficulties in academic reading and writing in English during his doctoral study. For instance, he confronted difficulties in writing literature reviews and clearly expressing his research in written English. As for his academic English listening and speaking competence, data do not show that he confronted these challenges. His prior master's study in the U.S. before enrolling in the doctoral program probably helped him increase his listening and speaking competence. Furthermore, in the current doctoral program, he had weekly meetings that he could listen to other lab members' research presentations, discuss research with them, and present his studies in the meetings before presenting at conferences. Consequently, these opportunities enhanced his academic English listening and speaking abilities and which somewhat helped him adjust to the Western academic environment.

As regards the 9th indicator (the ability to employ varied technologies to do academic tasks as assistive tools during acculturation processes), Cheng-Rui employed different types of technologies. These technologies comprise academic search engines, Taiwan online Yahoo Chinese-English dictionary, citation software, and online social

interactional software. He employed these technologies to fulfill some academic requirements and overcome certain academic difficulties he confronted during his academic acculturation processes. Nevertheless, his use of some technologies might hinder him from developing disciplinary knowledge and research competence in the long term. He, for instance, mainly utilized Google Scholar to look for scholarly works, but Google Scholar has its limited scope of academic papers that they included. Therefore, this search behavior might narrow Cheng-Rui's research perspectives. In addition, he exclusively employed Taiwan online Yahoo Chinese-English dictionary without utilizing another English-English dictionary. This behavior could constrain his understanding unfamiliar English words and usage because using only one online dictionary would be subject to its weaknesses. Moreover, field notes disclose that some Chinese translations of English vocabulary in Taiwan online Yahoo Chinese-English dictionary have incomplete explanations of meanings and usage of the English vocabulary. In addition, this dictionary contains a few synonyms. Such ways of employing technologies might, therefore, undermine Cheng-Rui to access the limited extent of research and to understand unfamiliar English vocabulary and usage.

Under the category of the expectations and requirements of MSE, for the 11th to 15th indicators, data disclose that Cheng-Rui obtained high-standard of discipline-specific core knowledge through taking and passing required MSE core courses with a GPA of 3.0 and above. He also successfully fulfilled the requirement of being an instructional assistant which developed his intellectual leadership. Moreover, his dissertation research shows originality, and multiple data do not reveal that he had the plagiarism issue during

the doctoral study as he had in the master's program. Furthermore, he finished his candidacy exam and dissertation within the required time frame.

Under the category of indicators from the scholarship of graduate students' academic acculturation, there are 25 indicators which were further divided into three sub-categories:

- 1) interpersonal relationships with peers, professors, and Cheng-Rui's advisor,
- 2) Cheng-Rui's academic performance in MSE, and
- 3) understanding of the Western academic culture and academic English competence.

Under the first sub-category, for the 16th indicator, data show that Cheng-Rui was able to have face-to-face formal and informal conversations in English with peers, colleagues, professors, and scholars in MSE communities. Nonetheless, data also disclose that in online environments, such as LinkedIn and Facebook groups, mostly he only read online MSE-related posts rather than actively participating in discussions. This shows that he might tend to position himself as a novice who waited for members of MSE communities to share information rather than positing himself as an experienced member who shared information and discussed MSE-related topics with other members. For the 17th indicator, data reveal that Cheng-Rui was uncertain what his advisor's expectations were and whether his academic performance satisfied his advisor's expectations. This uncertainty resulted from the lack of interactions and direct guidance from his advisor. This phenomenon and additional data also disclose that he did not have a healthy and sustainable advisor-advisee relationship (the 18th indicator). As for the 19th indicator (having a good relationship with other faculty members), data show that he participated

in a professor's short-term MSE-related research project only once. Other than this research participation, data do not reveal his interactions with other professors in the doctoral program. Regarding the 20th indicator (the relationship with peers), data display that he had a good relationship with lab members, classmates, and MSE doctoral students whom he met at conferences. When confronting academic difficulties, he would ask questions to his classmates and lab members. Nonetheless, he also mentioned that since he was the only one researcher who conducted research in a specific area in the lab, most questions he asked lab members were about the locations of lab equipment rather than research-specific questions.

Under the second sub-category related to Cheng-Rui's academic performance in MSE, with regard to 21st to 23rd indicators, data reveal that Cheng-Rui was able to write different genres for different academic purposes, such as class assignments, lab reports, conference proposals, a candidacy exam, a dissertation, and journal articles. Nevertheless, data also disclose that he struggled to write his dissertation and journal articles he attempted to publish. One of the reasons leading to his struggle might be the lack of sufficient academic guidance from his advisor. This could be proved when Cheng-Rui said "...after encountering the challenge for several times [the challenge of meeting his advisor regularly], I realized I need to rely on myself, and I shouldn't expect him to help me..." and "My advisor absolutely doesn't look at my articles because it takes him lots of time to read and give feedback." (interview transcript, June and September, 2015). Even though the post-doc in the lab could give Cheng-Rui English writing advice on his conference proposals, dissertation, and journal articles, Cheng-Rui stated that "the post-doc may not understand what I did...In terms of professional

knowledge, my professor [his advisor] would know best. I'm the second and then the post-doc.... The post-doc just revised words, grammar, or the structure of writing" (interview transcript, July, 2015). Hence, Cheng-Rui might not know what kinds of research was considered good, how to properly conduct experiments, how to correctly deal with problems during experimental processes, and how to write good literature reviews, experimental analysis, and interpretations of research results. The discipline-specific knowledge and research skills might not be able to totally obtain from taking discipline-based courses and from online sources. Those require experienced members or experts in MSE communities to provide sufficient guidance in order for Cheng-Rui, as a novice, to acquire. On account of this absence of guidance given by experienced members or experts in the field, Cheng-Rui might be able to write his research in English but not write as an insider for MSE communities. Moreover, he might be unable to precisely use discipline-specific language, terms, and concepts in his academic writing and various presentations.

Concerning the 24th to 27th indicators, the previous section of Cheng-Rui's academic difficulties reveal that he encountered difficulties in understanding the gist of scholarly works, systematically organizing his readings, and synthesizing scholars' arguments. These difficulties show that he might not possess good enough reading skills to thoughtfully and critically read scholarly texts, synthesize scholars' arguments, and not have an argumentative voice in his writing. However, data disclose that he attempted to read academic texts as discipline-specific knowledge sources and as writing models to help him write his research papers. This strategy might somewhat help him cope with academic challenges he encountered during acculturation processes. Regarding the 28th

indicator, data display that he was able to independently undertake research and experiments. Nevertheless, he reported that “after encountering the challenge for several times [the challenge of meeting his advisor regularly], I realized I need to rely on myself... shouldn't expect him to help me. When facing difficulties in conducting experiments, I rarely asked him...” (interview transcript, September, 2015). Thus, whether Cheng-Rui had acquired correct ways of carrying out research and experiments is uncertain. In relation to the 29th and 30th indicators, data show that he constantly made efforts to involve in professional activities, such as attending events held by corrosion-related organizations, participating in scholarly seminars and talks in his doctoral program, presenting his research at MSE conferences, and attempting to publish his studies. Moreover, once he presented his research at a conference and received an award for the best research presentation.

As regards the 31st to 36th indicators, data disclose that Cheng-Rui had acquired discipline-specific core knowledge through passing the MSE core courses with a GPA of 3.0 and above and the candidacy exam and completing his dissertation. Multiple data and his dissertation writing also show that he knew which academic camp (corrosion) he aligned with and knew key scholars in his research area. Additionally, his dissertation writing reveals that he was able to interpret research and experimental data. Nonetheless, whether his interpretations were precise or not is uncertain because he reported that his advisor did not provide sufficient guidance and suggestions for his dissertation writing. With respect to the 35th indicator, data do not disclose that he knew scholars' arguments when listening to their presentations. However, in interviews, he reported that when attending scholars' presentations at conferences and confronting unfamiliar scholars'

names and terminology, he would search for scholars' names and articles to do further reading. This strategy might familiarize himself with scholars' works and further understand their arguments while listening to their presentations. Concerning the 36th indicator, data display that Cheng-Rui understood partial MSE academic culture, such as the importance of social networking and major components in a conference proposal, a dissertation, and a journal article. Nonetheless, he might not understand MSE academic culture deeply due to insufficient guidance given by an experienced member or an expert in the field.

Under the third sub-category of understanding the Western academic culture and the ability of academic English, for the 37th to 40th indicators, multiple data display that Cheng-Rui understood the Western academic culture, such as the emphasis on the learner-centered instruction, class participation via actively taking part in discussions, and the evaluation of academic achievement via varied assessments. It is probable that his previous master's study in the U.S. helped him gain this understanding. Nonetheless, multiple data also reveal that his academic English competence, especially reading and writing competence, had not yet reached the 'good enough' level. He, thus, confronted several difficulties in academic English reading and writing during his academic acculturation processes. Regarding the 38th indicator, as mentioned in the section of Cheng-Rui's academic difficulties and previous paragraphs, he sometimes encountered the challenge of reading academic texts in English during his doctoral study. As for class discussions, he reported that he was surprised to see more domestic students (English-native speakers) in the current doctoral program than in his previous master's program (interview transcript, July, 2015). This higher proportion of domestic students in the

doctoral program, hence, resulted in a period of accommodating to active class discussions for Cheng-Rui at the beginning of his doctoral study.

Taken together, among the 40 indicators of successful academic acculturation, Cheng-Rui achieved 18 indicators (45%; 41% - 60%, moderate) in the satisfied level. This reveals that his acculturation to the Western academic culture and the MSE discipline is moderate. This result indicates that he had acculturated to the Western academic culture and the MSE doctoral program in a certain level, such as fulfilling the requirements and the expectations of the MSE doctoral program and completing his dissertation within the required time frame. Nevertheless, he still struggled to socialize into wider MSE communities and to meet the high demands of academic English competence in the communities. He continuously made efforts to partake in the MSE-related communities of practice, such as attending seminars, scholars' talks, and MSE-related organizations, presenting his studies at conferences, and attempting to publish his research in MSE journals. However, he seemed to be unable to understand and learn the kernel of MSE discipline-specific knowledge and competence, such as properly interpreting his research results in his dissertation and learning how to write for discipline-specific journals. He also continuously struggled to read and write in English for wider MSE communities during his academic acculturation processes.

4.7 Summary

Cheng-Rui's learning trajectory spans across three learning contexts (college in Taiwan, the master's program, and the doctoral program in the U.S.). One similarity across these three contexts is that he studied in the same academic field (material

science). Key differences between the college in Taiwan and the two learning contexts in the U.S. include:

- 1) The use of L1 Chinese on one hand and the use of L2 English language and academic culture on the other hand
- 2) There were a few student-to-student and student-to-instructor interactions in the Taiwan-based setting than in the US-based setting.
- 3) There were comparatively more opportunities for doctoral-level participation in MSE communities in several ways, such as presenting at conferences and attending scholarly talks.
- 4) There was a more visible use of various technologies in the course of learning at the doctoral level.

In addition to the similarity and differences, Cheng-Rui's definition of successful academic acculturation is characterized by some cardinal practices. These include having a capacity to discuss MSE-related research, participating in MSE communities of practices, and gaining recognition within the communities. These indicators of successful academic acculturation were explicitly described by Cheng-Rui during his interviews. In addition to these, a close scrutiny of other data (a survey, interviews, 14-week weekly journals, and field notes) reveals some indicators which were not directly identified by Cheng-Rui. These include:

- 1) a productive relationship with his advisor,
- 2) continuous engagement with the MSE scholarship,
- 3) a capacity to clearly present his research in English through apt use of disciplinary language,

- 4) the ability to establish a network within MSE communities,
- 5) the ability to employ varied technologies as assistive tools to carry out academic tasks during his academic acculturation, and
- 6) the ability of good academic English

Besides these indicators, the MSE doctoral program's expectations and requirements also disclose some indicators of successful academic acculturation that are essential for MSE doctoral students. These comprise to 1) acquire MSE core knowledge, 2) pass a candidacy exam within a time frame, 3) develop intellectual leadership, 4) meet the requirement of originality for all research works, and 5) complete a dissertation.

After evaluating Cheng-Rui's academic acculturation through these indicators from his definition of successful academic acculturation, collected data, the departmental expectations and requirements, and the scholarship of domestic and international students' socialization into graduate school, the result (achieving the 18 indicators in the satisfied level among the 40 indicators; 45%) reveals that his academic acculturation condition is moderate (41% – 60%, moderate) but tends to be poor (21% – 40%, poor). In other words, this finding discloses that Cheng-Rui struggled to acculturate to the Western academic culture and wider MSE communities . His struggles could be seen in several situations.

During Cheng-Rui's academic acculturation, he encountered various academic challenges, such as receiving insufficient support from his advisor, having trouble following arguments while reading scholarly works online, not comprehending the gist from his academic readings, and experiencing difficulties in writing. Some of these challenges derived from the shift from L1 Chinese to L2 English language and culture,

the lack of adequate exposure to academic English prior to studying in the U.S., scarce training in prerequisite skills for reading and writing academic papers in English, and insufficient practice stemming from minimal opportunities to write lengthy academic texts in English before writing his dissertation. In order to deal with some of these difficulties, Cheng-Rui developed varied strategies, notable among these are the use of technologies, tapping into his L1 Chinese resources, the formation of peer-to-peer support, and the attempt to obtain advisor-support. These strategies are intended to alleviate tension during his academic acculturation processes. For example, he utilized Google Scholar to search for academic papers for purposes of modeling both writing and approaches to academic challenges. Another example is that he used EndNote citation software to meet the requirements of different MSE citation styles. Additionally, he employed Taiwan Yahoo online Chinese-English dictionary to write academic papers. Nonetheless, although some of these strategies might have accrued some benefits for his academic acculturation, they might, in fact, hinder him from acculturating to his current doctoral program and MSE communities. For instance, he mainly relied on the first 10 web pages of Google Scholar to search for needed academic texts. He also mostly depended on Google Scholar's citation counts to determine the significance of academic texts whereby those with higher counts were considered as having a higher significance. Moreover, he mainly counted on Google Scholar which has its limitations, such as the scope of scholarly works and non-inclusion of the newest publications. Whereas this strategy of employing Google Scholar has some benefits, it might lead to an oversight of more current scholarly works or cause a blind spot for those studies that were not included in Google Scholar. Another example that works in this manner is his use of

Taiwan Yahoo online Chinese-English dictionary. His overreliance on this technological tool might limit him from seeing the nuances of English words and how to use certain English words and phrases in context because this resource seldom features English word usage. Moreover, as discussed in the preceding sections, some of his strategies might not effectively assist him in socializing into MSE communities. A case in this point is his concerted effort to receive his advisor's support. Due to his advisor's busy schedule, Cheng-Rui was unable to receive guidance all the time that he wanted this for instance when working on parts of his dissertation and on publications. Overall, these factors resulting from himself and others (MSE department, his advisor, and peers) affected him to acculturate to the Western academic culture, the present doctoral program, and wider MSE communities.

The following chapter shifts from Cheng-Rui to discuss Zhi-Kai's academic acculturation processes in the Department of Statistics. Zhi-Kai is the second case study in this dissertation.

Chapter 5: Zhi-Kai's Case Report

5.1 Zhi-Kai's Learning Background

Zhi-Kai's learning background comprises four stages: L1 (Taiwan) learning contexts at the college level, master's level, a research organization, and L2 (American) learning context at the doctoral level (see Table 5.1). At the time of this study, he was a fourth-year doctoral candidate in the Department of Statistics (DS) and during his doctoral study he co-authored four publications. Interview data show his motivation to study from the college to the doctoral level derives from his parents: "In my early age, I had already decided to study until the doctoral level because my parents are teachers in universities." (interview transcript, June, 2016). An understanding of his current academic acculturative path necessitates considering the influence of his parents' career track on his desire from an early age to become a professor.

In addition to this enduring parental influence, it is also important to consider various aspects of context that characterize his experiences across the college, the master's, and the doctoral level. These can be broadly categorized under the following five headings: 1) classroom context, 2) pedagogy and interaction, 3) language of instruction, 4) technological infrastructure, and 5) learning habits. Within these categories, a combination of data from various sources (e.g., a survey, interviews, weekly journals, document collection, and field notes) reveals descriptions of the following aspects of his academic acculturative context: instructional styles, teaching style supplemented by

technologies, difficulties in understanding instruction, language shift, and assessing students' learning.

To begin with, Zhi-Kai studied statistics from the college to the doctoral level. Most of his professors across these levels implemented traditional instructional styles, such as giving lectures in front of the class, writing teaching notes on a chalk or whiteboard, and rarely utilizing slides to teach. Interestingly, teaching presentation in his doctoral program in the U.S. tended to take on a more traditional instructional style when compared to his learning experiences in Taiwan:

"It's a little bit of a shock to see that professors' teaching styles here are more traditional than my Taiwanese professors in the master's program. Many professors here only use a white or chalkboard to teach and teach according to textbooks. Contrarily, in my master's program, one or two Taiwanese young professors, like my advisor, would employ technologies and more analytical ways of teaching." (interview transcript, July, 2015)

The above data show that he expected non-traditional teaching styles at the doctoral level (L2 learning context) characterized by more student-to-student and student-to-professor interactions and integrating technologies into teaching. The words "shock" and "Contrarily" illustrate the mismatch in expectations. Further data show that he continued to tap into the resourcefulness of instructional videos uploaded by his master's advisor during his doctoral study. Importantly, these instructional videos were mainly produced in Chinese although English was also used for specific statistical terminology. The videos featured the instructor teaching in class, covering several topics, teaching notes on a board, and were linked to additional online sources. Zhi-Kai characterized these videos as "very useful sources" and "they're very helpful". He continued to go back to these even though they were produced by his previous master's advisor in Taiwan:

"During my master's study, I watched the teaching videos when skipping classes. Now, they become very useful sources. My previous advisor still uploads his teaching videos to his website now. The videos include his voice and all of his notes. I sometimes go back to search for and watch those videos, they're very helpful." (interview transcript, July, 2015)

These instructional videos employed both L1 Chinese and L2 English, and this language combination eased his academic socialization into the Western higher education.

Underpinning the resourcefulness of these videos was the enduring relationship between him and his Taiwanese master's advisor which is shown by his tendency to "sometimes go back to search and watch those videos". This tendency provided him with supplementary bilingual academic sources for his doctoral study.

In spite of this effort to supplement his doctoral acculturative experience, Zhi-Kai reported encountering some difficulties, such as in understanding instruction and navigating language shifts among other academic challenges.

Table 5.1 presents some key characteristics of his L1 and L2 learning contexts which might influence his acculturation to the Western academic culture and the DS communities.

	L1 Learning Context – the College Level	L1 Learning Context – the Master’s Level	L1 Learning Context – A Job Position	L2 Learning Context – the Ph.D. Level
Classroom Context	1. Students' learning mainly evaluated examinations.	1. Students' learning evaluated through assignments, examinations, and a thesis.	➤ Learning happened in an office-based space.	1. Students' learning evaluated through assignments, examinations, a candidacy exam, and a dissertation.
	2. Assignments mainly consisted of math questions.	2. Assignments mainly consisted of math questions.		2. Assignments included short-answer questions, short papers, presentations, and projects.
	3. Data do not show the prominence of peer collaboration.	3. Wrote assignments and prepared exams with peers.		3. Prepared his qualifier exams with peers.
Pedagogy and Interaction	4. Instructors adopted traditional instructional styles (e.g., wrote notes on a chalkboard and gave a lecture in the front of the class and students took notes).	4. Instructors mainly adopted traditional instructional styles (e.g., wrote notes on a chalkboard and gave a lecture in the front of the class and students took notes). Some instructors would employ slides to teach.	➤ Learning happened on the job mainly through supervision by his supervisor. The Taiwanese government’s research organization encouraged independence in working and interactions were mainly with his supervisor and collaborators, including scholars, professors, and industrial workers.	4. Instructors adopted traditional teaching styles (e.g., mainly used a chalkboard to teach).
	5. Few student-to-student and instructor-to-student interactions during class.	5. Few student-to-student and instructor-to-student interactions during class.		5. Few student-to-student and instructor-to-student interactions during class.

Continued

Table 5. 1 Characteristics of Zhi-Kai's L1 and L2 Learning Contexts

Table 5.1 continued

	L1 Learning Context – the College Level	L1 Learning Context – the Master’s Level	L1 Learning Context – A Job Position	L2 Learning Context – the Ph.D. Level
Language of Instruction	6. Some teaching materials were written in Chinese and some in English.	6. Teaching materials were written in English.	➤ Interactions were mainly in Chinese. Some job-related publications were in Chinese and some in English.	6. Teaching materials were written in English.
	7. Chinese was the main language in and outside of class.	7. Chinese was the main language in and outside of class.		7. English was the main language in and outside of class.
	8. Data do not show the prominence of whether instructors' notes were written in Chinese or English.	8. Instructors' notes on a chalkboard were written in English.		8. Instructors' notes on a board were written in English.
Technological Infrastructure	<p>9. Data do not show whether the department was equipped with technological infrastructure or whether teachers employed technologies in their teaching.</p> <p>10. Mainly used textbooks as a resource for getting answers to questions.</p> <p>11. Data do not show the prominence of using online discussion forums.</p>	<p>9. Data do not show whether the department was equipped with technological infrastructure. However, Zhi-Kai's advisor employed slides, video-recording, and his own website.</p> <p>10. Mainly used Google search engine and Google Scholar to look for answers for his math assignments.</p>	<p>➤ Day-to-day work technologies, including a desktop, a laptop, statistic software, such as R program, processor software, such as LaTeX and BibLaTeX, the common use of the internet, citation software, such as Mendeley.</p>	<p>9. Zhi-Kai had an office which was equipped a desktop, a printer, and a phone.</p> <p>10. He often used his personal laptop to obtain online sources, run statistical programs, write papers, and prepare presentations.</p> <p>11. Mainly used Google search engine and Google Scholar to look for answers for his math assignments and research.</p>

Continued

Table 5.1 continued

	L1 Learning Context – the College Level	L1 Learning Context – the Master’s Level	L1 Learning Context – A Job Position	L2 Learning Context – the Ph.D. Level
Technological Infrastructure		11. Often went to PTT (a famous Taiwanese online university discussion forum) to ask and answer statistical questions.		12. Often went to PTT (a famous online Taiwanese university discussion forum) and Facebook to ask and answer statistical questions.
Learning Habits	<p>12. Quietly listened to lectures and took notes by hand.</p> <p>13. Did not preview and review teaching content before and after class except when preparing for exams. Data do not show whether he understood instructors' lectures and notes.</p> <p>14. Data do not show the prominence of doing co-curricular activities.</p> <p>15. Data do not show the prominence of his preference for exams or research.</p>	<p>12. Quietly listened to lectures and took notes by hand.</p> <p>13. Did not preview and review teaching content before and after class except when preparing for exams. Data do not show whether he understood instructors' lectures and notes.</p> <p>14. Attended Taiwan statistical conferences.</p> <p>15. He preferred doing research to taking exams.</p>	<p>➤ Work habits included the typical use of statistical analytic procedures, independent investigation of research-related and assigned tasks, constantly learning about appropriate communication skills based on work-related incidents that needed consultation.</p>	<p>13. Quietly listened to lectures and took notes by hand.</p> <p>14. Previewed and reviewed teaching content before and after class because sometimes he couldn't understand instructors' lectures and notes.</p> <p>15. Attended departmental seminars, reading groups, and Taiwan and American statistical conferences.</p> <p>16. He preferred doing research to taking exams.</p>

According to field notes which comprised information from the Department of Statistics' website, and assembled documents, the following are some highlights of the DS doctoral program:

Features of the DS Doctoral Program
Faculty members successfully continued to obtain competitive grants.
Faculty and students collaboratively conducted cross-disciplinary research.
Invited domestic and international scholars to give talks
Insufficient hard and software support for statistical research and teaching ("Due to limited resources, we cannot support every package that comes out for our primary supported platforms." DS website)
Lack of statistical technical support ("We do not know much about these packages as we aren't statisticians, but we may be able to point you in the right direction." DS website)
Had a requirement for students to take and pass core courses (in mathematical statistics, applied statistics, and computational methods) with a grade of B- or above
Had a requirement for students to succeed in qualifier exams (I and II) to evaluate learning in the first and the second years of doctoral study.
Had a requirement for students to complete the candidacy exam within two years after qualifier exam II. Students should also complete a dissertation proposal.

Table 5.2 Characteristics of Zhi-Kai's Doctoral DS's Program

These above data reveal that DS is characterized by potential strengths and weaknesses. One particular area that is important for research and statistical analysis but which remains challenging is the DS's provision of sufficient statistics-related technological support.

On the whole, Zhi-Kai's learning experience from the Chinese-based college level to the current English-based doctoral program might present him with, among others, linguistic acculturative difficulties. Similarities across college, master's, and doctoral programs in terms of the classroom context, pedagogy, and classroom interactions among other features of context might reduce tension during his academic acculturation processes. For example, under technological infrastructure, initially he utilized textbooks

to obtain answers to questions which gradually involved the use of Google search engine and Google Scholar at the master's and doctoral programs. This incremental use of technologies is important for easing the stress that came from socializing into Western academic spaces. Another factor that could ease his academic acculturative stress is opportunities to transfer productively to his present doctoral learning. In this regard, Zhi-Kai mentioned that he was able to transfer credits, statistical concepts, specialized statistical terminologies, and research experience from his statistical master's program to the present doctoral program. In interviews, he stated that he was required to take an ESL writing course during his first year doctoral study which emphasized plagiarism and citation styles. He stated he had already learned about these when writing his master's thesis. Even though he wrote his master's thesis in Chinese, some academic writing conventions, such as citation, the structure of an essay, and discussion disciplinary concepts, were still applicable at the doctoral level. While he was working as a statistical consultant after his master's study, he learned the practical application of statistical analysis and communication skills. Cumulative experiences at this level were, therefore, beneficial because of opportunities for hands-on real-life practice with statistical concepts. Taken together, an examination of his previous academic learning experience and work experience highlights contextual aspects that influenced Zhi-Kai's academic socialization in his doctoral program.

5.2 Zhi-Kai's Definition of Successful Academic Acculturation

When I interviewed Zhi-Kai, he had been studying in the DS doctoral program in the U.S. for four years. In an interview, he explicitly defined what successful academic acculturation meant for him:

"For me, successful academic acculturation means to feel comfortable to discuss statistical research in English with anybody. I have 80% confidence in it. For daily conversations, my confidence drops to 50%. If the conversation is not related to statistics, I sometimes couldn't understand what speakers talk about. Or, sometimes I feel lazy to discuss with them. I often just said hi and don't develop further conversations." (interview transcript, June, 2015)

These data show that according to Zhi-Kai, the main aspects of “successful academic acculturation” include confidence in one’s capacity to use English in conversation and comfort level to discuss discipline-based topics. He found himself lacking a conversational voice when engaging with non-discipline-based topics. His brief definition where success in academic acculturation amounts to feeling “comfortable to discuss statistical research in English with anybody”, highlights how he as a non-native-English speaker felt more successful upon mastering L2 English. In additional interviews, he self-reported that he did not encounter difficulties in discussing his own research or discipline-based topics when attending conferences. Nevertheless, further data reveal that he experienced difficulties in academic speaking in English during his early doctoral years. This study will elaborate more on this matter in a subsequent section on his academic difficulties.

He offered a further definition of his conceptualization of “successful academic acculturation” as follows:

"The second is to feel comfortable to study under the U.S. educational system. I’m pretty ok with this. I found many of my classmates, especially classmates from China, know how to study for exams but don't know how to do research.

They always complain about their advisors. For example, they keep complaining to me that their advisors ask them to read and report papers. They said 'It sounds that we teach our advisors. If we know how to teach, why do we have advisors?' But, for me, doing research means to read some papers and then discuss them with advisors. I think probably it's because they didn't study a master's program before and directly study the Ph.D. I studied a master's program before so I know how to do research. The third is to be able to think research problems and find solutions by myself. I feel I'm able to look for possible solutions for research problems, but whether the solutions are right or not is another story. At least I try to solve the problems and look for possible answers. The fourth is to be able to develop new and useful statistical analysis. The fifth is to publish papers and find a job related to statistics." (interview transcript, July, 2015)

These data outline various prerequisite skills for academic success that are based on the notion of finding a comfort level when studying “under the U.S. educational system.” These include undertaking research, communication with advisors, reading and discussing papers, independence, development of statistical analytical competence, and scholarly publication. More specifically, he suggested the need for doctoral students to be able to engage in independent research through knowing own research interests and being able to find solutions for research problems. He evaluated himself in this regard saying "I'm pretty ok with this". He then evaluated some of his classmates and concluded that they still needed to develop a comfort level in studying “under the U.S. educational system” as seen in “many of my classmates...know how to study for exams but don't know how to do research...They always complain about their advisors...They said 'It sounds that we teach our advisors. If we know how to teach, why do we have advisors?'”

He also considered that, during the process of independent research, it is significant to participate in discussions with experienced researchers "for me, doing research means to read some papers and then discuss them with advisors." According to Zhi-Kai, conducting research and analyzing data are not enough, and being able to make contributions in the field is also vital in order to “develop new and useful statistical

analysis". Furthermore, for a doctoral student to socialize into the DS communities, publishing own research is also important. His previous research experience in the master's program and in the research job might have contributed to how he understood advisors' expectations for doctoral students and the DS field's expectations for a scholar. His two published scholarly articles in journals before commencing his doctoral program offer evidence that he knew the DS's communities' expectations for research, writing, and publishing. These experiences which he brought to the doctoral program were resourceful in his socialization into the DS communities.

On the whole, Zhi-Kai's prior research experience in the master's program and the research job prepared him for realizing and satisfying his two co-advisors' and DS communities' expectations. In addition, his previous statistical learning experience in the L1 context where teaching materials were in English, especially in the master's program, enabled him to communicate with others about statistical research in English even though his English speaking competence was not proficient enough for engagement with others over non-statistical topics. Taken together, his definition of "successful academic acculturation" amounts to participation, independence, research orientation, and accumulative scholarly and work expertise which became resourceful for him to pursue the advanced level of statistical expertise.

5.3 Zhi-Kai's Academic Difficulties

Despite his well-rounded definition of successful academic acculturation, Zhi-Kai continued to encounter various challenges during his acculturation processes. Ample data, such as a survey, interviews, weekly journals, and other related documents, show

that he encountered outstanding academic difficulties in academic listening, speaking, and writing in English. Of these, academic writing in English was the most difficult for him to accomplish. The following sections introduce some examples of the challenges he confronted under these categories. Although English academic reading, writing, listening, and speaking are inseparable, in order to clearly analyze and discuss English academic difficulties he encountered during his acculturation processes, his English academic difficulties in listening, speaking, and writing are reviewed separately in this section.

5.3.1 Difficulties in academic listening.

The shift of linguistic learning contexts from L1 Chinese to L2 English presented Zhi-Kai's learning difficulties even though instructors' teaching styles in the current doctoral program were similar to those in his college and master's program. This linguistic shift seemed to directly influence his class participation in the beginning of his doctoral year:

“At the beginning of attending courses in the doctoral program, I really couldn't understand what professors said. Although I studied harder than before, I felt my understanding of lectures was worse than in Taiwan. I didn't record the lectures. Even if I recorded them, I still couldn't understand because some professors had strong accents. I had one professor from Turkey and one from Italy. It's very challenging when attending their classes. Around a half of the class time, my mind was blank. I usually tried to read textbooks [after class] to figure out the lectures... Moreover, I couldn't recognize their cursive writing on a board. I tried hard to understand what they wrote on the board. Later, I felt I just kept copying professors' notes and even couldn't keep up with their writing speed.” (interview transcript, July, 2015)

In addition to these challenges mentioned above, another data set also discloses that most of his professors in the doctoral program did not follow textbooks to teach which exacerbated his L2 English learning situation because he did not have a one-stop-source for accessing lesson content. Moreover, he experienced listening difficulties when

attending disciplinary weekly reading groups which consisted of three to four DS professors and some fellow doctoral students:

"During the first and second doctoral years, basically, I didn't understand what professors and other students said when attending a reading group. It might be because of my English ability and unfamiliar with the content. Now, this is my fourth year to attend the reading group. I occasionally can understand what they said now." (interview transcript, July, 2015)

Additional data reveal his description of mechanisms for coping with listening difficulties related to academic L2 English, such as the use of recording, typing out transcriptions, taking notes, and generally not talking "too much":

"At the first year of being a GRA, I recorded each conference call because my advisors asked me to give them a summary for each conference call so they could read it and remind them of the meeting. That was a project collaborating with a hospital in New York. We helped them analyze their data. After recording each conference call, I listened to the recording and typed out each word they said. I did that for a year. The collaborator did something related to knees. There're many medical words I didn't understand while they were speaking. After the first year, my advisors didn't ask me to give them a summary. That was another project with another collaborator. I was just taking a note while having a conference call. During a conference call, I usually didn't need to talk too much. My advisors would talk. I just listened, prepared for documents they needed, and gave the documents to them." (interview transcript, July, 2015)

The data above also show that Zhi-Kai was confronted by "medical words [he] didn't understand". He identified Google Translate (see Supplement 5-2) as a coping mechanism for dealing with this challenge when he said:

"The collaborators gave us articles related to human organs and man-made knees. There are lots of vocabulary that I couldn't understand so I often use Google Translate to check those words. I just want to know their Chinese meanings but not usage so using Google Translate is faster than using other online dictionaries." (interview transcript, July, 2015)

Overall, these data in this section reveal some challenges in English academic listening while highlighting some coping approaches Zhi-Kai employed in his academic acculturation processes.

Although he studied the field of statistics throughout his college, master's, and doctoral programs, his previous discipline-specific knowledge seemed insufficient in assisting him in adjusting to the L2 English learning context as shown in "I really couldn't understand what professors said". Further, his previous exposure to the Chinese-dominant linguistic setting as opposed to the English-dominant linguistic setting made it difficult for him to "understand what professors said" leading to his observation that "some professors had strong accents". As he moved from L1 Chinese to L2 English learning context he faced strong English accents, unrecognized cursive English writing on the board, instructors' fast speed of note-writing, and non-adherence to particular textbooks in teaching. Generally, the L2 English learning context was characterized by these kinds of challenges which indicate how this context was not optimized for L2 speakers, such as Zhi-Kai. His observation where he stated that he "couldn't recognize their cursive writing on a board" is a manifestation of the instructor's use of traditional chalk-and-talk methods as explored in the section on learning background. It is probable that the use of varied non-traditional methods of teaching, such as teaching using videos and slides, could resolve some of these challenges in listening. This language-based shift from L1 Chinese to L2 English also resulted in his difficulties in academic speaking.

5.3.2 Difficulties in academic speaking.

In his self-assessment of academic speaking, he said: "My English writing is ok comparing with my English speaking" (interview transcript, June, 2016) and "Before, I was afraid to say something wrong or others couldn't understand what I said because my English speaking is not good. Actually, it's really poor so at that time I took several ESL

spoken English courses” (interview transcript, July, 2015). In other words, by his own recognition and admission, English academic speaking presented him with significant challenges. These challenges were evident in data featuring his reflections on his first-ever experience giving an English presentation at a departmental reading group meeting:

"That was my first time in my life to give a presentation entirely in English. In fact, the reading group was for advanced doctoral students in their fourth or fifth doctoral years, but I attended it in my first year. The professor of the group who is currently one of my advisors listed many scholarly papers on his website and asked me to select one to present. I almost typed out what I wanted to say word by word for each slide. I practiced it for two to three times. When I presented it, it sounded like that I recited the script. One week before my presentation, the professor asked me whether I had any questions so I asked him to look at my slides. He went through each slide with me and asked me to briefly talk about what I wanted to say. Then, he gave me suggestions about how to revise each slide and what I should mention in some places. At that time, he was not my advisor. I felt this professor was nice. Hence, I asked him to be my advisor later because he was willing to spend his time on helping me." (interview transcript, July, 2015)

The language environment was a significant contributor to the challenges of English academic speaking that he experienced in his acculturation processes. In itself, doing something new can present challenges. In this case, he had to make a presentation entirely in English in front of an audience consisting of DS professors and peers who were ahead in the program. This situation led to increased pressure to perform in L2 English while navigating disciplinary concepts, Western classroom interaction practices, and the relationship among novice (himself), experienced researchers (peers who were ahead in the program), and professors (experts). His motivation to learn is evident by various coping strategies. He began by strategically typing out the transcript of his presentation “word by word for each slide” and practicing “for two to three times”. This repetitive practice involved working on explanations of concepts in English, pronouncing some complicated English words, and rehearsing timing. In itself, this strategy is

insufficient to resolve all speaking challenges he encountered because he reported that this presentation “sounded like that [he] recited the script”. The presentation was devoid of audience-interaction and lacked effective pacing. Data reveal that another strategy that he employed was through seizing the opportunity to have his professor look at his slides as shown in “I asked him to look at my slides”. A further strategy is evident in the way Zhi-Kai evaluated this professor as being “nice...because he was willing to spend his time on helping” him. He subsequently “asked him to be [his] advisor” thereby building a productive academic relationship with this professor. The professor (who later accepted to become his advisor) acted as a bridge to help Zhi-Kai understand Western audience’s and DS communities’ perspectives through his guidance on this and several other occasions. Additional data disclose that how this advisor and another one (co-advisors) would look at his conference presentation slides and provide suggestions for his mock presentation before attending a conference. Moreover, his advisors helped him prepare the acceptance speech for a department award for doctoral students’ outstanding research performance by reviewing his slides, listening to his mock presentations, and answering audience’s questions when he could not answer them.

This same kind of support by advisors is also evidenced in additional data when he was confronting difficulties in semi-formal oral interactions in English at a banquet during an academic conference. He reported that his two advisors started by “firmly suggest[ing]” that he engaged in “casual conversation with everyone” who was at the banquet and that they proactively introduced him to “some scholars”:

"Once I attended a conference which had a social time like a banquet. My advisors firmly suggested that I attended it. He told me to have a casual conversation with everyone. It's very difficult for me, especially on occasions when I do not know anybody. So, at the beginning, the first hour, I kept coming

out to chat with my advisors but they kept encouraging me to go back into the banquet room. Later, my advisors helped me to have conversations with strangers through introducing some scholars to me. Thus, I was able to have longer conversations with them." (interview transcript, June, 2015)

Such semi-formal social interactions with scholars are an important practice for new-timers, that is, they should socialize with other new-timers and old-timers in the academic communities. Nonetheless, Zhi-Kai was unfamiliar with these semi-formal social interactions and described how difficult it was for him to participate in semi-formal interactions. The two main challenges for him are communicating fluidly in L2 English and interacting with unfamiliar faces who had higher academic status in DS communities. Hence, he was unable to participate in conversations with other scholars. Non-participation might lead him to lose opportunities to build social networks. Going in and out of the banquet room demonstrates his low confidence and when he reported that "My advisors firmly suggested that I attended it... they kept encouraging me to go back into the banquet room", this action reveals that social networking is significant in the academy. Ultimately, he was "able to have longer conversations with them" which signals a growth in self-confidence. In this instance, his acculturation processes were supported by his advisors' insistence and guidance. Zhi-Kai's language shows a sense of symbolism in his academic acculturation as follows. Going into the conference banquet room to hold discussions with scholars in the field symbolizes increased self-confident and a capacity to engage in informal discussions. Notably, he gained the capability of doing this in English. As an international Chinese-speaking doctoral student who struggled to acculturate and participate in this Western academic community, when his sense of self-confidence faded, he left the room.

In summary, Zhi-Kai's speaking difficulties derive from various factors, such as lack of exposure to English before studying the doctoral program, the change of linguistic and cultural learning environments from L1 Chinese to L2 English, his low English speaking proficiency, and power relationships between him and experienced scholars. However, these data show that the encouragement and guidance by his advisors to go back into the conference banquet room symbolize the necessary support structures that international students, like Zhi-Kai, require in order to effectively participate and acculturate to Western academic settings. Another facet of academic challenges that he encountered comes in the form of difficulties in English academic writing.

5.3.3 Difficulties in academic writing.

Data show that unlike in the case of difficulties in speaking and listening, Zhi-Kai was unaware of the extent of his academic writing difficulties until when he had to write his dissertation. He reported that while he was in the doctoral program fulfilling coursework requirements, there were a few opportunities to write long English-based texts:

“Our class assignments were, in fact, rarely English but math which contained no more than two sentences or a lengthy text. I didn't have many chances to write long texts for assignments until recently.” (interview transcript, June, 2016)

The shift from Chinese to English learning context coupled with scant experience of writing long English prose contributed to his challenges in academic writing. The nature of DS fundamental courses emphasized more on solving mathematical questions through outlining formula and axioms rather than prosaic explanations. This emphasis is seen in “Our class assignments were, in fact, rarely English but math which contained no more than two sentences or a long text.” He started to notice that writing was a challenging academic skill, especially as he was writing his dissertation:

“Now, my writing difficulty is caused by insufficient vocabulary while writing my dissertation. I always use the same words. Although I check online dictionaries, I still run out of vocabulary because I need to write around 200 to 300 pages. I also don’t have enough knowledge of sentence structures I can use. I found I keep using simple sentence structures. But, my advisors want me to just finish writing my dissertation first and not worry about these issues because they’ll help me to revise. Also, they don’t want me to copy some sophisticated sentences from academic papers. At the beginning of writing my dissertation, I used to refer to academic papers to see how scholars wrote their papers. I knew I couldn’t plagiarize so I changed some of their words to my words but they [his advisors] said ‘It’s obviously not your writing style. Those sentences were not written by you.’ So, later, they asked me to not imitate scholars’ sentences and just write what I wanted to say.” (interview transcript, June, 2016)

As an L2 English writer, Zhi-Kai’s typically academic writing challenges include 1) a lack of adequate vocabulary and knowledge of appropriate sentence structures, 2) insufficient opportunities to rehearse academic writing, and 3) inexperience in taking up writing models from scholarship and internalizing these models to form his own writing style. This difference in the nature of DS assignments and the demands of the dissertation to write long prose was beyond his control. As discussed in the learning background section, the lack of prior exposure to English academic writing from the college to the doctoral level diminished his capacity to excel in English academic writing. However, these data reveal that his advisors continued to provide him support through 1) encouraging him to develop his own writing style in “they don’t want me to copy some sophisticated sentences from academic papers.... but they [his advisors] said ‘It’s obviously not your writing styles. Those sentences were not written by you.’” and 2) encouraging him to complete his dissertation writing and then attend to mechanical writing issues later. This is shown in “my advisors want me to just finish writing my dissertation first and not worry about these issues because they will help me to revise.”

Further data reveal that in addition to these problems he also had difficulty in clearly expressing his intended meaning in English:

“My advisors and I are close enough that we often find humor in my dissertation writing. They asked me to retell what I wanted to say in some places. After retelling them, they told me that 'what you wrote is right, but no one would write in that way. Your sentence structures are wrong. Also, some words are wrongly used and don't express exactly what you wanted to say.' They said, after my oral explanations, they knew what I wanted to express, but before my explanations, they were confused.” (interview transcript, June, 2016)

As an L2 speaker and writer of English, he struggled with 1) finding appropriate words that carried intended meaning and 2) articulating his meanings in ways that conveyed clearly to the Western academic audience. He was probably drawing from his L1 Chinese through direct translation or some ineffective linguistic navigation. He appeared relaxed around his advisors who joked with him about his errors in expression. Further, when he remembered and reproduced their advice word by word, this recollection shows that while interacting with his advisors, he developed a capacity to recall their guidance, and by saying what they said word for word he had internalized their expectation of how he should revise his dissertation. This internalization is seen in “what you wrote is right, but no one would write in that way. Your sentence structures are wrong. Also, some words are wrongly used and don't express exactly what you wanted to say.” Importantly, his advisors always encouraged him by pointing out differences between the points he made and language errors that obscured these points. The data reveal this distinction in “what you wrote is right, but no one would write in that way...they knew what I wanted to express but before my explanations, they were confused.”

Supplement 5-1 presents additional data to illustrate this productive working relationship between Zhi-Kai and his advisors. The before and after a snapshot of a conference proposal shows his advisors' indirect writing feedback approach. He had a habit of presenting his conference proposal drafts, such as the one in Supplement 5-1, to his advisors for advice. Non-direct methods adopted by his advisors include foregrounding the aim of the proposal, bringing in data forward, restructuring the content and format of the proposal, and ending the proposal by signaling scholarly literature. Overall, Supplement 5-1 demonstrates the use of modeling in English academic writing guidance. This modeling of academic writing occurred within a context characterized by cordial working relation and face-to-face interaction which pointed to the necessity of a close working relationship in achieving successful academic acculturation. Generally speaking, the close working relationship between him and his advisors indicates that advisor-support is necessary for his development of academic writing skills. It is possible that taking writing courses alone might not provide an effective support-structure. The relationship between him and his advisors points to the cardinal role of cordial interpersonal relations evidenced when he said, "My advisors and I are close enough that we often find humor in my dissertation writing" in supporting international students. Such support is seen through advisors interacting with advisees in non-confrontational, encouraging, and nurturing ways.

In an effort to address some of his academic writing needs, he took an ESL writing course during his early part of his doctoral program. Unfortunately, this course did not effectively meet his academic writing needs:

"The ESL writing course taught citation styles and how to cite sources. I feel those were not related to my English writing ability. I already knew how to cite

sources before. The course was meaningless. I originally thought the course would teach me grammar or rhetoric but it taught you rules to not plagiarize someone's work. Since my master's program required me to write a thesis, I already had understood some of these concepts and rules." (interview transcript, July, 2015)

His lamentations about these mismatched needs are captured in phrases, such as “I feel those were not related to my English writing ability,” “The course was meaningless,” and “The course didn't help me a lot.” Comparatively, the interactions between him and his advisors were more beneficial in improving his English academic writing competence. He identified that some concepts in the ESL course were redundant for him because he had learned them during his master’s thesis writing process. This is seen in “I already knew how to cite sources before” and “Since my master's program required me to write a thesis, I already had understood some of these concepts and rules.” In describing these circumstances, he repeatedly focused on himself using “I” and “my”. A general point that emerges here is the benefits of individualized instruction and pedagogy of differentiation.

Zhi-Kai provided data exemplifying some feedback approaches his advisors used. Most of these data were in the form of dissertation drafts bearing written feedback by his advisors. These approaches include crossing out unnecessary words, providing correct usage, circling areas with inaccuracies, using symbols, such as crosses and arrows, to highlight errors and suggest restructuring, adding annotations in the margins which took the form of questions and direct statements, and rewriting a passage. As an L2 English writer, he reported that he sometimes faced difficulties in understanding his advisors’ written feedback:

"The interesting thing is that I wrote the entire journal paper, but after I gave them my draft, the draft they gave me back was changed. The meaning was the same

but words were totally different. Some places were even rewritten. I didn't ask them why they changed to that way...For my dissertation, they usually just corrected some usage or grammatical errors. They corrected line by line, and there were many errors. I'm afraid to see their feedback with question marks which means that sentences or an entire paragraph need to be rewritten. If tenses or wording have errors, I can directly revise them. When I see question marks, I don't know where they couldn't understand and I don't know how to revise. I didn't ask them. I just tried to fix these by myself." (interview transcript, June, 2016)

One possible reason why his advisors gave the journal paper different treatment from the dissertation is the journal paper was co-authored by the two advisors and him. Hence, his advisors had legitimated authority to use "totally different" words essentially rewriting parts of it. For his dissertation, they "just corrected some usage or grammatical errors. They corrected line by line". Zhi-Kai noticed that in the rewritten journal paper while his voice still existed, the language was entirely changed. This is shown in "The meaning was the same but words were totally different." The use of the word "totally" in "words were totally different" emphasizes the extent to which Zhi-Kai (as a struggling L2 English academic writer) was using language that did not measure up to language use as expected by his advisors (who are distinguished scholars in DS communities). Similarly, the word "but" in "The meaning was the same but words were totally different" emphasizes the contrast between his intended meaning (which was retained after his advisors' revision) and the English word choice suggested by his advisors (using more sophisticated English than his current level of competence). Although most of his advisors' feedback was generally useful, these data reveal that he was unable to interpret their expectations "When [he] [saw] question marks" without additional clarification. Figure 5.1 below demonstrates one such example of a lone-question-mark in the right margin.

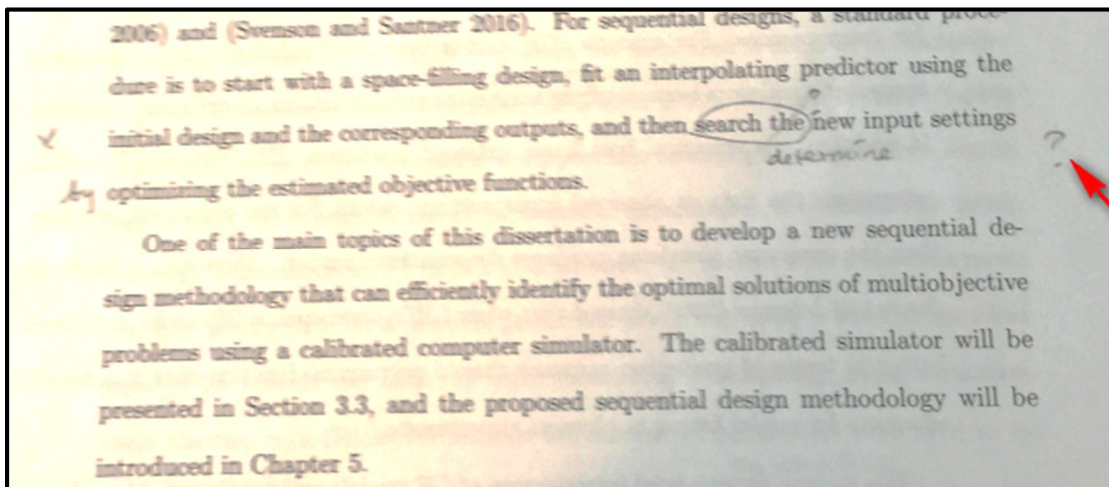


Figure 5.1 An Excerpt from Zhi-Kai's Dissertation Draft Showing a Floating Question Mark Annotation by His Advisors

Zhi-Kai stated that he was unable to interpret this question mark saying “I don't know where they couldn't understand and I don't know how to revise” although he “just tried to fix these [areas of question marks] by [himself]”. Even though previous data reveal a cordial relationship between him and his advisors, these data show that as an L2 speaker of English he struggled to understand his advisors' expectations. As a result, his academic acculturation processes were characterized by complex instances of understandings and misunderstandings which shaped how he mastered English academic writing.

5.4 Zhi-Kai's Use of Technologies for Academic Acculturation

One of the strategies that Zhi-Kai employed to resolve some of his academic difficulties is through utilizing various forms of technology. Table 5.3 visualizes his self-reported frequency (partial data) of employing some significant technologies for

academic purposes over a 14-week duration. The technologies he often utilized include academic search engines, statistical analytical software, online lexical resources, online social interactional technologies, document preparation and presentation software, and citation software. The 14-week self-reported technology use further indicates that academic search engines were the highest frequency-use (180 times). This is followed by the use of online lexical resources (90 times) and statistical analytical software (67 times). The lowest frequency-use was Microsoft word processor followed by the use of citation software. Taken together, the use of academic search engines, online lexical sources, and statistical analytical software were instrumental in Zhi-Kai's direct academic acculturation processes in DS communities. The use of Microsoft word processor was minimal because he was using LaTeX which has superior capabilities in word processing among other functions. Most of his use of these technologies occurred in L2 English. One visible exception is when he used Google Translate between L1 Chinese and L2 English.

Broad Categories of Technologies	Specific Technologies Used	Approximate Frequency /14 weeks	Uses
Academic Search Engines	Google Search Engine	180	<ol style="list-style-type: none"> 1) Searched for scholarly papers 2) Searched for MATLAB's functions and codes 3) Searched for some LaTeX's functions and symbols 4) Searched for R functions 5) Searched for statistical distributions and mathematical proof
	Google Scholar	20	➤ Searched for scholarly papers and their reference lists
	School Library Search Engine	22	<ol style="list-style-type: none"> 1) Downloaded papers 2) Searched for books 3) Requested books from other libraries
Document Preparation & Presentation Software	LaTeX	35	<ol style="list-style-type: none"> 1) Wrote and edited meeting notes 2) Wrote the dissertation 3) Made slides for conferences or other academic purposes
	Microsoft Word	4	<ol style="list-style-type: none"> 1) Made meeting notes 2) Made a report
Statistical Analytical Software	MATLAB	35	<ol style="list-style-type: none"> 1) Analyzed statistical data (GRA project) 2) Ran dissertation simulations 3) Wrote statistical programs for his dissertation 4) Revised statistical programs 5) Made statistical plots 6) Made figures for slides
	R	5	<ol style="list-style-type: none"> 1) Wrote statistical programs 2) Did statistical analysis
	GAP	10	➤ Did statistical analysis

Continued

Table 5.3 Zhi-Kai's Self-reported 14-week Weekly Journals of His Technology Use for Academic Purposes

Table 5.3 continued

Broad Categories of Technologies	Specific Technologies Used	Approximate Frequency /14 weeks	Uses
	Microsoft Excel	5	(Used to supplement other statistical software) 1) Cleaned data (GRA project) 2) Made a table 3) Organized data
	School Server (FTP (FileZilla) vSSH)	12	(Used to supplement other statistical software) 1) Uploaded MATLAB script and code to advisors 2) Ran large simulations
Online Lexical Resources	Google dictionary	75	1) Looked up unfamiliar vocabulary 2) Searched for word usage
	Google Translate	15	➤ Translated some medical words from English to Chinese to help him read GRA papers
Citation Software	Mendeley	12	1) Organized scholarly references 2) Generated bibliographies
Online Social Interactional Technologies	AT&T Connect Online Meeting	14	➤ Made conference calls with his advisors and collaborative project partners (GRA project). They used the screen-share function to collaboratively access documents and a desk phone to talk.
	Email	5	➤ Communicated with GRA project collaborators, a post-doc collaborator, and his advisors
	Phone	2	➤ Made two conference calls with GRA project collaborators
	Skype	3	➤ Dissertation meetings with his advisors

5.4.1 Academic search engines.

Zhi-Kai employed search engines mainly for academic purposes and more specifically he utilized them to fulfill academic purposes, such as searching for academic papers and information on statistical analytical software's functions and codes. His use of academic search engines was entwined with the understanding of statistical analytical software. Google search engine was an indispensable technology in his academic acculturation processes. Notably, some technologies were institutionally-provided and others were individually-sourced. That is, the school library search engine was provided by the university, whereas Google and Google Scholar emanated from his personal effort in engaging in academic research. He described his use of Google Scholar as supplementing his use of the institutionally provided school library search engine as follows:

“I always use Google Scholar to search papers first. After I decided which papers I want, I go to the school library to download them. The search function of Google Scholar is very good and convenient. The school library search engine is only used for downloading papers.” (interview transcript, July, 2015)

Further, he described his use of Google and Google Scholar saying:

“I use Google to perform a general search of concepts, terminologies, or words, such as ‘calibration computer example’. After searching via Google, I may find some information on academic papers which I am looking for. Then, I will use Google Scholar to search for these papers. Hence, Google Scholar is used for specific searches.” (interview transcript, June, 2015)

One notable affordance of Google Scholar is its capacity to identify citation counts for scholarly articles. Zhi-Kai had a preference for highly cited articles which he read before turning to the other less cited ones:

“Sometimes I found some interesting references in a paper that I was reading. Then, I would go to Google Scholar to look for those references. Sometimes I set up the ranking system while searching for papers in Google Scholar and then start to read papers from higher citation numbers. I read their titles first to see whether they are what I want or related to my dissertation...I usually will read all web pages Google Scholar generated in case those are related to my dissertation.” (interview transcript, July, 2015)

These data show that his key strategy was to identify and read scholarly papers based on their citation counts and relevant to his dissertation. The main highlights of his strategies are to 1) read all web pages to find papers of interest, 2) look for “some interesting references”, 3) determine citation counts for these references through “set[ing] up the ranking system” in Google Scholar, 4) read the title of an article “to see whether they are what I want”, and 5) read selected articles. Reading references in a scholarly paper is a useful approach in visualizing sources for further reading in order to ground his understanding in disciplinary conversations. Nonetheless, these strategies mainly rely on Google Scholar to supply an inventory of scholarship and citation counts which might be problematic if Google Scholar has missing entries or erroneous citation counts.

In addition, he heavily depended on Google to research on speakers and scholars before attending conferences. This approach is beneficial for accessing scholars and the scholarship that are related to his areas of interests which allowed him to constructively engage with the wider scholarship:

“I’ll Google the researchers to see whether they’ve papers or not. Then, I’ll read their papers to double check whether their topics are related to my study. If they don’t have papers, then, I’ll attend their sections to find out what exact research they did. Sometimes the titles of conference papers sounded as if they were related to my study but after attending their sessions I found what they did was different.” (interview transcript, August, 2015)

Furthermore, he also employed his laptop and Google search engine to connect some content of some scholars’ speeches with his own dissertation research:

“...if I hear some interesting topics, I’ll take out my laptop and immediately Google them, especially topics related to my dissertation and papers. For example, if speakers talk about research topic ‘A’, I find if my study has any connection or it’ll continue developing and later merge with ‘A’. Then, I’ll Google it to see whether someone did the similar research or not.” (interview transcript, August, 2015)

As illustrated by these data, a laptop and the internet-based Google function enhanced his participation in DS communities through identifying scholarly links between his

research and other scholarship. He, therefore, looked for “topics related to [his] dissertation and papers” while envisioning the trajectory of his research for possible future connections with other scholarship. This is seen in “[his study] will continue developing and later merge with ‘A’”. Thus, these approaches in the use of academic search engines indicate that Zhi-Kai purposefully attended conferences to maximize on engaging in scholarly conversations.

In addition to enhancing disciplinary participation, he also utilized Google to search for scholarly papers to comprehend academic concepts:

“For example, a paper mentioned many terms, but I just roughly know them. I don’t know the meanings behind these terms. So, in order to understand the paper, I search for these terms through using Google which generated several papers that introduced these terms. Or, I Google the terms and then Google generated a link to Wikipedia. Then, I look at Wikipedia. Currently, I don’t have too many terms I don’t know when reading an academic paper, especially related to my dissertation.” (interview transcript, June, 2015)

Google’s capacity to generate millions of sources including academic texts allows him to see how scholars explained and used research-related terms. More specifically, this approach facilitates a contextualized understanding of scholarly terms. By his own assessment, Zhi-Kai argued that this approach was advantageous because he did not “have too many terms [he doesn’t] know when reading an academic paper” which demonstrates his continuing acquisition of important concepts and knowledge in the field of statistics.

At the start of his doctoral program, when he encountered difficulties in comprehending math assignments, sometimes he would initially tap into peer-to-peer support. When this failed, he either consulted relevant textbooks or turned to Google:

“I would go online to search for papers or online sources to help me answer math questions because some questions were actually simplified from academic papers. In fact, I often used Google more than textbooks to search for this information. Also, I sometimes searched for answers by watching teaching videos hosted on my previous master’s advisor’s website.” (interview transcript, July 4, 2015)

When he said “some questions were actually simplified from academic papers”, he meant that the subject content of the assignment was generally at a simple level than the subject content covered in the scholarly papers he was reading. Reading these papers, therefore, gives him a capacity to engage with his assignments which were comparatively simpler. These data also show an enduring relationship between him and his previous master’s advisor. Although he was in the doctoral program in the U.S., he reported that he “sometimes searched for answers by watching teaching videos hosted on [his] previous master’s advisor’s website.” Overall, watching these videos illustrates how overtime he accumulated resources which he continued to draw upon as he proceeded along his doctoral academic acculturation processes. These resources include previously used websites and online resources seen when he said: “I sometimes searched for answers by watching teaching videos hosted on my previous master’s advisor’s website”. These also include prior learned academic concepts shown in “Currently, I don’t have too many terms I don’t know when reading an academic paper, especially related to my dissertation.” Another example of these accumulating resources is L2 English competence and academic practices for researching and writing. Cumulatively, these resources are beneficial during his socialization into the present DS discipline.

5.4.2 Online lexical resources.

Multiple data reveal the prominence of online lexical resources in various strategies employed by Zhi-Kai to compensate for his insufficient L2 English competence. Collectively, these data establish the following points:

- A. An online dictionary is an important companion in his emailing process in the early doctoral years. This improved somewhat over time.

- B. As he struggled to learn about paraphrasing and word choice, the use of Google dictionary (see Supplement 5-3) is an essential part of his academic writing process. It is also instrumental in re-wording ideas.
- C. Google Translate serves as an important site to help him navigate between unfamiliar L2 English medical terms and the more familiar L1 Chinese translation.

Although Table 5.3 does not show the use of online lexical resources as having the highest frequency, navigating between L1 Chinese to L2 English language formed a significant hurdle in his academic acculturation. For instance, L1 Chinese employs a markedly different orthography from L2 English.

According to interview data, Zhi-Kai started with low self-confidence about his English proficiency which led him to labor over tasks, such as email writing in English, in his early doctoral years:

“At the beginning of studying in the Ph.D., when I wrote a simple email to my advisors, it probably took me around one to two hours to finish the email. While writing it, I was looking up words in an online dictionary and thinking about which sentence structure I should use and kept changing words and sentences. Now, I write emails to advisors faster than before. I still need to spend time on thinking about what and how to write but won’t look up words and spend one to two hours on writing emails.” (interview transcript, July, 2015)

The use of an online dictionary serves as a tool for “thinking about which sentence structure [he] should use and [for] changing words and sentences”. Additionally, the difference between “it probably took me around one to two hours to finish the email” and “I still need to spend time on thinking about what and how to write but won’t look up words and spend one to two hours” shows that he might have increased his confidence in writing emails in English. This improvement was stated explicitly in “Now, I write emails to advisors faster than before”. This improvement might also be explained by his increasing familiarity with his advisors.

However, Supplement 5-6 shows an email written by Zhi-Kai in response to one of his advisors where his writing difficulties become visible. A close scrutiny of this email reveals three issues with regard to his capacity to write an email in English. These are genre-related structural difficulties in email writing, inaccurate syntax construction, and unclear semantic structure. Zhi-Kai copied the question “Can you delete (2.4.7) without losing anything?” which had been asked by his advisor in a previous email. This question was not incorporated seamlessly in his email response and was, therefore, left to float above his actual response. He used the green color font to present this question which signifies its separation from the rest of content. If he had internalized his advisor’s question, his response would have been *Yes, I will delete 2.4.7. Deleting it will not influence the content because I never used this formula again*. However, he wrote, “Yes, because I never used this formula again”. This shows that he had trouble employing correct English sentence structures. Thus, the use of “Yes, because....” demonstrates a reliance on a Chinese sentence structure. In Chinese, this sentence might have been as 是的，因為我沒有再用這個公式了 (direct translation from Chinese: Yes, because I never used this written formula anymore.) At the end of the email, he made an implicit appeal to his advisor for further guidance saying “I keep assuming it must be right but it is not. Although I still don’t know where it is wrong now, I will definitely try to figure it out.” This appeal could be confusing or unclear to his advisor because within it he said that he continuously assumed that the subject matter was right and added an imperative statement “it is not”. This is followed by an admission that “I still don’t know where it is wrong now” together with a pledge to “definitely try to figure it out”. Taken together, it is unclear whether he needed help, was confused, or would solve the matter independently. It is possible that Zhi-Kai was influenced by his Taiwanese

culture to not ask for help directly, but to give hints. In Taiwanese culture, when asking for support from others, there is a tendency to describe one's current predicament followed by an assumption that interlocutors would spontaneously offer support. What arises is an implicit request for support that is pragmatically suited to not put interlocutors on the spot while maintaining a cordial relationship.

Additionally, when writing lab meeting notes, he tended to focus less on grammatical accuracy than when writing his dissertation:

“Each week I have a lab meeting. For meeting notes, I don't care about usage and grammar. As long as they [his advisors] understand my writing, that's enough. For my dissertation, I care about usage and grammar. Sometimes I copy some sentences from scholarly works and don't want to write my sentences similar to their sentences so I will Google synonyms to change the original sentences.” (interview transcript, June, 2015)

Although he employed Google dictionary to find synonyms (see Supplement 5-3) in his dissertation writing process, there are a few potential drawbacks to this approach. Google synonyms do not always supply words that fit appropriately within the context of particular sentences. They are also based on general English grammatical use which sometimes differs from discipline-specific word usage. Figure 5.2 exemplifies a sentence from his dissertation draft and feedback from his advisors. In the original sentence, he wrote “many physical experiments which cannot be operated practically can only be implemented ...” and his advisors suggested to replace “experiments” with “systems” and “operated practically can only be implemented” with “explored by direct experimentation”. Google synonyms might supply him with “experiments”, but, in this case, his advisors thought that “systems” worked better in the context.

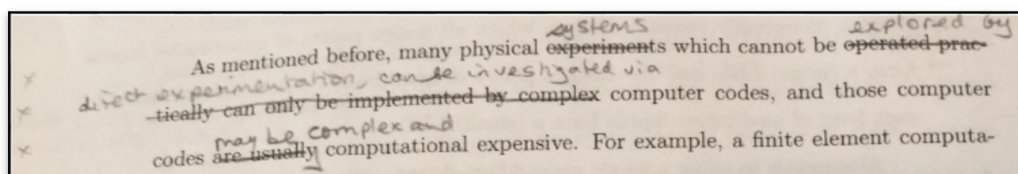


Figure 5.2 Excerpt from Zhi-Kai's Dissertation Showing His Advisors' Writing Feedback

Additional data show his use of Google dictionary is also prominent when he wrote various academic genres, such as conference proposals and journal articles, to check English use and accuracy. Multiple data also reveal that Google and Google Translate are vital tools in his navigation across linguistic resources. His 14-week weekly journals (see Table 5.3) show that he utilized Google Translate to look up unfamiliar words. Visual data disclose that he either directly typed Chinese or English words in Google search engine which generated simplified interface of Google Translate (see Supplement 5-4) or directly went to the web page of Google Translate (see Supplement 5-5) to type Chinese or English words:

“The collaborators gave us articles related to human organs and man-made knees. There’re lots of vocabularies I couldn’t understand so I use Google Translate to check those words. I just want to know their Chinese meanings but not usage so using Google Translate is faster than using other online dictionaries. If I want to know how to use certain words, I probably will use online dictionaries. In fact, I rarely use online dictionaries. I usually use Google. After typing a word, Google will provide links to many words. [Supplement 5-3]. But for collaborators’ articles, I just wanted to know their Chinese meanings. Using online dictionaries is very frustrating. When using Google Translate for reading collaborators’ articles, I typed all English vocabulary on one column and it translated them into Chinese in the other column. Then, I printed it out to read. I get used to printing out papers. I don’t have the habit to read on a computer.” (interview transcript, July, 2015)

According to these data, Zhi-Kai developed a capacity for comparing the efficiency of various technologies as seen in “Google Translate is faster than using other online dictionaries.” Moreover, he mastered specific applications of these technologies as shown in “After typing a word, Google will provide links to many words.” The above data also reveal his preference for using Google Translate over online dictionaries when he read research collaborators’ medical-related academic texts. He reported that it was comparatively more difficult to use online dictionaries than Google Translate as proved by “Using online dictionaries is very frustrating.” Through an online dictionary, he could only search for one medical term at a time. Additionally, since medical terms he was looking for were all in English, the search

results, including explanations, were also all in English. Nevertheless, through Google Translate, he could type a list of several medical terms in English, specify that the translation was done in L1 Chinese, and then search for all of these terms at once (see Supplement 5-2). Hence, he did not need to process English-to-English when trying to understand unfamiliar medical words because Google Translate assembled an inventory of unfamiliar medical terms and their Chinese equivalent which he printed out to read. This is seen in “[He doesn’t] have the habit to read on a computer.” The wider data disclose that over time he formed a habit of printing out and reading scholarly materials as supposed to reading them digitally.

In addition to using Google Translate to comprehend unfamiliar medical terms, he formed a habit of checking for English translations or equivalents through directly typing Chinese words in Google search engine. The search results yielded various links but important to Zhi-Kai was the box at the top of the web page (see Supplement 5-4) where the English term that he was looking for was presented. This box is from Google Translate. Supplement 5-4 shows that he had the option of exploring more translation search results through clicking on an arrow to either show “4 more translation” or “show less”. The data below also reveal that he utilized Google search engine to understand grammatical and punctuation use:

“I often use Google Translate to check vocabulary because its interface is simple and easy to use. I type a Chinese word and an English translation will come out. I’m lazy to use online dictionaries. I just directly use Google and then type Chinese. If I don’t know how to use certain grammar, I also use Google to find them out. For example, I don’t know whether there is a comma after the word ‘which’. I will Google its grammar. Google is very convenient.” (interview transcript, July, 2015)

These data reveal that two significant phenomena of using Google search engine to look for vocabulary, grammar, and punctuation for Zhi-Kai. First, he found the use of Google Translate through Google search engine simple and convenient to use, especially when looking up vocabulary as seen in “its interface is simple and easy to

use. I type a Chinese word and an English translation will come out.” Although looking up vocabulary via Google search engine is convenient, it is problematic to only count on the translation that Google Translate generated because it does not provide further descriptions of the translations of the English words and no examples of their usage. Therefore, it is possible that the translation might not fit the context that he was writing. He stated that “I’m lazy to use online dictionaries. I just directly use Google and then type Chinese” which indicates this reliance. Second, he utilized Google search engine to help him understand certain grammatical and punctuation rules. There is, however, uncertainty regarding how he decided which sources would provide the most accurate search results from the abundant online sources.

Overall, the use of technological lexical resources is a central feature of his navigation between L1 Chinese and L2 English in his effort to overcome language barriers while acculturating to the Western academic culture and DS communities.

5.4.3 Statistical analytical software.

The use of technologies in the form of statistical analytical software is a significant feature of Zhi-Kai’ academic acculturation because of the nature of his discipline. As a doctoral student in the Department of Statistics, research and the use of software for analyzing quantitative statistics are required. As evidenced by the data, he mainly used MATLAB, R, and GAP statistical analytical software for various academic projects. His other uses of computer technologies, which is in the wider data but did not come up in the data in this dissertation, consist of Microsoft Excel, Microsoft PowerPoint, and the school server. Field notes disclose that the DS provided an introductory course on the use of SAS statistical analytical software, and over time faculty in DS developed a tradition of using R statistical analytical software.

Nonetheless, data show that Zhi-Kai had the preference for utilizing MATLAB. In addition, multiple data reveal that he frequently employed varied software to assist him in cleaning and analyzing data, running statistical program tests, uploading data and self-designed statistical programs, and making diagrams for different research projects. These projects include his dissertation, GRA research, collaborative research with scholars from different academic disciplines, and one of his advisors' book project.

To begin with, although he did not take any courses or attend workshops about the operation of MATLAB, he employed it for various data analyses. He relied on online sources to teach him how to operate the program:

“I use MATLAB to do many things related to statistical data. I didn't learn how to run it from courses or training. When I don't know how to use it to program, I'll Google its functions and codes. Even if I take MATLAB courses, I'll still forget some functions. There're thousands of ways to use it. So, when I need to use some functions, I'll Google them. Most of the time I use MATLAB to analyze my dissertation data. Every week I more or less Google MATLAB functions.” (interview transcript, July, 2015)

His use of MATLAB is characterized by a learning-on-the-job approach where he employed Google whenever he “need[ed] to use some functions”. In this way, the conjoined use of Google search engine and MATLAB is a feature of his data analysis since he turned to Google whenever he needed to learn about MATLAB functions and codes. This is seen in “When I don't know how to use it to program, I'll Google its functions and codes...” Google is also resourceful in helping him to recall MATLAB functions and codes as shown in “Even if I take MATLAB courses, I'll still forget some functions.” MATLAB is important statistical analytical software in Zhi-Kai's disciplinary learning. His use of MATLAB entails analyzing statistical data, running statistical program tests, and making statistical plots:

“My advisors' research projects [GRA projects] are more analytical so the use of statistical software to analyze those data is much easier. I just run the simple analysis. For my own [dissertation] data, it's more difficult to write a

program...I am developing a new statistical method so I need to run many simulations to see whether my method is better than traditional methods. I use MATLAB to run these simulations. Every day I write the program and then run simulations in MATLAB.” (interview transcript, July, 2015)

In his dissertation, he was trying to make a breakthrough in the traditional statistical analysis. MATLAB is the place where he ran simulations in order to “[develop] a new statistical method”. These efforts cohere with his definition of successful academic acculturation presented in an earlier section whereby he “develop[ed] new and useful statistical analysis” (interview transcript, July, 2015). The DS did not provide courses or training in employing MATLAB. He knew this program because of the influenced of one of his current doctoral advisors who used it:

“My advisor who uses it didn’t teach me how to use it. We only discuss logical concepts of programs, but for details of how to program I learned them from online. Since my advisor is older, usually I teach him how to program. He would discuss how to do it in terms of theories, but he doesn’t know how to write programs.” (interview transcript, June, 2015)

It is possible that his advisor might have been using MATLAB without a deeper understanding of programming functions. Zhi-Kai tried to learn how to operate MATLAB online while providing technical support for his advisor is seen in “usually I teach him how to program”. He was concurrently a novice as seen in “I learn them from online” and an expert in the use of MATLAB for statistical analysis as shown in “usually I teach him how to program”.

Given DS mainly used R program in class examples, Zhi-Kai brought his expertise whereby he used R during his master’s study in Taiwan. A possible reason for the lack of introductory courses to MATLAB is that his department emphasized more on SAS and R than other statistical programs. Field notes reveal that although the DS provided an SAS introductory course, in multiple data, Zhi-Kai never mentioned the use of this statistical software. Also, there was no course, workshop, and information on the use of R statistical software. Nevertheless, knowing how to employ R seems to be implicitly expected by DS professors as stated below:

“MATLAB is more often used by engineers whereas R is specially used by statisticians. The [DS] academy prefers to use R so in class many professors give examples that are written in R. Especially professors in my current program, 50% of the examples given in class are written in R. However, I didn’t learn how to use R here. I started to use R when studying in Taiwan.” (interview transcript, June, 2015)

Even though DS offered explicit courses in the use of SAS, the department appears a tradition where using R statistical software is prevalent. This prevalence was estimated at “50% of the examples given in class are written in R”. When he said “I started to use R when studying in Taiwan”, it shows that he tapped into past learning from his master’s program to adjust to the current doctoral academic context. As indicated in Table 5.2 describing characteristics of DS, there was limited technical support within this department which could have led him to use Google as a source of technical guidance in mastering MATLAB.

Besides MATLAB and R, he also knew how to use other statistical analytical software, GAP, which was developed by his prior supervisor in the research organization in Taiwan:

“Recently, I use GAP to analyze statistical data for my personal collaborative biological research project. I use it not other statistical software because it’s able to produce some complicated diagrams that other statistical software cannot easily produce. When being a research consultant in the previous research organization, I learned some things so I know GAP fits better for biological data. The collaborator is going to publish her article and my name will be put it there.” (interview transcript, August, 2015)

These data reveal that he possessed knowledge and competence in utilizing different statistical software (MATLAB, R and GAP) to achieve his academic goals. In addition, these data show that his previous research job experience exposed him to statistical programs, such as GAP, which he brought to the current context as seen in “When being a research consultant in the previous research organization, I learned some things so I know GAP fits better for biological data.” Thus, prior exposure enables him to smoothly navigate between language that could be read by R and by

MATLAB. His competence of navigating different statistical analytical software can be seen through his work on “language that MATLA can read” in his dissertation:

“Recently, I am revising a program which was written in R by one of my departmental professors. He has one program is very similar to mine, but he wrote it in R so I’m revising it to language that MATLAB can read. It’s a part of a major program for my dissertation.” (interview transcript, June, 2015)
His capability of navigating between different statistical analytical software as shown

in the data above had received uptake by one of his advisors. In additional interview data, he reported that “One of my advisors who developed some programs is going to publish a book. I helped him to debug his programs because there were some mistakes. He will put my name in his book” (interview transcript, July, 2015).

On the whole, data in this section illustrate Zhi-Kai’s use of statistical analytical technologies during his acculturation to DS academic communities. This use includes GRA collaborative projects, dissertation writing, his advisor’s book project, and collaborative projects with a peer-collaborator in addition to offering technical support to one of his advisors who used MATLAB. An important feature of this use includes bringing his previous experience (with MATLAB, R, and GAP from his master’s program and the research job) to bear in his current doctoral learning context. He navigated between being a novice who learned about these technologies and an expert who had a capacity to teach about aspects, such as programming. The nature of DS necessitates the use of SAS and R statistical analytical software, but these data reveal that Zhi-Kai went beyond these by employing additional statistical analytical software, such as MATLAB and GAP.

5.4.4 Online social interactional technologies.

Additionally, Zhi-Kai employed various online social interactional technologies, such as email, Skype, Facebook, PTT (a famous online Taiwanese university

discussion forum), Google Talk, Line, AT&T Connect, and a phone. Even though his self-report in Table 5.3 did not feature Facebook and PTT, interview data show that these were his most commonly used online social interactional technologies. He utilized all of these online social interactional technologies to interact with his advisors, research collaborators, previous master's peers, present doctoral program's peers, and scholars outside of the school. When interacting through PTT, Facebook, and Google Talk, he mainly employed L1 Chinese. When interacting through email, AT&T Connect, Skype, and a phone, he mainly utilized L2 English to communicate with his advisors and GRA research collaborators.

To begin with, data disclose that his use of some of these technologies derives from his prior habit of utilizing them in Taiwan. For example, he described his use of PTT as follows:

“When studying in college, I went to the PTT’s statistical discussion board more frequently to ask questions. After studying in the master’s program, I gradually didn’t ask questions because my questions became more difficult and a few people could answer them. So, I went there to answer someone’s statistical questions. Even now if I’ve time, I’ll go there to answer questions. Most questions are asked by students who don’t major in statistics so their questions are much easier than my own questions. Sometimes I spend lots of time on reading posts on the statistical board in PTT and post in Hwa-Fan group [pseudonym for this closed discussion group comprising of his peers in his previous master’s program] on Facebook. If I’ve time, I’ll answer their questions, especially when I’m stuck in writing my dissertation. Since sometimes I couldn’t figure out my own statistical problems, answering others’ statistical questions and teaching them to make me feel a sense of accomplishment.” (interview transcript, July, 2015)

These data reveal that he positioned himself as a novice seeking statistical help and an expert answering other’s questions as shown in “I went to the PTT’s statistical discussion board more frequently to ask questions” and “I went there to answer someone’s statistical questions” respectively. Through answering other people’s statistical questions, Zhi-Kai developed his scholarly persona and confidence in statistics as seen in “answering others’ statistical questions and teaching them to make

me feel a sense of accomplishment.” Spending “lots of time on reading posts on the statistical board in PTT and posts in Hwa-Fan group” is a significant component of his gradual development of accomplishment. The Facebook-based Hwa-Fan group provided him a dedicated membership that reciprocated questions and answered around statistics:

“If we face questions about statistics, we’ll post questions there and whoever knows the answers will reply to the posts. We help each other. For example, I helped one of my collaborators who is doing research about microorganisms to analyze her data. I’m not specialized in that area, but I know some of my MA’s peers do it so I posted my questions on the Facebook group to see their suggestions. Sometimes I also answer their questions.” (interview transcript, July, 2015)

In the data above, when he said “I helped one of my collaborators who is doing research about microorganisms to analyze her data”, this collaborator was his peer from a different department in the same institution and was not a member of Hwa-Fan group. Since Zhi-Kai was not an expert in microorganisms, he used this group on the collaborator’s behalf by posting his “questions on the Facebook group to see their suggestions”. These data reveal reciprocity among Hwa-Fan members in “We help each other” and “I posted my questions in the Facebook group to see their suggestions. Sometimes I also answer their questions.” Notably, the membership of Hwa-Fan group is Taiwanese, and the language they used is mainly Chinese.

In addition to Hwa-Fan and PTT group membership, he also participated in two other online-based groups: 1) a statistical specialized group called “R group” on Facebook which was formed by his master’s peers and 2) a general-purpose group called “Taiwanese student association” which was formed by Taiwanese students studying in the university where Zhi-Kai studied in the doctoral program. Although the Taiwanese association offered general information about living and studying in the U.S., these two online groups provided further channels for him to obtain information about statistics and publications:

“...my previous classmates formed a group called ‘R group’ on Facebook. This group has weekly face-to-face meetings. They record their weekly meetings and then post the videos in the R group on Facebook. They introduce how to use R statistical software. They teach many new packages that I never heard and used before. Some are very interesting.” (interview transcript, July, 2015)

The R statistical analytical software was implicitly required by the department because most class-based examples of statistical questions were written in R. The R group on Facebook is a peer-resource network allowing members to discuss the operation of this software. To do this, “they record their weekly meetings and then post the videos in the R group on Facebook”. This group offers a wealth of learning as seen in “They teach many new packages that I never heard and used before.” Thus, through participation in this kind of online groups, Zhi-Kai continued to learn various useful academic skills. One such skill was the use of Mendeley citation software. More specially, this software helped him simplify the process of writing citations and references:

“I started to use Mendeley a half year ago. I heard it from Hwa-Fan group formed by my previous master’s peers on Facebook. Someone recommended this software [through a post]. I use it to organize my literature review. After downloading academic articles, I dragged those PDFs to Mendeley and then it would automatically generate citations and bibliographies. Otherwise, I need to type references one by one. I did it at the beginning when I didn’t know Mendeley.” (interview transcript, June, 2015)

These data give evidence of his state before and after learning Mendeley in “I need to type references one by one. I did it at the beginning when I didn’t know Mendeley.” Zhi-Kai derived direct benefit in utilizing Mendeley to organize his literature review. Moreover, participation in these groups through online social interactional technologies is beneficial because it broadened his knowledge of statistics, publications, and some useful technologies used for academic purposes, such as R statistical analytical software and Mendeley citation software.

Notably, the technological infrastructure that supports this peer-to-peer connection shapes the kinds of activities that members can engage in. Data reveal this influence

of technologies on group activities when Zhi-Kai communicated with his doctoral peers, especially before his candidacy exam. He employed QQ (communication software developed by a company in China) and email to discuss academic questions. Interview data reveal that around 60 percent of doctoral students, who enrolled in DS in 2011 when Zhi-Kai started the program, were international students. Most of these students came from China. QQ is a fashionable communication software used by students from China. Chinese is the main language of communication. Zhi-Kai who was the only Taiwanese student in his program adopted QQ at the beginning of his doctoral study to communicate with this group of students:

“In my first doctoral year, I used QQ with my peers from China to share our assignments or documents via taking pictures of our assignment or documents. After the first year, I rarely use it.” (interview transcript, July, 2015)

This software is particularly convenient because it is installed on a cell phone meaning it is readily available and mobile. QQ has a capacity to send text messages, record and send audio and video files, take and send pictures among other functions. Through the use of QQ, Zhi-Kai and his peers were able to “tak[e] pictures of [their] assignment or documents” and share. These data also offer evidence of a peer-to-peer network that focused on particular needs was discontinued afterwards. When he said “After the first year, I rarely use it”, this suggested that the QQ-based group addressed his needs during his “first doctoral year”. This QQ group can, therefore, be described as a peer-to-peer, purpose-orientated, and short-lived online networking resource for Chinese-speaking doctoral students who were in DS.

In addition to QQ, he also employed email as a first step to consult with his peers in the doctoral program if he had questions, especially when he was unavailable on campus. Other steps included making an appointment and face-to-face discussions:

“I don’t come to the campus so often. I often email my peers first if I’ve questions I want to ask them. If the questions are urgent, I’ll go to school ...When we discuss academic issues, email is the first step to roughly know

what our questions are and then we go to find answers. If we need to discuss, it's more convenient to discuss face-to-face. For example, when preparing for our qualifying exams, we would ask each other which questions we had via email. Then, we made an appointment in an email and then discussed the questions face-to-face...." (interview transcript, July, 2015)

These steps are useful for Zhi-Kai and his peers as they prepared for qualifying exams as seen in "when preparing for our qualifying exams, we would ask each other which questions we had via email. Then, we made an appointment ... and then discussed the questions face-to-face". Emailing serves a number of functions including exploration and clarification in "we would ask each other which questions we had via email".

Other functions are group-organization in "we made an appointment in an email" and individual expression of needs in "I often email my peers first if I've questions".

Though emails are useful in these ways, face-to-face is preferable as seen in "If we need to discuss, it's more convenient to discuss face-to-face". It is possible that face-to-face interactions enable him and his peers to have discussions in a more comprehensive manner which is difficult and inefficient to discuss in emails.

Emailing is also an effective tool for him to interact with and obtain support from students and scholars outside of the school:

"Sometimes, at statistical conferences, I met doctoral students. I'd email them to have discussions of statistical issues after the conference... At a conference, I met a Canadian professor whose research is close to mine and he was interested in my research so we exchanged our email addresses. At the conference, I mentioned about problems I was facing and he suggested that I read an academic article which talked about how to deal with those problems. So, he sent me the paper via email. We also shared our codes to each other. I read the article and felt the researcher's method is very good so I adopted it in my dissertation." (interview transcript, June, 2015)

In his effort to acculturate to the DS communities, Zhi-Kai tactfully employed email to form support networks that reached beyond his institution. On one hand, he reached out to doctoral students in other institutions by "email[ing] them to have discussions of statistical issues after the conference." On the other hand, he identified faculty from other institutions with whom he had academic engagements. One example is the

Canadian professor whose research was close to his and “[the professor] was interested in [his] research”. These data show reciprocity between him and this professor in “I mentioned about problems I was facing and he suggested that I read an academic article which talked about how to deal with those problems” and “We also shared our codes to each other”. By sharing codes, Zhi-Kai meant he was able to help this professor by supplying information about how to code for achieving certain statistical analytical results. He was, therefore, not only a novice but also a new scholar with emerging expertise.

He also utilized email to compensate for limitations of face-to-face communication and for his advisors’ physical unavailability at meetings:

“My advisors and I often use email to communicate with each other, especially for GRA projects. We use email because my advisors are retired and only come to the campus two or three days... For reading, I actually prefer that my advisors write down their questions so I can go back to slowly read and respond one by one. Sometimes I’m not sure what they ask me to do. Then, I would email them to double-check. In that situation, I prefer to email.”
(interview transcript, July, 2015)

As an L2 speaker, Zhi-Kai found that emailing was a useful technology for capturing his advisors’ questions in written form which gave him time to “go back to slowly read and respond one by one. He also employed emails for clarification as seen in “Sometimes I’m not sure what they ask me to do. Then, I would email them to double-check.” The use of email in this case is perhaps preferable because, as opposed to face-to-face interaction, emailing generates a written record which he could return to. It is possible that this feature of emailing presents him opportunities to think and organize his thoughts, slowly respond to questions, and check an online dictionary while writing email.

Additionally, sometimes he and his advisors adopted synchronous communication via Skype when one of his advisors or himself was not in the U.S. When they Skype, they usually only used the audio function:

“If I go back to Taiwan for a break, I’ll use Skype to have meetings with my two advisors so the calls will become three-way. Comparing to face-to-face talks, there is a big difference. I prefer to face-to-face.” (interview transcript, July, 2015)

Although utilizing Skype is convenient for him and his advisors to call in from different places, he did not prefer such synchronous online communication. It is possible that synchronous communication with only audio function does not allow him to get contextual cues that face-to-face interaction would have. These contextual cues include facial expressions and gestures.

Zhi-Kai also reported that when he and his advisors had online meetings with one of their collaborators, they employed AT&T Connect (online communication software):

“Every week, we use AT&T Connect, which was paid by the collaborator, to share each other’s screen so every time when he was talking, we could see his PowerPoint or documents. The screen share function doesn’t show faces but the slides or documents. Then, we speak to them via calling them through a phone. If we use AT&T Connect to call, sometimes the voice is intermittent and cannot be heard very clearly. Sometimes the call is three or four ways, and sometimes I couldn’t understand what they said when they spoke at the same time and when I should speak. I feel face-to-face talking would be better for me to understand their talking and to see their facial expressions.” (interview transcript, June, 2015)

These data raise points, such as the formation of academic networks and reaching beyond the institution. An important piece of background information to this AT&T Connect conversation is Zhi-Kai was employed by a hospital (which was a collaborating institution) through his advisors. This conversation focused on his GRA position to statistically analyze the collaborator’s data. Also, notably, this two or three-way online communication is sometimes constrained by the quality of AT&T Connect seen in “If we use AT&T Connect to call, sometimes the voice is intermittent and cannot be heard very clearly.” Nevertheless, he utilized a phone call to compensate for unclear voice which was AT&T Connect’s drawback. The use of a phone service to compensate for AT&T Connect’s low voice quality amounts to

compensation of functional inadequacy. While doing this, conversational turn-taking presents another challenge for Zhi-Kai, as an L2 speaker, as seen in “sometimes I couldn’t understand what they said when they spoke at the same time and when I should speak.” These data suggest that he struggled to comprehend not only L2 English but also clearly hear when interlocutors spoke simultaneously.

Taken together, Zhi-Kai’s different uses of online social interactional technologies are characterized by networking and reciprocity. Data show these through words and phrases, such as “I’ll answer their questions”, “We help each other”, “‘R group’ on Facebook”, “previous master’s peers”, “Someone recommend”, and “we would ask each other which questions we had via email”. Additionally, he used a multi-pronged approach in constructing online social networks. This approach includes belonging to several long-lasting (e.g., Hwa-Fan group, R group, and Taiwanese student association on Facebook) and short-lived (e.g., QQ) online networks. This approach also includes interacting with advisors and other scholars through more formal means, such as email and mainly using L2 English. When interacting with peers, he chose diverse online social interactional technologies (e.g., Facebook, and QQ) and interactions were mainly in L1 Chinese. Online social interactional technologies provide Zhi-Kai with a robust support network from previous master’s peers, current doctoral peers within and outside of his institution, and faculty within and outside of his institution. Some of these peer groups were constructed around language (e.g., Chinese speaking), nationalities (e.g., Taiwanese), and academic focus (e.g., a group on Facebook focusing on R statistical analytical software). Thus, these data reveal that Zhi-Kai navigated between L1 Chinese and L2 English language and culture. He also navigated the use of various technologies with different affordances as he employed online social interactional technologies for his academic acculturation. Importantly, in

a context characterized by dominant L2 English, prior language and cultural exposure are significant components in his academic acculturation processes.

5.5 The Relation between Zhi-Kai's Use of Technologies and His Definition of Successful Academic Acculturation

In the section of “Definition of successful academic acculturation”, Zhi-Kai indicated that successful academic acculturation entailed understanding expectations and navigating demands of western higher education, being an independent researcher, and being able to make contributions to one’s academic field. This success is determined by the following conditions: 1) feeling comfortable enough to discuss statistical research in English with anybody, 2) feeling comfortable enough to study under the U.S. educational system, 3) being able to independently formulate research problems and find solutions, 4) being able to develop new and useful statistical analysis, and 5) publishing papers and solidifying career prospects.

His use of technologies had a direct and indirect influence on his achievement of these conditions which in turn had a potential to enhance his academic acculturative experience. Data also reveal that his self-confidence is essential for his successful academic acculturation. Zhi-Kai reported having confidence “to discuss statistical research in English with anybody [face-to-face]” (interview transcript, June, 2015). Although he gave the self-confidence to discuss statistics in English as a condition for academic acculturative success, data show various instances where he succeeded and where he experienced challenges. For example, he discussed his dissertation and statistics-related research in English with students and scholars in other institutions through email. Employing asynchronous email communication enabled him, as an L2 English learner, to have time to organize his thoughts and plan what he wanted to

express in English. This advantage of employing email can be seen when he said: “I actually prefer that my advisors write down their questions so I can go back to slowly read and respond one by one” (interview transcript, July, 2015). Nevertheless, sometimes the quality of online social interactional technologies, such as AT&T Connect, Skype, and a phone, might constrain Zhi-Kai from easily hearing utterances and clearly discussing statistical analysis with interlocutors (issues of audibility). This constrained audibility is proven by “If we use AT&T Connect to call, sometimes the voice is intermittent and cannot be heard very clearly.... Sometimes the [phone] call is three or four ways, and sometimes I couldn’t understand what they said when they spoke at the same time” (interview transcript, June, 2015). Unlike in face-to-face interactions where contextual cues (e.g., gestures and facial expressions) enhance communication, in synchronous communication which lacks the use of the video function or with the poor quality of the video function due to an unstable Internet connection, Zhi-Kai could not take advantage of contextual cues. As an L2 English user, these failures of the affordances of technologies further complicated his communication processes.

In addition, he identified independence as a key condition for successful academic acculturation. Data reveal that he attempted to solve math questions on assignments by himself through employing Google Scholar to look for online sources and academic papers. This is shown in “I would go online to search for papers or online sources to help me answer math questions because some questions were actually simplified from academic papers. ... I sometimes searched for answers by watching teaching videos hosted on my previous master’s advisor’s website” (interview transcript, July 4, 2015). Moreover, when he was unsure of certain MATLAB’s functions and codes, he utilized Google search engine to obtain this information. Data

also disclose that when encountering statistical problems, he was inclined to seek answers by himself via asking his previous master's peers on Facebook as shown in "I'm not specialized in that area but I know some of my MA's peers do it so I posted my questions in the Facebook group to see their suggestions" (interview transcript, July, 2015). Overall, his use of words, such as "I would go online..." and "I sometimes searched for answers...", positioned him as taking ownership of his learning. Further, when he said "I'm not specialized in that area...", he recognized his lack of expertise and others' expertise in the area. This recognition is also evidence of his agency in his academic acculturation processes.

Another key condition for successful academic acculturation is participation in DS communities. Data show that he participated in various ways. These include engaging in the discipline-based statistical analysis as seen in "My advisors' research projects are more analytical so the use of statistical software to analyze those data is much easier. I just run simple analysis" (interview transcript, July, 2015). This evidence demonstrates that when analyzing data from his GRA research projects, he employed existing analytical methods to analyze the data. Another instance of his participation is when he analyzed his own dissertation data to find a better statistical analysis which probably was not developed in DS communities. This is proved by "I'm developing a new statistical method so I need to run many simulations to see whether my method is better than traditional methods" (interview transcript, July, 2015). To develop this new statistical method, he adopted MATLAB to continue to write, revise, and test his self-designed statistical package in order to make a breakthrough in his research area. Data also reveal that he participated in DS communities through publishing research with his advisors and other collaborators (GRA collaborators, non-DS-disciplinary faculty, and friends). This participation entails tapping into his prior research

experience in analyzing biological data via GAP statistical analytical software and analyzing one of his collaborators' biological data. This collaboration led to the publication of four peer-review journal articles where Zhi-Kai was the second author. This participation also entails knowledge of several statistical software (e.g., MATLAB, R, and GAP). Based on this knowledge, he was able to assist one of his advisors in debugging statistical packages for a new book. Subsequently, he was named as a contributor to this book publication project. Furthermore, his knowledge and capacity of analyzing data via statistical software enable him to do GRA research projects which had a potential of becoming scholarly publications. Through these opportunities for publications, he continued to develop a scholarly presence and voice and was increasingly active in DS scholarly communities. These also demonstrate that he knew the expectations of DS communities.

On the whole, technologies are a necessary tool for Zhi-Kai's adjustment to the Western academic culture and socialization into DS communities. Although fraught with some tensions emanating from linguistic and cultural differences (L1 Chinese and L2 English language and culture), his use of technologies coheres with his definition of successful academic acculturation. This coherence foregrounds practices, such as participation in DS communities, independence, network of support, and developing disciplinary competence.

5.6 The Evaluation of Zhi-Kai's Acculturation to the DS Discipline

In order to evaluate how well Zhi-Kai has acculturated to the statistics discipline, I adopted the self-developed evaluation approach (see Table 5.4), the percentage scale, and descriptive descriptions (see the detailed evaluation of the participants' academic acculturation in the section on data analysis in Chapter 3).

Category	Indicators of Successful Academic Acculturation	S, SS, DS, NP, NA
Zhi-Kai's definition of successful academic acculturation	1. Felt comfortable enough to discuss statistical research in English with anybody	SS
	2. Felt comfortable enough to study under the U.S. educational system	S
	3. Had the ability to independently formulate research problems and find solutions	S
	4. Had the ability to develop new and useful statistical analysis	S
	5. Published papers and solidified career prospects	S
Indicators from collected data on Zhi-Kai	6. Knew one's research interests in the early doctoral years	S
	7. Had a productive relationship with his advisors	S
	8. Continuously engaged in research and scholarship	S
	9. Had the capacity to navigate several statistical analytical software	S
	10. Used an array of technologies in an assistive role during his academic acculturation processes	SS
	11. Possessed good academic English competence	SS
Expectations and requirements of the academic department (Department of Statistics)	12. Timeliness (e.g., required students to pass the qualifier exam I at the end of the 1 st year, pass the qualifier exam II at the end of the 2 nd year, and complete a candidacy exam within 2 years after qualifier exam II)	S
	13. Obtained high standard of disciplinary core knowledge (e.g., required student to take and pass core courses with a grade of B- or above; qualifier exam I and II evaluating students' 1 st and 2 nd years of doctoral study)	S
	14. Disciplinary conventions/High quality of graduate work (e.g., Completed the dissertation and passed the oral defense)	S
Indicators from the Scholarship of doctoral students' academic acculturation	Interpersonal relationships with peers, professors, & advisors	
	15. Had the ability to have (online and/or face-to-face formal and informal) conversations with scholars (Casanave, 2008; Hedgcock, 2008; Simpson & Matsuda, 2008; Morita, 2009), including peers, colleagues, professors, and other scholars in DS communities	SS
	16. Knew old timers' expectations and had the ability to use effective strategies to satisfy those expectations (Hedgcock, 2008)	S

Continued

Table 5.4 The Evaluation of Zhi-Kai's Academic Acculturation

Table 5.4 continued

Category	Indicators of Successful Academic Acculturation	S, SS, DS, NP, NA
Indicators from the Scholarship of doctoral students' academic acculturation	Interpersonal relationships with peers, professors, & advisors	
	17. Had a healthy and sustainable advisor-advisee relationship (Gardner, 2007; Golde, 1998; Girves & Wemmerus, 1988; Simpson & Matsuda, 2008)	S
	18. Had a good relationship with the faculty (Gardner, 2007; Golde, 1998; Girves & Wemmerus, 1988; Weidman & Stein, 2003)	SS
	19. Had a good relationship with peers (Gardner, 2007 & 2010; Golde, 1998)	SS
	Zhi-Kai's academic performance in DS	
	20. Had the ability to write as an insider and write for a wider audience (Hedgcock, 2008; Li, 2008)	SS
	21. Had the ability to write different writing genres for different academic purposes in English (Hedgcock, 2008) (e.g., class assignments, RA reports, conference proposals, qualifying exam(s), a candidacy exam, a dissertation, and journal articles)	SS
	22. Had the ability to use disciplinary language, terms, and concepts in speaking and writing (Casanave, 2008)	S
	23. Had the ability to thoughtfully and critically read scholarly texts (Casanave, 2008; Hedgcock, 2008; Li, 2008)	S
	24. Had the ability to use strategies to purposefully read academic texts (Hedgcock, 2008) (e.g., read texts as sources of disciplinary knowledge and as models to recognize, analyze, reproduce, selectively reshape textual conversations)	S
	25. Had the ability to have an argumentative voice and make scholarly arguments (Li, 2008)	SS
	26. Had critical thinking and synthesis competence (Gardner, Hayes, & Neider, 2007; Li, 2008)	SS
	27. Had the ability to independently conduct research and/or experiments (Gardner, 2007; Girves & Wemmerus, 1988)	S
	28. Received awards related to academic performance (Mendoza, 2007)	S
	29. Involved in professional activities (Li & Collins, 2014; Gardner & Barnes, 2007; Weidman, Twale, & Stein, 2001) (e.g., attend conferences, seminars, workshops, and scholarly talks)	S
	30. Acquired disciplinary core knowledge (Casanave, 2008)	S

Continued

Table 5.4 continued

Category	Indicators of Successful Academic Acculturation	S, SS, DS, NP, NA
	Zhi-Kai's academic performance in DS	
	31. Knew key figures in the field (Casanave, 2008; Hedgcock, 2008)	S
	32. Knew which academic camp(s) he aligned with (Casanave, 2008; Hedgcock, 2008; Li, 2008)	S
	33. Knew ways of constructing knowledge (Casanave, 2008) (e.g., knew how to interpret research and experimental data)	S
	34. Knew speakers' arguments when listening to speakers' talks (Simpson & Matsuda, 2008)	NP
	35. Understood disciplinary communities' culture (Gardner, 2007; Hirt & Muffo, 1998) (e.g., the important elements in a conference proposal and a journal article, the emphasis of problem-solving competence and interdisciplinary research collaboration)	S
	Understanding of the Western academic culture and academic English competence	
	36. Had the ability to use English to do academic English speaking, reading, listening, and writing without difficulties (Sato & Hodge, 2009)	SS
	37. Understood course materials (Morita, 2009)	SS
	38. Understood and was able to participate in class discussions (Morita, 2009)	NA
	39. Understood the Western academic culture (Jones, 1999; Li & Collin, 2014; Robinson-Pant, 2009), such as the emphasis on the student-centered teaching, the ability to communicate and construct knowledge, critical thinking, independence, and class participation through oral discussions	SS

Among the 39 indicators of successful academic acculturation from the four sources, Zhi-Kai received S 24 times (61.53%), SS 13 times (33.33%), DS (dissatisfied) zero time, NP one time (2.56%), and NA one time (2.56%). This result (achieving 24 indicators in the satisfied level among the 39 indicators, 61.53%) indicates that overall Zhi-Kai had acculturated to the Western academic culture and the statistics discipline.

Under the category of his definition of successful academic acculturation, for the 1st indicator, multiple data disclose that he felt comfortable to discuss statistical related research with others in formal occasions but not in informal situations, especially conversing with scholars or interlocutors whom he did not know. Regarding the 2nd indicator, he got used to studying under the U.S. educational system and understood professors' and advisors' expectations. In relation to the 3rd indicator, data show that he had the ability to independently formulate problems and seek possible solutions. In an interview, he mentioned that "I feel I'm able to look for possible solutions for research problems, but whether the solutions are right or not is another story. At least I try to solve the problems and look for possible answers" (interview transcript, July, 2015). Concerning the 4th indicator (the ability to develop new and useful statistical analysis), data reveal that he attempted to devise a new statistical analytical method to cope with biological data. A peer-reviewed journal article that he wrote with his advisors was to propose this new analytical method in statistics communities. With regard to the 5th indicator (publishing papers and solidifying career prospects), by the time of the interviews, he continued to undertake research with several collaborators, including his friend, collaborators in his graduate assistant research projects, his advisors, and other professors whom his advisors introduced. Through the varied research experiences with experts in different academic fields, Zhi-Kai developed broader research perspectives, enhanced his research competence, learned disciplinary conventions, and established a professional status in the statistics academy.

Under the category of indicators that emerged from data on him, for the 6th indicator, Zhi-Kai knew his research interests and orientation in his first doctoral year. This early understanding likely originates from his past experiences of studying in a

statistics master's program and working in a governmental research organization in Taiwan. In an interview (interview transcript, June, 2016), he reported that most of his doctoral peers did not know their dissertation orientations until the third year when having their candidacy exams. On the contrary, Zhi-Kai knew what dissertation topic he wanted to explore in his first doctoral year. Concerning the 7th indicator, data reveal that he had a productive relationship with his advisors. His past learning experience in the master's program and research experience in Taiwan helped him understand the culture of advisor-and-advisee and professor-and-student.

Furthermore, the opportunities to interact with professors in reading groups in his early doctoral years enable him to know which professors were willing to help him and this further assisted him in selecting his advisors. His foresight, hence, facilitates the later good relationship with his advisors. Regarding the 8th indicator (constantly involving in research and scholarship), data disclose that he continually engaged in conducting own and collaborative research, absorbing discipline-specific knowledge through reading scholarly works, presenting at statistics conferences, and publishing his research.

As for the 9th indicator, multiple data reveal that he had the capacity to navigate several statistical analytical software, including MTLAB, R, and CAP. His past research experience in Taiwan equipped him with the ability to employ R and CAP statistical analytical software to analyze data during his doctoral study. For MATLAB which he utilized for his dissertation, he knew and used it is because one of his advisors also employed it. Nonetheless, his doctoral department did not offer MATLAB related courses or workshops, so he relied on online resources to learn how to operate it and analyze his dissertation data. However, it is uncertain whether he correctly employed MATLAB to analyze his data or not. In relation to the 10th

indicator, multiple data show that he employed several technologies to assist him in various academic purposes and in surmounting some of English challenges he encountered. Nonetheless, like Cheng-Rui, Zhi-Kai's use of some technologies is problematic. For instance, he exclusively adopted Google Scholar to look for academic papers. However, Google Scholar has its limitations. This search habit could limit his research perspectives to only read the statistical studies that Google Scholar provided. Moreover, during the process of writing academic papers in English, he solely utilized one English dictionary (Google Dictionary) to look up unfamiliar English words and synonyms rather than using multiple English dictionaries to cross-check meanings and usage of unfamiliar English words. His use of one dictionary might not give him broader definitions and usage of English vocabulary and sufficient synonyms. Concerning the 11th indicator (possessing good academic English competence), he possessed necessary academic English competence to complete academic tasks but might not be proficient in academic English to clearly express his ideas, especially in academic writing.

Under the category of expectations and requirements of the DS doctoral program, from the 12th to 14th indicators, data reveal that Zhi-Kai obtained the high standard of disciplinary core knowledge through completing and passing statistical core courses with the required score above and qualifier exams within the required time frame. In addition, he successfully finished his dissertation within the required time frame.

Under the category of indicators from the scholarship of local and international students' socialization into graduate programs, there are 25 indicators which were further divided into three sub-categories: 1) interpersonal relationships with peers, professors, and Zhi-Kai's advisors, 2) Zhi-Kai's academic performance in the

Department of Statistics, and 3) the understanding of the Western academic culture and academic English competence.

Under the first sub-category of interpersonal relationships with peers, professors, and his advisors, regarding the 15th indicator, multiple data disclose that Zhi-Kai was able to have online and face-to-face formal and informal statistical related conversations with his doctoral peers, advisors, other faculty members in his doctoral program. He was also able to formally interact with professors and scholars in wider statistics communities. The formal interactions include professional presentations in seminars and at conferences. Nonetheless, if the interactions were in informal occasions, such as banquets or social time at conferences, seminars, or workshops, Zhi-Kai felt uncomfortable and uncertain about how to interact with professors and scholars. This is probably affected by the Taiwanese culture where people usually only interact with interlocutors whom they have already known in informal settings. Moreover, in Taiwanese culture, it is atypical to say 'hi' to strangers on the street or in informal settings which this cultural aspect is opposite to American culture. Such cultural differences might require Zhi-Kai and other international students to understand the norm and behavior of the target culture and step out of their comfortable zone to adjust to the new cultural aspect. This understanding might also need members of the target culture to explicitly inform Zhi-Kai and other international students. Furthermore, the adjusting process might also require a long period for Zhi-Kai and other international students whose native culture is far distant than the target culture.

In relation to the 16th indicator, Zhi-Kai knew expectations of old timers (his advisors) and was able to adopt effective strategies to satisfy their expectations. Interview data reveal that the experiences of studying in a master program and

working as a research assistant for a research organization in Taiwan assisted him in understanding old timers' expectations and meeting the expectations. Concerning the 17th indicator, as it was mentioned in preceding paragraphs, Zhi-Kai had a healthy and sustainable advisor-advisee relationship. As for the 18th indicator, in an interview (interview transcript, June, 2015), he reported that once he needed a professor's statistical program to develop his statistical program so he communicated with the professor via email. He also reported that once he gave a talk for the departmental award, and after the talk during the social time, he had brief chats with some professors in his program (interview transcript, June, 2016). Other than these two events, data do not disclose his regular interactions with DS faculty members except for his two advisors. Regarding the 19th indicator, Zhi-Kai had a good relationship with peers in the present doctoral program. An example is when taking courses in his early doctoral years, he utilized QQ (social interactional software) to discuss assignments with peers. During the preparation for his qualifying exams, he and his doctoral peers would consult with and help each other to prepare for the exams' questions. Nonetheless, data also display that Zhi-Kai seemed to only interact with peers from China. Although he explained that his doctoral program had the great proportion of international students from China, there were still a few domestic students. The reason he only interacted with students from China might be more convenient for him to speak his native language (Chinese) with peers from China than speaking English (L2) with English-native-speaking peers.

Under the second sub-category of his academic performance in DS, for the 20th to 22nd indicators, multiple data disclose that generally he was capable of writing different genres for various academic purposes in academic English. The writing genres include class assignments, reports for his research assistant projects,

conference proposals, qualifying exams, a candidacy exam, a dissertation, and journal articles. Additionally, he was able to use discipline-specific language, terms, and concepts in English speaking and writing. Furthermore, he was competent to write as an insider of DS communities, especially with his advisors' guidance. However, data also show that his limited academic English competence sometimes hindered him from clearly expressing his ideas and interpreting data and research findings. This weakness also influenced him to be unable to write effectively for a wider audience. Nevertheless, his advisors often provided him support not only for statistical knowledge but also for articulate explanations in academic English speaking and writing.

As regards the 23rd and 24th indicators, data disclose that, at the beginning of his doctoral years, Zhi-Kai confronted difficulties in strategically reading academic texts in English and often spent a great deal of time on only reading one academic article. Nevertheless, in his later interviews, he reported his progress in adopting purposeful reading strategies to achieve his reading goals and to thoughtfully and critically read scholarly texts. Concerning the 25th and the 26th indicators, data reveal that Zhi-Kai had not yet mastered at making persuasive scholarly arguments. In the literature review chapter of his dissertation, he reviewed some scholars' use of certain statistical analysis and described which statistical analysis he adopted in his dissertation. Nonetheless, nowhere in his writing gave a clear justification for selecting the particular statistical analysis to analyze his data. This indicates that he encountered difficulty in having an argumentative voice. It also implies that he might be able to apply critical thinking while reading those scholars' texts but unable to synthesize their arguments accompanying with his research positions. With respect to the 27th indicator, multiple data display that Zhi-Kai was able to independently conduct

research and experiments. For the 28th and the 29th indicators, data show that he constantly engaged in professional activities, especially after finishing his candidacy exam. The professional activities he involved in include attending seminars in his current doctoral program, presenting his research at DS conferences in the U.S. and in Taiwan, undertaking collaborative research with others, and co-authoring with collaborators and his advisors for scholarly publications. He also received an award from his present doctoral program for his contributions to the statistics field as a doctoral student.

Regarding the 30th to 32nd indicators, data show that Zhi-Kai fulfilled required departmental core courses, passed the qualifying exams and the candidacy exam, and completed his dissertation within the required time frame. These confirm that he acquired disciplinary core knowledge. Moreover, data reveal that he knew which academic camp he aligned with. He reported that his previous research experience in the master's program and the research job in Taiwan helped him have his research interests and orientation much earlier than his doctoral peers (interview transcript, July, 2015). In addition, he stated that this early understanding enabled him to cumulate more scholarly readings related to his research area than other doctoral students (interview transcript, July, 2015). In addition to this, he also kept updating his knowledge of his research topic through attending sessions related to his research topic at conferences and seminars. This constant intellectual development assisted him in knowing key scholars in his research area.

Regarding the 33rd indicator, data show that Zhi-Kai knew ways of constructing knowledge. For instance, his dissertation writing reveals his understanding of adopting statistical analysis to analyze his data and interpreting his experimental data and research findings. In relation to the 34th indicator, data do not show the

prominence of his understanding of scholars' arguments when listening to their scholarly talks or presentations. However, Zhi-Kai described that before conferences, he would search for and read academic papers of scholars whose sessions he would attend at the conferences. This action could familiarize himself with the scholars' arguments and terminology and concepts they would present during their sessions. As a result, this familiarization could increase his understanding the scholars' arguments while listening to their presentations. Concerning the 35th indicator, with his advisors' guidance, Zhi-Kai understood DS disciplinary culture. This could be seen when submitting a conference proposal and presenting at a conference, his advisors would provide him advice to improve his proposal writing and oral presentation. In addition, his advisors would encourage and offer Zhi-Kai support to help him interact with scholars during conferences. Furthermore, in an interview (interview transcript, June, 2016), Zhi-Kai recounted how his advisors invited him to co-author a journal article, and through this process he learned ways to write a scholarly article for the DS audience and to respond to reviewers' comments. He explained that his previous journal articles which he published with his personal collaborator who was in biology did not emphasize on statistics. He, thus, did not learn how to write a pure statistics-related journal article and to respond to reviewers' comments. Such discipline-specific culture might be unable to be acquired by novices through themselves but through guidance from experienced members or experts in the communities.

Under the third sub-category of understanding the Western academic culture and academic English competence, for the 36th indicator, multiple data show that Zhi-Kai struggled to speak and write in academic English. Nonetheless, his advisors, as English-native speakers, often provided advice to assist him in improving his academic English speaking and writing competence. Even though he still had these

difficulties, data reveal that he had better academic English competence than his earlier doctoral years. Regarding the 37th indicator, data reveal that he understood course materials, especially directly related to statistics. Nevertheless, if the courses were not related to statistics, such as math courses offered by the math department, he had difficulty in comprehending the materials and lectures (interview transcript, June, 2015). This difficulty might stem from his limited English competence, the content of the math courses, or the teaching methods that the professors adopted. Concerning the 38th indicator, in an interview (interview transcript, July, 2015), he reported that most of his professors in DS taught through the traditional method (e.g., Professors wrote notes on a board; students quietly listened to lectures; there were a few discussions in class). This type of teaching is similar to the one he had in Taiwan. He, therefore, did not encounter the challenge of participating in class discussions. As regards the 39th indicator, data show that Zhi-Kai understood the partial Western academic culture, such as the emphasis on student-centered teaching. However, there are some Western academic cultural aspects he did not know, such as the informal social interaction in a professional circle and the emphasis on the learning processes rather than the outcomes. Once in an interview (interview transcript, June, 2015) he complained that he did not understand his advisors' intention to ask him to write down all processes of his try-out statistics programs for his dissertation. He felt it wasted his time on writing down the all try-out processes which contained unsuccessful experimental results. He queried his advisors about whether he could report the final version which was the correct one instead. Nonetheless, his advisors disagreed with his idea and did not give Zhi-Kai a further explanation of their intention to have him to write down all try-out processes. This mismatch of the assumption of the learning purpose between Zhi-Kai

and his advisors and no explanation of this Western academic cultural aspect made him confused and lost the chance to learn this aspect.

On the whole, among the 39 indicators of successful academic acculturation, Zhi-Kai achieved 24 indicators (61.53%; 61% - 80%, good) in the satisfied level. This result shows that overall Zhi-Kai had acculturated to the Western academic culture and DS discipline but still needs to improve some areas, such as general academic English competence, skills of having informal social interactions with scholars, and understanding some disciplinary culture (e.g., the processes of publishing research in a statistics journal).

5.7 Summary

Zhi-Kai's learning trajectory spans across four learning contexts (college, the master's program and the research job in Taiwan, and the doctoral program in the U.S.). The major similarities across the four learning contexts are that he took the same subject (statistics) and instructors' teaching styles were generally traditional. The major differences between the three Taiwanese contexts and the doctoral context in the U.S. include 1) L1 Chinese and L2 English language and academic culture, 2) comparatively more opportunities at the doctoral level to participate in DS communities in various ways, and 3) the use of a variety of technologies to assist himself in learning during his doctoral study. His definition of successful academic acculturation is characterized by

- 1) having the ability to discuss statistical research in English with others,
- 2) understanding the doctoral program culture,
- 3) participating in discipline-specific communities of practices,
- 4) making contributions to the field, and

5) being independent.

These indicators of successful academic acculturation were articulated by Zhi-Kai during the interviews. After a close look at other data (a survey, interviews, 14-week weekly journals, and field notes), some indicators were not explicitly identified by Zhi-Kai. These include:

- 1) knowing one's research interests in the early doctoral years,
- 2) having a productive relationship with his advisors,
- 3) continuously engaging with research and the scholarship,
- 4) having a capacity to navigate several statistical analytical software for different academic purposes,
- 5) being able to use an array of technologies in an assistive role during his acculturation processes, and
- 6) possessing good academic English competence.

In addition to above indicators, the DS doctoral program's expectations and requirements also influenced Zhi-Kai's academic acculturation processes. Some indicators from the DS doctoral program's expectations and requirements contain to 1) acquire disciplinary core knowledge, 2) complete qualifying exams within required time frames, and 3) accomplish a dissertation.

After evaluating Zhi-Kai's academic acculturation through these four sources of indicators, the (achieving 24 indicators among the 39 indicators, 61.53%) reveals that generally Zhi-Kai had acculturated to the Western academic culture and DS communities, but his acculturation condition is not good enough. This result also discloses that he still struggled to adjust to some Western and disciplinary cultural aspects. His struggles could be seen in several situations.

During Zhi-Kai's academic acculturation processes, he endured difficulties in academic listening, speaking, and writing in English. More specifically, these difficulties were in areas, such as coping with fast pace of speaking, being uncertain of conversational turn-taking, the lack of familiarity with interaction conventions between novice and experts, the lack of paraphrase skills, insufficient lexical capacity, grammatical and semantic structural inaccuracies, the lack of knowledge of Western rhetorical structures, and the absence of understanding some Western academic cultural aspects (e.g., the emphasis on the learning process rather than the learning outcome). In order to deal with some of these challenges, he deployed different approaches tapping into a variety of online and human resources, such as advisors' support. Some of his technology use could surmount certain academic challenges he encountered, such as utilizing an English dictionary to extend his English lexical capacity. Nevertheless, some of his technology use were unable to help him overcome certain academic difficulties, such as the lack of the ability to socially interact with scholars in DS-related informal occasions and of the capacity to clearly express own ideas in academic English. Fortunately, Zhi-Kai had a good relationship with his advisors, and some of these academic difficulties could be solved through his advisors' support. Especially, those academic difficulties that Zhi-Kai confronted required guidance from members of the Western culture and experts in DS communities. As an international student, like Zhi-Kai, who gets used to his L1 language, learned L2 English for several years in his hometown. Nonetheless, learning L2 English rules is not equivalent to being able to use well the target language in actual contexts. Even though immersing in the L2 English environment could gradually enhance his English competence, it would take a long time to achieve English proficiency for Zhi-Kai as an international student. Besides the shift from L1

Chinese to L2 English, the change from his native academic culture to L2 English academic culture also influenced his academic acculturation processes. Especially, some cultural aspects are opposite to his L1 academic cultural aspects (e.g., the emphasis on the learning process v.s. the underscoring learning outcome). These differences of cultural aspects need members of the target culture to explicitly explain to an international student, like Zhi-Kai, in order to raise his awareness of these differences. It also requires him, as an international student, to acclimatize for a long time to the Western academic cultural aspects that are different from his native academic culture. Hence, it is crucial for an institution, an academic department, and faculty members to provide an international student, like Zhi-Kai, essential support to enhance his overall academic English competence, understand the Western academic culture, and adjust to the new academic culture. Appropriate academic support could reduce academic difficulties that an international student, like Zhi-Kai, confronts during academic acculturation processes. For instance, even though Zhi-Kai confronted difficulties in academic English writing, with the support and encouragement from his advisors, Zhi-Kai could still complete his dissertation, co-author with other scholars from different fields and publish six peer-review journal articles. In the last interview, he reported that he was also working on revising a journal article which he co-authored with his advisors and professors from other fields. Meanwhile, he stated that he was attempting to use his graduate assistant research projects as sources for future publications.

The following chapter shifts from Zhi-Kai to discuss Tian-You's academic acculturation processes in the Department of Computer Science and Engineering. Tian-You is the third case study in this dissertation.

Chapter 6: Tian-You's Case Report

6.1 Tian-You's Learning Background

At the time of this study, Tian-You was the first-year doctoral student in the Department of Computer Science and Engineering (CSE) and was preparing for his qualifying exam at the end of the first doctoral year. During his college in Taiwan, he established a career goal to become a CSE professor in the future (interview transcript, April, 2015). Hence, in the beginning of his college study, he decided to pursue a doctoral degree in the U.S. He voluntarily participated in two college-level research projects in the fourth year and presented research results at a CSE conference in Taiwan. In addition, since he planned to study in the U.S. which is an English dominant environment, he sometimes wrote assignments and exam questions in English to increase chances to practice his English writing. However, he reported that he did not receive any training in academic English (writing, speaking, listening, and reading), and his instructors did not correct his English writing so he was unable to learn from the practice. Moreover, the English courses he took focused more on general English. After graduating from the college, he studied in the CSE master's program in Taiwan. During this study, all teaching and learning materials were written in English. Furthermore, his assignments, exams, and master's thesis were all written in English. Nevertheless, he self-reported that he still did not receive training in academic English. During the master's study, he started to participate in the wider CSE's communities via attending and presenting his master's thesis research in foreign countries (e.g., Japan, China, and the U.S.). Nonetheless, during an interview,

he mentioned his experience of presenting research in English at a CSE conference in the U.S. which demonstrates the lack of training and opportunities of using academic English in speaking:

“I was very nervous. It’s a 15-minute presentation. I practiced to talk through my slides via audio recording my practice sessions and listening to them and then modifying my slides and talks at home. At a hotel, I kept practicing until a few hours before the actual presentation...I was not fluent. Sometimes I was stopping my talk and thinking what I should say and how I should say it in English.” (interview transcript, November, 2015)

In addition to participating in CSE conferences, he was also involved in publications. By the end of his master’s program, he published two CSE peer-review journal articles with other researchers. Nonetheless, he mentioned that he merely wrote a few sections, particularly experimental results, but the big portion of the two articles was written by other researchers. After graduating from the master’s program, he worked as a research assistant in a Taiwanese government’s research organization for a year. He reported that research he conducted was indirectly related to his master’s thesis but still associated with CSE. At the end of the research job, he presented his research results at a CSE conference in Austria. The above data show that the motivation to become a professor in the CSE discipline continuously stimulated Tian-You to engage in CSE practice and seize opportunities to practice his academic English speaking and writing even though he still endured to lack training in academic English, especially speaking, writing, and listening.

After the research job, he came to study in the present CSE doctoral program in September, 2014. In the first interview, he said “It’s quite difficult for me to adjust to American general and academic culture. At the beginning, I often didn’t understand

what my team members said and kept quiet during meetings” (interview transcript, April, 2015). Table 6.1 lists major characteristics of his current CSE doctoral program according to the descriptions on CSE website and related documents. These features are considered to possibly impact Tian-You’s acculturation to the CSE doctoral program and wider CSE communities.

Features of the CSE Doctoral Program
a) Provided technological hard and software and support for research and instruction
b) Constantly invited guest speakers from academy and industries to give talks
c) Prepared graduate students to make contributions to computing research and education and to the society through working with "key academic partners within and outside of [the university], and with key industrial partners" (CSE website)
d) "[D]evelop[d] and educate[d] a diverse and highly-regarded community of computer scientists through a supportive infrastructure for women and underrepresented minorities", especially for black and Hispanic groups in the US (CSE website). Notably, diversity on the CSE website did not mention international students from a variety of countries.
e) Provided information for all students but did not differentiate between the needs of international and domestic students. Only information for international students was the description of the requirements for getting associateships and awards: “students whose native language is not English must demonstrate proficiency in spoken English. Without such a demonstration, students reduce their chances of getting associateships and the awards are smaller” (CSE website)
f) Had a requirement for students to take and pass core courses in three areas: 1) algorithms, 2) computability and complexity or programming languages, and 3) computer architecture or operating systems.
g) Had a requirement for students to take and pass courses in one major and two minor research areas with a GPA of 3.3 and above after the qualifying exam
h) Had a requirement for students to pass a qualifying and candidacy exams and to complete a dissertation and an oral defense

Table 6.1 Characteristics of Tian-You’s Doctoral CSE’s Program

Before enrolling in his current doctoral program represented in Table 6.1 above, Tian-You attended college and master’s program in Taiwan. Some characteristics of

these programs which might influence his acculturation to the Western academic culture and the CSE communities are presented in Table 6.2. Whereas Table 6.1 presents the requirements for doctoral students and detailed features of his current CSE doctoral program, Table 6.2 presents the CSE doctoral program's instruction styles, pedagogy, technologies, and his learning styles. Thus, this table constitutes a juxtaposition of L1 (Taiwan) learning contexts at the college level, master's level, a research organization, and L2 (American) learning context at the doctoral level. These characteristics are classified into five categories: a) classroom context, b) pedagogy and interaction, c) language of instruction, d) technological infrastructure, and e) learning habits.

	L1 Learning Context - College Level	L1 Learning Context – Master’s Level	L1 Learning Context – A Job Position	L2 Learning Context – Ph.D. Level
Classroom Context	1. Students’ learning evaluated through assignments, exams, and occasional oral presentations.	1. Students’ learning evaluated through assignments, exams, and a thesis. There was only one class oral presentation during the two years.	<ul style="list-style-type: none"> ➤ Learning (which took the form of on-the-job practice) happened in an office-based space. ➤ Carried out organizational research projects and interacted oral consultations with his supervisor 	1. Students’ learning evaluated mainly through assignments, exams, a qualified exam, a candidacy exam, and a dissertation. Sometimes professors gave students extra points for participating in an online discussion board through a course management (Carmen) provided by the institution or professors’ websites. Sometimes professors required students to orally present the content of scholarly papers.
	2. There were some written assignments and some computer programming.	2. There were some written assignments and some computer programming.		2. More assignments in the current doctoral program than in the college and master’s program. Most assignments were electronic versions.
	3. Most teaching and learning materials were in an electronic form.	3. Most teaching and learning materials were in an electronic form.		3. Most teaching and learning materials were in an electronic form.
Pedagogy and Interaction	4. Instructors mainly adopted slides to give lectures and occasionally asked students questions.	4. Instructors mainly adopted slides to give lectures and occasionally asked students questions.		4. Instructors mainly adopted slides to give lectures.

Continued

Table 6.2 Characteristics of Tian-You’s L1 and L2 Learning Context

Table 6.2 Continued

	L1 Learning Context - College Level	L1 Learning Context – Master’s Level	L1 Learning Context – A Job Position	L2 Learning Context – Ph.D. Level
Pedagogy and Interaction	5. Few student-to-student and instructor-to-student interactions during class.	5. Few student-to-student and instructor-to-student interactions during class.	➤ Learning happened on the job mainly through supervision by his supervisor. The Taiwanese government’s research organization encouraged independence in working and interactions were mainly with his supervisor and colleagues (researchers).	5. More student-to-student and instructor-to-student interactions during class.
	6. In terms of research, he worked directly with professors in two college-level research projects in his fourth year.	6. In terms of research, a previous Master’s student who graduated and worked in the industry sometimes assisted him when he had questions about research. Their communication was mainly through email and Skype. He also worked closely with his advisor.		6. He started to work in his advisor’s research team from the second semester until the time of this study. The team consisted of doctoral students and post-docs. His advisor required that each post-doc or experienced doctoral student led a new doctoral student in the team. Hence, Tian-You worked closely with a post-doc. The post-doc helped him when he faced questions about research, conference papers, and regular lab meetings. He worked more closely with the post-doc than his advisor.
Language of Instruction	7. Teaching materials including lecture slides and textbooks were written in English.	7. Teaching materials including lecture slides and textbooks were written in English.	➤ Interactions were mainly in Chinese. Some job-related publications, including conference papers, were written in English.	7. Teaching materials including lecture slides and textbooks were written in English.
	8. Chinese was the main language in and outside of class.	8. Chinese was the main language in and outside of class.		8. English was the main language in and outside of class.

Continued

Table 6.2 Continued

	L1 Learning Context - College Level	L1 Learning Context – Master’s Level	L1 Learning Context – A Job Position	L2 Learning Context – Ph.D. Level
Technological Infrastructure	<p>9. The department was equipped with instructional technologies, such as a computer and a projector.</p> <p>10. Used his own desktop to browse professors’ websites and download lecture slides. Sometimes searched online resources via Google to help him understand teaching materials in English and write assignments.</p> <p>11. Data do not show the prominence of using various technological software to help him organize academic tasks, learn disciplinary knowledge, conduct research.</p>	<p>9. The department was equipped with technologies for research and instruction, such as a computer, a projector, and a laptop.</p> <p>10. Used his office computer to browse his professors’ websites and download lecture slides. Sometimes searched online sources via Google to help him understand teaching materials in English and write assignments</p> <p>11. Often adopt various technological software to help him organize academic tasks, learn disciplinary knowledge, conduct research.</p>	<p>➤ Day-to-day work technologies, including a desktop, a laptop, software for writing and running computer programs, software for collecting and analyzing data, processor software, such as LaTeX and BibTeX, the common use of the internet, and note taking software (EndNote).</p>	<p>9. The department was equipped with sufficient technologies for research and instruction.</p> <p>10. Often used his laptop and institution-provided desktop in his office to do research and academic learning at school. Often searched for online sources via Google to help him understand teaching materials and unfamiliar terms or concepts and write assignments.</p> <p>11. Often adopted various technological software to help him organize academic tasks, learn disciplinary knowledge, conduct research, communicate with professors, his advisor, research team members, and peers, and obtain academic information, such as workshops and conferences.</p>

Continued

Table 6.2 Continued

	L1 Learning Context - College Level	L1 Learning Context – Master’s Level	L1 Learning Context – A Job Position	L2 Learning Context – Ph.D. Level
Learning Habits	<p>12. Quietly listened to lectures and took notes by hand.</p> <p>13. Quickly previewed lecture slides before a class and painstakingly reviewed teaching content weekly via reading lecture slides, textbooks, and his notes. Then, reviewed teaching content again when writing assignments and preparing for exams.</p> <p>14. Often discussed with peers about assignments and exams.</p> <p>15. Sometimes assignments were written in English.</p>	<p>12. Quietly listened to lectures and took notes by hand.</p> <p>13. Quickly previewed lecture slides before a class and painstakingly reviewed the teaching content weekly via reading lecture slides, textbooks, and his notes. Then, reviewed the teaching content again when writing assignments and preparing for exams.</p> <p>14. Sometimes discussed with peers about assignments, exams, teaching content, and research.</p> <p>15. All assignments, exams, and the master’s thesis were written in English.</p> <p>16. Often conducted research in the lab</p> <p>17. Attended and presented research at a computer science conference in the US.</p>	<ul style="list-style-type: none"> ➤ Work habits included the typical use of software to collect and analyzed research data, to write and run computer programs, and to present research results. ➤ Attended and presented research at computer science conferences overseas, such as Japan and Austria. 	<p>12. Quietly listened to lectures and took notes by hand or using his laptop. When lecture notes were written words, he used his laptop to take notes. If there some notes that required him to draw diagrams or write math equations, he took notes by hand.</p> <p>13. Due to busy research assistant work, he previewed teaching content when having time to do so. Reviewed teaching content via reading lecture slides, textbooks, and his own notes and writing assignments.</p> <p>14. Often wrote assignments and prepared for exams by himself</p> <p>15. All assignments, exams, and the qualifier exam were written in English.</p> <p>16. Conducted various research projects for his advisor’s research team in the lab.</p>

Continued

Table 6.2 Continued

	L1 Learning Context - College Level	L1 Learning Context – Master’s Level	L1 Learning Context – A Job Position	L2 Learning Context – Ph.D. Level
Learning Habits	<p>16. Voluntarily attended two college-level research projects in his fourth-year college and worked in professors’ labs.</p> <p>17. Attended and presented research at a computer science conference in Taiwan. Additionally, he attended a computer programming contest.</p>			<p>17. Attended and presented research at CSE conferences in the U.S. Also, he often participated in workshops and seminars which involved research, presentation skills, and English academic writing and which were hosted by the CSE department and institution.</p>

Within these contexts, language is a significant factor whereby language and academic cultural differences have a telling effect on Tian-You's academic acculturation processes. More specifically, the shift from L1 Chinese learning context to the present L2 English learning context presented him with some linguistic and academic cultural challenges. The change of language from Chinese to English significantly influenced his academic participation. Moreover, numerous data reveal that he lacked exposure to academic English listening and speaking and opportunities to receive formal training in academic English before studying the doctoral program in the US. Multiple data demonstrate that this lack of exposure and training in academic English coupled with the language change made Tian-You encounter various difficulties in English academic listening, speaking, and writing. Differences between L1 Chinese and L2 English academic culture, such as classroom discussions, also made him face situations where he did not know what he should say and how and when to express his thoughts during class discussions. For example, in L1 Taiwan academic culture, students usually quietly listen to lectures while taking notes during a class. On the contrary, in L2 American academic culture, students are expected to participate in class discussions through expressing own thoughts and opinions. He self-reported that he rarely participated in class discussions during his doctoral study (interview transcript, April, 2015).

However, the similarities among the four learning contexts might reduce tension during his academic acculturation processes. First, he studied CSE across the three educational levels which might help him transfer some disciplinary terminologies, knowledge, concepts, and research skills to his present doctoral program. Second, teaching materials in college and the master's program which were written in English

might ease his difficulties in academic reading. The data prove that he confronted a few challenges in academic reading during his acculturation processes. He also self-reported that “I don’t feel a big difference in reading because during my master’s study, textbooks and teaching materials were written in English” (interview transcript, April, 2015). Third, instructional styles from college to the doctoral program have some similarities. His professors in these three learning contexts were inclined to integrate slides into teaching and provide lecture slides before a class. In an interview, he said that “I don’t feel big differences in terms of professors’ instruction. One difference is that class discussions occur here more frequently than in my previous college and master’s program” (interview transcript, August, 2016). Fourth, he continued to tap into learning habits from the past in order to cope with acculturation in his current doctoral program. These include previewing and reviewing teaching content before and after class, taking notes during a class, and adopting online sources to help him understand some disciplinary concepts and write assignments. These learning habits might assist him in overcoming some academic difficulties he confronted during his doctoral study. Fifth, his prior research experience via carrying out two research projects during the college, writing the master’s thesis, and doing the research job equipped him with fundamental competence and enables him to transfer some skills to the current doctoral learning context. In an interview, he self-reported that:

“Some students who study computer science don’t know how to write computer programs but just learn theories, big concepts. But, I did lots of programming when writing my master’s thesis and doing the research job. This experience actually helps me to work in my advisor’s research team now. They emphasize a lot on the abilities of programming and knowing how to do research from the beginning until the end.” (interview transcript, August, 2016)

Notably, the use of “the beginning until the end” suggests some kind of linearity connecting various stages in his past learning and research experiences. Taken

together, a scrutiny of Tian-You's learning background including research experience spotlights contextual aspects which affected his acculturation to the Western academic culture and CSE communities.

6.2 Tian-You's Definition of Successful Academic Acculturation

Tian-You distinctly described two essential conditions for his successful acculturation to CSE communities: a) the ability to demonstrate competence in knowing how to defend his research arguments and discuss studies with other researchers in CSE communities and b) the ability to make contributions through publications in CSE. The following interview data show this first condition where he described another first-year international doctoral student's ability to defend his research positions and articulately discuss CSE related research with others. This description implies that he thought this ability was a significant condition to successfully socialize into CSE communities:

“For me, adjusting well is to be able to discuss CSE related research with other researchers [through written and oral communication] without difficulties. For this, I feel I'm ok, but it's not good enough due to my spoken English. Writing e-mail is ok... A Pakistani student in my advisor's research team started his doctoral program in the same year as I did. He can fluently present his research and confidently defend himself through back and forth discussing with audiences [during a team meeting]. For me, I can present what I prepare, but if audiences ask me questions, sometimes I don't know how to respond to them. I'd just accept what they said and suggested at that time. After the meeting, I'd rethink about whether their criticism and suggestions are reasonable... I saw most of the team members are able to do that. I can understand what they said but can't speak fluently and express myself clearly.” (interview transcript, June, 2015)

He self-assessed his ability to discuss CSE related research in oral and written English in comparison to other researchers in his advisor's research team, particularly the doctoral student who also enrolled in the CSE program in the same year as he did. Tian-You was unable to orally express his thoughts and arguments clearly in English like his first-year-doctoral peer and other members. Such a discrepancy between him

and his first-year-doctoral peer made him evaluate himself as “I feel I’m ok, but it’s not good enough due to my spoken English.” In other words, when communication was established through a written format, such as email, he was able to discuss CSE related research with others. Nevertheless, if communication was established through an oral format, especially which required interactions with an audience, he felt his spoken English was “not good enough” for him to “speak fluently and express [himself] clearly”. This phenomenon displays the benefit of employing a written form of communication for international students who have insufficient English speaking competence, like Tian-You. A written form of communication enables him to have time to think, organize, and type what he wants to say. Moreover, it allows him to review and revise what he wrote before sending conversation out. Contrarily, an oral form of communication demands him to quickly understand what an audience said and immediately respond to them in English. For a non-native-English speaker who has not yet reached high English proficiency, these demands are heavy. Additionally, Tian-You did not have enough exposure to English and opportunities to speak English when studying in Taiwan. Moreover, defending oneself research positions and interacting with an audience during a presentation or a meeting are parts of the Western academic culture which he was unfamiliar with. These factors, hence, placed him in a disadvantageous position among his colleagues and resulted him in encountering difficulties in “speak[ing] fluently and express[ing] [himself] clearly”. His comparison with his first-year-doctoral peer might also be irrational since his English learning experience might not be identical to his peer. Nonetheless, without “good enough” oral English articulation to describe his research and defend his research positions, he could not be understood and recognized in his advisor’s

research team and in CSE communities even if he had good research perspectives and capability.

His second condition of successful academic acculturation is the ability to publish in the CSE field:

“In my research area, I’m able to make some breakthroughs. It means I’m able to continuously present at famous conferences and seminars and publish in famous journals. In my field, most people see the number of your publications although some scholars may not have many publications, but they have groundbreaking work or large projects. Most people see what you publish and whether you present your research at top conferences and publish in top journals or not.” (interview transcript, June, 2015)

The above data reveal that three things are important when publishing: 1) the number of the publications as seen in “most people see the number of your publications”, 2) the content of the publications as seen in “they have groundbreaking work” and “Most people see what you publish”, and 3) scholarly association of the publications as seen in “whether you present your research at top conferences” and “publish in top journals”. Tian-You’s definition of successful academic acculturation includes a consideration of publications in terms of number, content, and scholarly association. Based on this understanding of these considerations of academic success, he established his publication goals early during his academic acculturation processes. This is shown in “able to continuously present at famous conferences and seminars and publish in famous journals”. This early understanding might derive from his prior research experience in college, master’s program, and the research job in Taiwan.

On the whole, his definition of successful academic acculturation contains a) the ability to orally defend his research arguments and discuss CSE relate research with other researchers in CSE communities and b) the ability to make contributions in CSE communities through continuously presenting and publishing his research at top CSE conferences and journals. His prior research experience and understanding of CSE

conventions in his early academic acculturation processes might assist him in planning doctoral study and academic career.

6.3 Tian-You's Academic Difficulties

From the time Tian-You started his doctoral study and when I was interviewing him, he experienced numerous challenges with regard to adjusting to the Western academic culture and the culture of the CSE communities. Some of the challenges impacted his learning immediately. During the first interview, he described his learning experience in the first semester:

“My first semester was the most difficult period because I didn't get funding... I was very worried whether I'll not have funding even later. I was adjusting to the teaching and learning here while I was worried how to pay tuition and living expense. I felt very tired. Luckily, in the second semester, I got the funding. I work in my advisor's research team.” (interview transcript, April, 2015)

Table 6.1 above mentioned that his present CSE department did not offer sufficient and helpful information to international students about adjusting to their doctoral program. The only information provided by the department is:

“students whose native language is not English must demonstrate proficiency in spoken English. Without such a demonstration, students reduce their chances of getting associateships and the awards are smaller” (CSE website). Field notes show that in order to “demonstrate proficiency in spoken English”,

international students in this institution are required to obtain the *International English Language Testing System* (IELTS) speaking 8.5 above, Test Of English as a Foreign Language Internet Based Test (TOEFL iBT) speaking 28 above, or the institutional ESL program's spoken test. The CSE information for international doctoral students, in fact, did not attempt to assist this group of students in adjusting to the CSE academic culture but seems to give them a warning. Moreover, field notes reveal that CSE did not provide other financial information for international doctoral students. On account of limited information on financial support, Tian-You

emotionally and physically experienced great challenges in the beginning of his acculturation to the CSE doctoral program. In the first semester, the challenges he tackled contained the differences in language and academic culture between Taiwan and America and the financial hardship. This disruptive start in his case led to worry and further influence his learning. The phrase “the most difficult period” is a superlative form emphasizing the extreme hardship he encountered when he joined the CSE doctoral program.

Besides this temporary financial hardship, he confronted other academic difficulties, including listening, speaking, and writing in English. Among these three, he reported that “So far I feel spoken English is the most difficult one to overcome” (interview transcript, April, 2015). Although English academic reading, writing, listening, and speaking are inseparable, in order to clearly analyze and discuss English academic difficulties he encountered during his acculturation processes, his English academic difficulties in listening and speaking and writing are reviewed separately in this section. Hence, the following section discusses listening and speaking challenges he encountered during his academic acculturation processes.

6.3.1 Difficulties in listening and speaking.

Before studying in the present doctoral program, his college and master’s learning were in Taiwan where English is a foreign language. Even if teaching materials his professors in Taiwan adopted were in English, Chinese was the main language in and outside of class. In addition, he had been learning in Taiwan for more than 18 years, so he was accustomed to Taiwanese instructors’ teaching styles. Therefore, the shift in language and academic culture from Chinese to the English dominant environment is one of the significant factors influencing his academic acculturation processes. In an

interview, he expressed the challenges of accommodating to the American classroom culture at the beginning of his doctoral study:

“When I just came here, it’s quite difficult. During classes, sometimes I didn’t understand what professors talked about... I try to watch American TV series. I feel it helps me improve my English listening although they’re not related to academy... My class discussions often contain some disciplinary terminologies. I’ve already known the terms, but professors’ talking often blends with local English usage. My listening is not good. I often didn’t understand professors’ lectures. Now, I don’t feel it’s a big challenge. Maybe I’ve been listening to several courses and I’m more familiar with their speaking styles.” (interview transcript, April, 2015)

In addition to not entirely understanding professors’ lectures, sometimes he also had a problem with comprehending his classmates’ oral language use. As a result of his inability to understand professors’ and peers’ conversations, he was sometimes unable to participate in class discussions:

“I rarely participate in class discussions, but I try to do my best. We’ve many discussions, but my English is not good. Sometime I couldn’t understand what they [professors and classmates] were talking about. If professors asked questions and I knew the answers, I’d try to answer them. Sometimes I’d just discuss with my classmate next to me in a low voice.” (interview transcript, April, 2015)

The above data demonstrate that he experienced linguistic and classroom cultural obstacles. These linguistic obstacles are evident in “During classes, sometimes I didn’t understand what professors talked about” and “I rarely participate in class discussions but I try to do my best... my English is not good.” His academic cultural obstacle is affirmed when he said “professors’ talking often blends with local English usage”, “Sometime I couldn’t understand what they were talking about”, and “We’ve many discussions”. These three pieces of evidence show his unfamiliarity with local English usage, domestic topics, and Western classroom culture, respectively.

Particularly, the Western classroom culture emphasizing learning, including oral participating in discussions is quite different from the Taiwanese classroom culture where students view instructors as knowledgeable figures and believe in learning from knowledgeable figures rather than from students. This belief, hence, leads to a

few instances of class discussions in Taiwan classroom. This difference possibly made Tian-You feel uncomfortable to participate in class discussion orally as seen in “Sometimes I’d just discuss with my classmate next to me in a low voice”. In an effort to surmount these difficulties in listening and speaking, he “watch[ed] American TV series” to help him “improve [his] English listening“ and “try to do [his] best” to participate in class discussions. Nonetheless, it is uncertain whether watching American TV series which consist of general spoken English could actually aid Tian-You in improving his academic spoken English and in comprehending lectures which are full of academic language.

Additionally, he confronted similar challenges when attending meetings in his advisor’s research team. In this team, his newcomer status and limited research experience in comparison to other members, coupled with many group members, various accents, unfamiliar content that members discussed, and fast-paced discussions led to further deterioration in his comprehension and participation during meetings:

“It’s hard to follow their discussions. Our team has many people. When having a meeting, they discuss many things, and I just join the team. Also, due to English, it’s hard to follow. Some members from different countries have their accents, and everyone has his own accent. It makes me even harder to understand what they said. I get used to their accents now, but it’s still difficult. Now, I can understand a little bit of what they discuss but still cannot participate in their discussions. Sometimes I don’t understand their conversations due to the content of their discussions I’m unfamiliar with. Another reason is English. Also, sometimes they discuss very fast. When I was still thinking about what they said, they had finished the topic and moved on to the next one. So, I passed the time to discuss the earlier topic... If I couldn’t understand what they said, after the meeting, I’d use lab time to ask them privately. Also, I’d spend time on finding and reading articles related to what they said.” (interview transcript, April, 2015)

The above data reveal that Tian-You repeatedly positioned himself as an outsider who could not access the group constructed by the others who were positioned as insiders. This is seen when he used “they” and “their” in “they always discuss many

things, and I just join the team”, “I get used to their accents”, “[I] still cannot participate in their discussions”, and “When I was still thinking about what they said, they had finished the topic...” Furthermore, he encountered difficulties in justifying his arguments when presenting his research during a meeting. This challenge was obvious when he compared himself with his peer who also started the doctoral program in the same year as he did:

“Before submitting conference papers, lab members who will submit their papers are required to present in meetings. Then, other members will give suggestions. A Pakistani student in my advisor’s research team started his doctoral study in the same year as I did. He can fluently present his research and confidently defend himself through back and forth discussing with audiences. I can present what I prepare, but if audiences ask me questions, sometimes I don’t know how to respond to them. I’d just accept what they said and suggestions at that time. After the meeting, I’d rethink whether their criticism and suggestions are reasonable or not...I understand what they said but couldn’t react to the questions immediately and don’t know how to defend myself right away...I saw most of them [senior doctoral students and post-docs] are able to do that. I can understand what they said but can’t speak fluently and express myself clearly.” (interview transcript, June, 2015)

These data show three main aspects of his acculturation to his advisor’s research team:

- 1) His advisor’s research team had a unique culture. This culture includes: a) recruiting researchers with different levels of research experience (e.g., new doctoral students, like Tian-You, senior doctoral students, and post-docs) and different cultural backgrounds, b) presenting research in a team meeting before submitting conference proposals in order to get suggestions from other team members, c) presenting research to defend own arguments, and d) fast-paced discussions with numerous members in the team so members who were going to submit conference proposals would have time to present their research. In an interview, he reported that the number of team members and types of team practices in his current research team were quite different from his previous research teams in Taiwan. The differences include more members from different

countries in a team, presenting own research before submitting a paper to a conference, defending own research positions, and fast-paced discussions. Due to these differences, he experienced difficulties in adjusting to the present unique research team culture. Even though these characteristics of his advisor's research team are factors impeding his smooth acculturation to the team, these characteristics, in fact, might assist him in socializing into the wider CSE communities. For instance, presenting own research in the team which comprised several experienced researchers could help him revise his conference proposals through receiving research feedback from members, practice his oral presentations in English, and practice ways of defending himself. Fast-paced discussions in English which resembled actual academic discussions in formal academic contexts could develop his academic listening competence and quick response. Exposure to various English accents in the team could assist him in listening to and interacting with international researchers at CSE conferences.

- 2) He confronted challenges of academic speaking in English, particularly the ability to defend his own research positions.

The above data also corroborate his three difficulties. The first difficulty is the inability to participate in discipline-specific research discussions as seen in “due to English, it's hard to follow” and “[I] still cannot participate in their discussions”. The second difficulty is the incapacity to defend his research viewpoints as shown in “if audiences ask me questions, sometimes I don't know how to respond to them”. The third difficulty is the failure to provide research suggestions to his team members who had more research experienced as proved by “I can understand a little bit of what they discuss, but I still cannot participate in their discussions.” Accomplishing these tasks (participation in disciplinary research discussions, defending himself, and giving

research feedback to colleagues) requires not only a high level of proficiency in English academic listening and speaking, but also adequate discipline-specific knowledge and research skills. Most importantly, successfully completing these tasks necessitates a change in his habits (which were formed by his L1 Chinese academic culture) of presenting research and of interacting with peers and colleagues. In Chinese academic culture, researchers are expected to be modest to accept others' suggestions even though some suggestions might not be constructive. Arguing back may cause the audience to lose face and also show that researchers do not have the magnanimity to accept criticisms and suggestions. In Chinese culture, there is a saying that “滿招損，謙受益” meaning that if one is consumed with self-satisfaction, he or she would be unable to see his or her own drawbacks. Since he or she could not see own drawbacks, he or she would be unable to improve him or herself. In view of the differences of academic culture between Taiwan and America, Tian-You's imperfect English competence, and novice status in the research team, he was struggling to accustom himself to his advisor's research team culture.

3) He developed strategies to overcome these difficulties.

While he was adjusting to the Western academic culture and the CSE culture, he also devised several strategies to cope with the difficulties he encountered. The first strategy is that he began by accepting the audiences' suggestions when being asked and he was uncertain of how to defend his research positions. Then, he rethought members' criticisms and suggestions after meetings as shown in “if audiences ask me questions, sometimes I don't know how to respond to them. I'd just accept what they said and suggestions at that time. After the meeting, I'd rethink whether their criticism and suggestions are reasonable or not”. Although this strategy could resolve his dilemma between defending his academic arguments and his inability to think and

respond quickly in English, this strategy might not be beneficial for his long-term academic development because being able to defend own research perspectives is a prominent academic skill in the Western academic culture. The second strategy is that he attempted to ask other team members about the content of discussions after meetings to compensate for his incapacity of understanding as verified by “If I couldn’t understand what they said, after the meeting, I’d use lab time to ask them privately.” Thirdly, he sought online sources to help him understand what team members said during meetings as seen in “I’d spend time on finding and reading articles related to what they said.” Taken together, his linguistic difficulties intersect with cultural differences leading to various challenges in his acculturation to the current CSE doctoral program.

6.3.2 Difficulties in academic writing.

In addition to challenges of English academic listening and speaking, he also confronted difficulties in academic writing in English. Although he had experience in writing academic English in L1 learning contexts (see 6.1 learning background), he did not receive written feedback from instructors and formal training in English academic writing in college, master’s program, and the research job. He also had experience in publishing two peer-reviewed journal articles in English with other researchers before studying in the doctoral program. Nevertheless, he reported that he only wrote a few sections in the articles and the rest of the sections were written by his co-authors who had more experience in CSE research and English academic writing (interview transcript, August, 2016). In the first doctoral year, he was required to take one ESL writing course. Nonetheless, he self-reported that he learned more about English academic writing from feedback given by his advisor and a post-doc

who worked closely with him than from the ESL writing course (interview transcript, April, 2015). In view of the lack of appropriate training in English academic writing and effective English writing instruction, multiple data reveal that he encountered difficulties in writing class assignments and conference papers. For class assignments, he stated that he always ran out of words to clearly express his answers and hence devised a way to support his written explanations:

“If I write more, I’m afraid I cannot explain it well and readers cannot understand it. I write an answer shortly...Once I wrote an assignment. My answer was right, but the explanation seemed to be unclear. My professor circled it and gave me a big question mark. I asked him and he said he couldn’t understand my explanation. Although my answer was right, he wasn’t sure whether I understood the question. So, I orally explained my answer to him and he knew I understood how to answer the question. Because of that experience, I think sometimes providing an example [a diagram] could help me explain my answer clearly. So, for my later assignments, I always give examples [diagrams] and never get that kind of feedback from professors anymore.” (interview transcript, May, 2015)

The above data reveal that he had difficulties in clearly writing explanations in English. Meanwhile, he thought more explanations could confuse readers further. However, a possible explanation why his professor was confused might be that his explanation was short which resulted in an unclear expression. When he orally explained his answer to the professor, his professor understood his oral explanations. This shows that his written explanation in English was unclear enough for the professor to understand. On account of this experience of the question mark given by his professor, he developed the strategy of drawing a diagram via Lucidchart (online visualization software) or PowerPoint to support his answers and to compensate for his weakness in English writing. He self-evaluated this strategy by saying “[I] never get that kind of feedback from professors anymore.” The words “that kind of feedback” refer back to “a big question mark” and show that providing an example via drawing a diagram assisted him in making his written expression easily comprehensible. Supplement 6-1 depicts a diagram that Tian-You added to his written

explanation for one of his assignments in order to clarify his written answers. This diagram is comparable to a picture format and hence provided readers with a quick understanding of his written answer. In this diagram, a combination of lines, symbols, layers, and numbers presented some hierarchal relationships that might not have been explained clearly in his written expression.

Besides the challenge of writing class assignments, he also confronted difficulties in writing conference papers. Before submitting a paper to a CSE conference, he always submitted his draft to the post-doc who worked closely with him to review first. In an interview, he reflected on how he felt when reading the post-doc's revised version:

“Before each submission, I'll give my conference paper to the post-doc. Then, he'll read and directly revise it. He actually changed my writing a lot. For example, after reading a paragraph I wrote, he understood what I meant. Then, he'd rewrite it. He changed a lot, but the meaning was similar to mine. Also, he'd add some parts to make my meaning clearer. He mainly changed my introduction. For the methodology and experimental results, he didn't change too much. He just added some parts and corrected grammatical errors. After comparing to his revision, I feel the way I write an introduction is not good enough. I don't write it from a big angle and then narrow it down to my main topic. He's been in this research area for 10 years and knows lots of research so he can write from a big angle to the research problem that we are addressing... I likely learned this writing style before, but when I actually write a paper, I just can't write it well... I'm just here around one year, so his and my writing are obviously different.” (interview transcript, June, 2015)

The above data reveal that he had difficulties in presenting his research and perspectives clearly in academic written English as seen in “He changed a lot, but the meanings were similar to mine. Also, he'd add some parts to make my meanings clearer.” In addition, although he learned the Western way of writing an introduction, he had not yet internalized it as shown in “I likely learned this writing style before, but when I actually write a paper, I just can't write it well.” The word “likely” shows that he might have learned how to write the Western style of an introduction before but was unable to thoroughly apply the learning to his actual writing. For an L2

language learner as Tian-You, the period from learning English academic writing conventions to being able to write smoothly requires many years of continuing being exposed to English academic readings and practicing academic writing through receiving written feedback, correcting errors, and constantly writing. As the section on his learning background mentioned, he had opportunities to write English in L1 Taiwan learning contexts but was not given written feedback on most of his writing. Thus, he might not even know what kinds of writing problems he might have and how to improve his writing weaknesses when having the opportunities to write English in L1 learning contexts. Moreover, he self-analyzed his situation of being unable to write an introduction well because he just joined his advisor's research team and studied this area of research for a year. In yet another interview (interview transcript, August, 2015), he stated that his college research focused on programming for common use software; his master's thesis aimed at wireless research; his present doctoral research area which was also related to his advisor's research project aimed at developing software for supercomputers. Although he explained his inability to write the Western-style introduction was due to a limited number of years in the current research area, in fact, this might not be the main factor. The number of years in a research area possibly influences the depth of research knowledge that he acquired. Nevertheless, the ability to write from a general description to a research problem is probably not greatly affected by the number of years spent in a research area but more by the capability of writing the Western-style introduction. This inability of writing the Western-style introduction is seen in "I don't write it from a big angle and then narrow it down to my main topic." Since he had not internalized the Western style of writing an introduction, he struggled to write an introduction of a conference paper for a CSE conference.

With regard to interactions between him and the post-doc, on one hand, and his advisor, on the other hand, these data show that he worked closer with the post-doc than with his advisor. The post-doc's role could be described as an apprentice-oriented model as seen in "Before each submission, I'll give my conference paper to the post-doc. Then, he'll read and directly revise it", "He changed a lot ...", and "He just added some parts and corrected grammatical errors." Although there were many changes to Tian-You's document, he still felt ownership of his research ideas as proved by "He changed a lot, but the meaning was similar to mine." Conversely, when he did not mention his advisor in this lengthy data which he described the process of writing his conference paper, this reveals that the advisor's role is not hands-on and present in the revision process. His advisor, therefore, plays a supervisor-role. This supervisor-role is further confirmed by additional data (interview transcript, June, 2015) when he reported that after several revisions with the post-doc, his advisor would be the last person to check the conference paper before submission.

Other than the problems of writing clear expressions and an introduction in a conference paper, he also experienced difficulties in ways of presenting his research in a conference paper meeting the expectations of his research team and Western CSE communities:

"The conference paper I submitted last time didn't get accepted so I revised it. I'll submit it to another conference. Our lab always submits papers to some top conferences each year. The conference I plan to submit is the middle ranking. It's not a top one but still good. After revising my paper, I sent it to other experienced researchers in the team. They revised it a lot. I added some parts previous reviewers suggested... Some reviewers said my related works were not enough and also some areas were confusing. ... Some reviewers said my research results tended to be practical not research-orientated, so this time I added some analyses and math models." (interview transcript, November, 2015)

The above data reveal that his research competence and conference experience were not enough for top CSE conferences as seen in “Our lab always submits papers to some top conferences each year. The conference I plan to submit is the middle ranking”. This is verified further when his conference paper was perceived as not having reached the standard to be reviewed by conference reviewers as shown in “I sent it to other experienced researchers in the team. They revised it a lot.” Moreover, reviewers’ feedback for his last conference paper reveals that his way of writing this conference paper did not highlight the strength of his research as proved by “Some reviewers said my research results tended to be practical not research-orientated”. The possible reason he did not highlight the strength of his research might be that he was unable to present the various components of his research in a way that reviewers could understand. In this regard, the reviewers’ suggestions show that his conference paper writing competence still needed to be improved.

While struggling to write a conference paper, he also confronted a dilemma of satisfying advisor’s, experienced researchers’, and CSE communities’ expectations for the section of the literature review. This section is also called related work in CSE communities:

“Some reviewers said my related works were not enough... For the early draft of my [conference] paper, I cited many studies but other experienced researchers and my advisor deleted many of them. I found they don’t like to cite many studies. I feel related work is important, but they don’t care too much about it. My advisor said citing too many studies would kill my paper, so he asked me to not write too many citations and just write one to two sentences in the section of related work. Other researchers in our team also do that. I don’t know why, but what I can do now is to follow what my advisor said...My other colleague from China also cannot understand it.” (interview transcript, November, 2015)

During the field work, a scrutiny of 10 conference papers from two top CSE conferences reveals that most researchers cited more than 15 previous studies and described the prior studies in their introductions before indicating their research

problems. These findings from the field work are inconsistent with Tian-You's report when he said "My advisor said citing too many studies would kill my paper, so he asked me to... just write one to two sentences in the section of related work." Nevertheless, from the field work, his collaboratively authored conference papers did cite prior studies, and the description of prior studies was more than "one to two sentences". This inconsistency might have been caused by his misunderstanding of what his advisor meant about how to write related work. This misunderstanding might result from his insufficient English and unfamiliarity with the Western style of writing a CSE conference paper. When he said "My other colleague from China also cannot understand it", he took a defensive position as if he was suggesting that he was not the only one who did not understand it. This defensive position might further hinder him from learning CSE conventions of writing a conference paper during his acculturation processes.

On the whole, these data reveal that Tian-You confronted difficulties in writing assignments and CSE conference papers. These difficulties are compounded by his status as an L2 English learner who navigated academic language and cultural conventions in the Western setting. However, his interactions with other more experienced CSE communities (in his advisor's research team) prove beneficial to his acculturative effort. Thus, during the process of writing conference papers, he could learn the conventions through back and forth rewriting and revising with the post-doc and through the last stage of double-checking by his advisor before submission. Such relationships which he worked with old-timers (the post-doc and his advisor) might accelerate the speed of his socialization into CSE communities. Nonetheless, his beliefs regarding ways of writing his research related work which is contrary to his advisor's beliefs might be obstacles during his academic acculturation processes.

6.4 Tian-You's Use of Technologies for Academic Acculturation

Multiple data reveal that Tian-You adopted a variety of technologies for different academic purposes. His use of various technologies might be because of his computer science's background. He also had a habit of looking for and playing with different software. This habit could help him understand what functions new software have, how he could utilize the functions to undertake academic tasks and learning, and how the software was designed. Interview data further reveal that this habit was formed when he studied in college in Taiwan. It is possible that studying computer science and playing with different software could help him catch up with the present trends in computer science industries and stimulate his ideas of software designs and research. Table 6.3 visualizes his self-reported frequency of utilizing some essential technologies for academic purposes within 14 weeks. According to this table, he often employed online social interactional technologies (288 times), note-taking and documenting software (219 times), reading and presentation software (138 times), online lexical resources (66 times), and academic search engines (45 times). The lowest frequency-use is citation software (5 times) followed by online storage (6 times). The use of citation software is minimal because he was a first-year doctoral student when he was interviewed for this study. Thus, he was still taking CSE core courses and had not started to write his dissertation. Moreover, he might not need to utilize citation software to help him organize abundant literature because a conference paper in his field generally has no more than 20 citations (field work). Notably, his use of technologies is characterized by the frequency and the quality of technology use. Table 6.3 reveals that his use of PDF software and PowerPoint has a high frequency (138 times/14 weeks) whereas his use of Google Scholar and Google Book search engines has a lower frequency (10 times/14 weeks). While it is possible to

argue that this high frequency indicates the PDF and PowerPoint are significant in his acculturation processes, the low frequency in the use of Google Scholar and Google Book search engines do not reflect the impact these technologies had on his acculturation processes. Therefore, this section considers both his frequency of use and the qualitative impact of technologies on his academic acculturation processes. Taken together, the use of online social interactional technologies, note-taking software, reading and presentation software, online lexical resources, academic search engines, and online videos offers a conducive atmosphere for Tian-You's academic acculturation in CSE communities.

Board Categories of Technologies	Specific Technologies Used	Approximate Frequency/ 14 weeks	Uses
Academic Search Engines	Google Scholar & Google Book	10	1) Searched for more explanations of terminologies that professors mentioned in courses via searching for academic articles, dissertations, and books 2) Read partial important sections related to the terminologies
	Google scholar citation & dblp (a CSE search engine particularly providing bibliographic information on major conference proceedings and journals)	5	1) Searched for CSE conference, seminar, and journal papers to understand which researchers were key figures in CSE communities 2) Read their papers and obtained the information of citation counts to understand CSE research trends and further help him know which research orientations he could work on.
	IEEE Xplore (a CSE academic search engine)	10	1) Searched for academic papers for the current research project 2) Searched for and downloaded particular conferences' papers
	ACM Digital Library	10	➤ Searched for and downloaded particular conferences' papers
	AMiner (a CSE search engine particularly offering information of ranking and impact factor of CSE conferences and journals)	5	➤ Searched for CSE famous conferences' and journals' ranking and impact factor
	Wikipedia	5	➤ Searched for unfamiliar CSE terms and concepts
Reading and Presentation Software	PDF Software & PowerPoint	138	1) Read CSE books, dissertations, academic papers, and slides provided by professors or obtained online for courses and research 2) Took notes via the note-taking and highlighting functions for courses and research

Continued

Table 6. 3 Tian-You's 14-week Weekly Journals of His Technology Use for Academic Purposes

Table 6.3 Continued

Board Categories of Technologies	Specific Technologies Used	Approximate Frequency/ 14 weeks	Uses
Note-Taking and Documenting Technologies	Evernote	28	1) Recorded experimental problems and solutions 2) Recorded and searched for experimental procedures and parameters 3) Took notes when attending conferences
	Google Keep	140	1) Recorded assignments and conferences deadlines and set up reminders (everyday tasks) 2) Recorded research progresses and set up reminders
	Google Sheet	27	➤ Recorded experimental data and generated diagrams for research
	Microsoft OneNote	10	➤ Took notes about questions based on daily English conversations and then sought clarification from the ESL spoken class instructor
	Cell phone voice recording App	14	➤ Recorded spoken English classes and listened to the recordings while practicing spoken English at home
Drawing Software	Gnuplot (professional visualization software)	10	➤ Constructed graphics for course assignments to make his assignments look more professional
	Lucidchart (visualization software)	2	➤ Drew flowcharts to clarify his written explanations for his assignments
	PowerPoint	3	➤ Drew flow charts
	Coggle (mind mapping software)	6	1) Drew mind maps to clarify research questions and solutions 2) Drew mind maps to clarify current and new research questions
Online Videos	Coursera (online open courses)	20	➤ Reviewed some courses on CSE core knowledge to prepare for his qualifying exam
	YouTube	5	1) Watched some videos recommended by senior researchers on speeches given by industrial engineers and other professors based on CSE hard and software 2) Watched TED videos about using technology in education

Continued

Table 6.3 Continued

Board Categories of Technologies	Specific Technologies Used	Approximate Frequency/ 14 weeks	Uses
Online Videos	Intel Webinar (web seminar)	2	➤ Participated in webinar with team members to understand Intel's new designed methods for hardware
Citation Software	BibDesk	5	➤ Generated bibliographies
Preparation Software	TexShop / ShareLaTeX	30	➤ Revised a journal article via LaTeX and shared with his previous master's advisor to collaboratively revise the article via ShareLaTeX
Online Social Interactional Technologies	LinkedIn Groups	4	➤ Read High-Performance Computing related academic articles
	Facebook	3	➤ Discussed a final exam with Taiwanese classmates
	Google Hangouts	70	➤ Discussed the progress of the current research projects with the post-doc who worked closely with him and other team members
	Email (Inbox by Gmail or school email)	150	➤ Discussed the progress of the current research projects with his advisor and senior researchers
	Piazza (a course-based, exclusive access online discussion forum developed by one of his professors)	14	1) Read classmates' questions and the professor's and graduate teaching assistant's answers 2) Participated in online discussions
	Stackoverflow and Quora (discipline-based online discussion forums)	32	1) Searched for possible answers when he faced experimental, programming, and theoretical questions 2) Searched for information about how to operate some software for research

Continued

Table 6.3 Continued

Board Categories of Technologies	Specific Technologies Used	Approximate Frequency/ 14 weeks	Uses
	CONSIDER (an online discussion forum which is course-based, exclusive access, and anonymous to student users developed by one of his professors)	15	1) Answered course questions given by the professor and the GTA in and out of the class 2) Discussed assignments with classmates
Online Lexical Resources	COCA	16	➤ Looked up usage of English grammar and academic vocabulary
	Treasure.com / Google dictionary	20	➤ Looked up synonyms to help him write papers
	Merriam-Webster	30	➤ Looked up unfamiliar English vocabulary and usage
Time Management Software	RescueTime (a website can record mobile devices, software, and websites used and how much time these were used)	14	➤ Automatically recorded what software he used, what websites he browsed, and how long he spent on using the software and websites (on both of his cell phone and laptop)
Online Storage	Google Drive	1	➤ Downloaded dissertations, academic papers, computer programs, and experimental data and then organized and classified them
	Dropbox	5	➤ Shared research data and materials with peers

6.4.1 Online social interactional technologies.

Email. As shown in Table 6.3, online social interactional technologies have the high frequency use (299 times) during Tian-You's academic acculturation processes. This indicates that these technologies had a significant impact on his academic socialization. Multiple data reveal that he employed a variety of online social interactional technologies, such as email, Google Hangouts, online discussion forums, Facebook, and LinkedIn, to discuss course assignments and research and obtain CSE related information. Nevertheless, in his first interview, he expressed a higher preference for face-to-face communication than online interaction and the advantages of face-to-face and online interaction:

“I prefer discussing by face-to-face to online because I can practice my oral English. Also, face-to-face discussions can stimulate some thoughts in me. At least I can know whether speakers understand what I said via seeing their facial expressions. If they don't understand, I can use another way to explain. Or, if I can't understand what they said, I can see their facial expressions and gestures. But, the advantage of typing words via online platforms, like email, is that I've more time to think about what and how I could describe something.” (interview transcript, April, 2015)

As an L2 English learner, he faced difficulties in academic listening and speaking.

These difficulties could be resolved by relying on additional sources, such as body language, to increase his comprehension of what interlocutors said and help his audience understand his expressions. The above data also reveal that he knew his weakness of spoken English and attempted to grasp opportunities to practice his English speaking as seen in “I prefer discussing by face-to-face to online because I can practice my oral English.” It is likely that the more practice he had, the more he could improve his spoken English competence. Even though he expressed his preference for face-to-face discussions, he noticed the advantage of communication through typing which gave him

more time to think and write. Noticing this advantage is also corroborated by his additional data. The following data show the advantages of online asynchronous communication via typing as follows: a) express ideas clearly, b) the absence of pressure to respond immediately, c) more time to think about what he wanted to write, and d) more time to write what he wanted to express:

“I feel I can express my ideas clearer through online than face-to-face. Like email, I can spend time on thinking about how to describe what I want to say first. But, for face-to-face communication, I need to respond immediately. Sometimes I’m still thinking what I want to say, but I need to respond right away. So, my expression may not be good. Like during meetings, I might express something unclear, and my advisor misunderstood what I meant. Then, I needed to spend more time on explaining it... If I use email, I can write down my completed thoughts first. Then, I reread my writing to see whether there’re some problems before sending it out.” (interview transcript, April, 2015)

The above data reveal that he was aware of difficulties he faced and of a strategy to compensate for these difficulties as verified by “my expression may not be good”, “I might express something unclear, and my advisor misunderstood...”, and “If I use email, I can write down my completed thoughts first. Then, I reread my writing to see whether there’re some problems before sending it out.” This strategy is to employ email to compensate for his weaknesses of speaking in English. Using email allowed him to have more time to ponder over communication with interlocutors and prepare himself to respond effectively. In this case, emailing serves in an assistive role as he navigated communication in English.

Another advantage of utilizing online social interactional technologies for him is that the technologies enable him to interact with other researchers in the world. In an interview, he expressed his interactions via email and Skype with previous master’s professors and researchers of academic articles he read:

“I’ve research collaboration with my previous professors in Taiwan. They want to publish journal articles, and I did some of their experiments... I discuss with them via email and Skype... Sometimes I read articles or dissertations and have questions, I’ll email the researchers. In our field, it’s very normal to do that. Or, I ask them whether they could share their self-designed computer programs. Most of them are willing to share. We try to help each other.” (interview transcript, April, 2015)

These data reveal the advantage of employing online social interactional technologies for him to communicate with researchers in the world as verified by “I discuss with [my professors in Taiwan] via email and Skype” and “Sometimes I read articles or dissertations and have questions, I’ll email the researchers [who may be in different countries]”. Such online communication via Skype and email provides him opportunities to discuss research with oversea researchers without being present in the same place. Moreover, it enables him to participate in multiple CSE communities other than his present advisor’s research projects. His professors in Taiwan are a part of an L1 Chinese CSE community, and researchers of academic articles and dissertations he read are a part of a global multilingual CSE community. Such online communication cross borders benefits him to develop broader research views and increase opportunities to undertake cross-countries research (e.g., knowing CSE research conducted in Taiwan and the U.S. v.s. knowing CSE research conducted in various countries). This exposure positioned him to eventually become a global researcher which enhanced his acculturation to CSE wider communities.

Despite these above benefits of utilizing email, some disadvantages of using it to interact with professors exist. These disadvantages include receiving no response from professors and miscommunication. These phenomena seem to particularly affect his interactions with professors:

“My professors always tell students to ask questions via email or during office hours. In fact, they prefer us to ask questions via email. After emails, if I still have questions, I’ll directly ask professors face-to-face. The advantage of using email is that I can throw questions to professors immediately when having questions. Then, I wait for their responses. The disadvantage is that I need to wait for their responses. Sometimes they don’t reply to my emails. Sometimes it’s probably my English, so they misunderstood or confused my questions. Or, sometimes their responses are too simple. They’re very busy. I may write a long paragraph to ask a question, but they just write one to two sentences which I still couldn’t understand. So, I still have to ask them face-to-face.” (interview transcript, April, 2015)

The above data disclose that Tian-You seems to have no choice of which communicative channel to use when interacting with his professors as seen in “they prefer us to ask questions via email.” In addition, even if he followed his professors’ rule to ask questions by email, there was no guarantee that he would receive his professors’ responses, and he seems not to have a solution for this situation. Moreover, the advantage of clearly expressing his ideas via written email sometimes became a disadvantage, especially when his written expressions were unclear as seen in “Sometimes it’s probably my English, so they misunderstood or confused my questions.” The word “probably” demonstrates that he was unclear about the cause of misunderstanding and confusion by his professors. Unlike email, in a face-to-face situation, he enabled to clarify his questions by synchronously communicating with his professors which an online asynchronous communication could not have. Furthermore, unlike face-to-face communications, asynchronous and written communications are unable to instantaneously communicate with interlocutors until reaching a mutual understanding. In order to reach a mutual understanding in the email environment, interlocutors may need to write emails over several turns or write more than “one to two sentences” in order to clarify confusing places. Such an asynchronous and written communication requiring time and effort to reach a mutual understanding might make “very busy” professors to be

unwilling to spend additional time on writing long emails to answer students' questions as confirmed by "sometimes their responses are too simple."

Google Hangouts. In his weekly journals and interviews, he reported that he often employed Google Hangouts to discuss research with his advisor's research team members. More specifically, he mainly employed it with the post-doc for emergent cases:

"When I just joined the team, the post-doc and other researchers asked me to use Google Hangouts... We use it, especially when approaching the deadlines of conference papers or research projects. I mainly use it with the post-doc. He'd directly message through it to ask me to test something or briefly discuss something. If we need to discuss in detail, we use email. So, my Google Hangouts keeps open... Last week, I had a conference paper due at 8 am on Tuesday. My advisor emailed his suggestions around 11 pm on Monday. Then, I quickly revised it and then sent it back to him. He looked at it and gave suggestions again. We went back and forth several times... Meantime, the post-doc and I used Google Hangouts to discuss our revisions. For example, I revised this part and he revised another part. When we finished revising the paper, I sent it via email to my advisor. He doesn't use it but knows we use it." (interview transcript, June, 2015)

The above data exhibit features of Google Hangouts as used in this interaction, including succinctness and immediateness as seen in "He'd directly message through it to ask me to test something or briefly discuss something." These features enable him and the post-doc to promptly go "back and forth" messaging and share writing with each other in order to meet the deadlines of conference papers or projects. Additionally, these features allow them to have an intensive collaboration to write or revise a paper within a short period. Moreover, the data disclose that he communicated with the post-doc and his advisor in different ways. When communicating with the post-doc, he employed Google Hangouts whereas when communicating with his advisor, he utilized email. This distinction of using Google Hangouts and email was not decided by him but by his advisor and other researchers who joined the team before him (experienced researchers)

as seen in “the post-doc and other researchers asked me to use Google Hangouts” and “[My advisor] doesn’t use [Google Hangouts] but knows we use it.” Therefore, this uncovers his hierarchical use of online social interactional technologies. This hierarchy demonstrates that his advisor’s research team existed stratified levels, according to researchers’ research experienced in CSE communities. Furthermore, the hierarchy implies a distance between novices and experts (his advisor and senior researchers) in his advisor’s research team. The hierarchy and the distance might influence Tian-You’s academic acculturation processes.

Facebook. Besides Google Hangouts, he also employed other social interactional technologies to communicate with his classmates. In his survey responses, he reported that he always employed email, communicative apps, and social media sites to discuss assignments, courses, and research with peers. In an interview, he further described his use of particular social interactional technologies with specific groups of students:

“I often use Facebook, Line, or Skype to talk to Taiwanese students. I particularly use Facebook to discuss assignments and final exams with Taiwanese classmates. I joined Taiwanese student association Facebook group when coming here. Many Taiwanese students also joined the group so it’s easy to communicate with my Taiwanese classmates via it. Our messages are mainly in Chinese, but some terminologies are in English. For lab colleagues or students from other countries, I don’t know what communicative apps they use. Since everybody knows email, I use it to discuss with them. English is the only language. Or, if I’ve questions I want to ask them, I ask them after classes or in the lab... For email, I need to wait longer to get responses but for Facebook, I send a message out and can quickly receive responses. But, typing messages via those apps is like writing emails. Sometimes writing still couldn’t clearly express what I want to say or I couldn’t understand what interlocutors meant.” (interview transcript, April & May, 2015)

The above data reveal that he used Facebook because it was the most popular technology utilized by Taiwanese students. When interacting with students from other countries, the common communicative technology, email, which “everybody knows”,

was his first choice when he did not know what the most popular social interactional technology other groups of students utilized. His uncertainty of the popular social interactional technologies used by other groups of students also implies that he was not close to students other than Taiwanese students. Additional interview data confirm this implication: “My department has many international students but Taiwanese students are a few. Some of my international classmates are from China and India. They often form their own groups so it’s hard for me to join them” (interview transcript, August, 2016). This lack of intimate relationships with classmates from other countries probably led him to mainly “use Facebook to discuss assignments and final exams with Taiwanese classmates”. Another possible reason he utilized Facebook to communicate with his Taiwanese classmates is that he could use L1 Chinese to discuss assignments, exams, and research, as seen in “Our messages are mainly in Chinese.” When employing email to discuss academic tasks with students from other countries, “English is the only language” which might cause the miscommunication between him and his classmates. These data reveal that he found that writing via technologies constrained his ease of communication. This problem is exacerbated by the English only environment which is proved by “Sometimes writing still couldn’t clearly express what I want to say or I couldn’t understand what interlocutors meant” and “English is the only language”. These data also disclose that the centrality of an assortment of online social interactional technologies (e.g., Line, Skype, and Facebook) to Tian-You’s interactions with peers during his academic learning processes. In addition, he sometimes employed a face-to-face channel to communicate with peers as seen in “if I’ve questions I want to ask them, I ask them after classes or in the lab.” Therefore, his use of face-to-face and technology-based

communication was shaped by various advantages and disadvantages of these communication modes.

Besides utilizing Facebook to discuss coursework with Taiwanese peers, he also occasionally browsed CSE related articles through his Facebook account:

“I joined some Facebook groups. A group was created by one of my Taiwanese professors. He regularly posts in computer science related articles there. He also has a blog where I can download new and professional techniques. I skim through those articles and his blog occasionally. I don’t often use Facebook for academic purposes. More often I use IEEE Xplore [a CSE academic search engine] to search and read articles. Using Facebook easily distracts my attention from work... Every morning, I read e-magazines related to computer science I subscribed to. I also look at my friends’ posts in Facebook’s News Feed. Some groups’ posts show up in News Feed. If I’m interested in groups’ posts related to research, I’d look at them.” (interview transcript, April & July, 2015)

The above data disclose that his use of Facebook was not only for discussing assignments and exams with peers but also for continuing and maintaining relationships with previous CSE professors in Taiwan as verified by “A group was created by one of my Taiwanese professors.” Such an online academic group where members knew each other created an online community for the members to maintain their academic relationships and keep being updated, especially when members lived in different countries, allows him to be part of CSE communities and keep up with the development of CSE scholarship in Taiwan. Moreover, the feature of the News Feed on Facebook (see Supplement 6-2) which automatically shows members’ online posts on the main web page of his Facebook account enables him to continue receiving CSE related information while browsing his friends’ non-academic posts. Although he said “Using Facebook easily distracts my attention from work”, he still paid attention to CSE information during his leisure time. He probably thought “Using Facebook” was not considered as academic learning and “[using] IEEE Xplore to search and read articles” was academic learning.

The way he used IEEE Xplore extended some functions (e.g., search for CSE articles within huge databases of CSE academic papers) that Facebook could not offer him and which meant IEEE Xplore was a complimentary technology.

LinkedIn. Another online social interactional technology he employed to receive scholars' publication information is LinkedIn. He did not know this new function of LinkedIn until his advisor sent him CSE scholars' academic articles via email:

“My advisor often sends some links to academic articles he thinks they are good for us to read. Once he sent a link connecting to LinkedIn. I just realized it has this function. Before, I thought it was an online place for people to put their resumes. After my advisor's introduction, I joined LinkedIn and found there're many academic articles. My advisor wants us to know the newest research, development, hardware, and software to see whether there is something we can use in our research projects. LinkedIn regularly sends me emails when there're new articles. I'd click the links to read the articles. Those articles are published by outstanding researchers.” (interview transcript, May, 2015)

The above data reveal that his advisor, as an expert in the CSE field, shared links to what he thought was good research with novice researchers as proved by “My advisor often sends some links to academic articles he thinks they are good for us to read.” This sharing of expert's research perspectives could develop Tian-You's ability to distinguish good and bad research and further cultivate his research competence by seeing those good research as models. Moreover, the function of LinkedIn provides him opportunities to gain expose to the latest scholarship as proved by “LinkedIn regularly sends me emails when there're new articles...Those articles are published by outstanding researchers.” LinkedIn is, hence, a window to CSE communities and instrumental in his academic socialization.

Online discussion forums. Online discussion forums are another means for him to obtain computer science information during his academic acculturation processes. An online forum primarily means for asking questions, seeking and providing help, and discussing. Table 6.3 shows that among several online discussion forums, Starkoverflow and Quora which are predominantly computer science online open discussion forums have a high-frequency use (32 times/14 weeks). His survey data also disclose that he participated in online discussions more often than in face-to-face discussions. In an interview, he further described using a discipline-based online discussion forum, Stackoverflow (see Supplement 6-3), which English was the main language, to solve the problems he confronted during study or programming:

“I usually go there to see if others ask similar questions as mine. Then, I’d see whether someone answered the questions and how they answered them. I usually can find similar questions as mine. Reading related discussion posts can avoid wasting my time on trying wrong methods. In fact, I Google my questions, and the first or second search result always links me to Stackoverflow. It’s mainly used by people to discuss computer programs. When facing some questions about programming or theories, I’ll go there to find answers. If I see someone’s questions and know the answers, I’ll also post my answer.” (interview transcript, April, 2015)

The above data disclose that he relied more on getting support from wider online CSE communities than from immediate support (e.g., his professors, lab colleagues, and classmates) to resolve the questions he encountered during the processes of his academic learning and programming. This is verified by “I usually go there to see if others ask similar questions as mine. Then, I’d see whether someone answered the questions and how they answered them.” Moreover, he thought that reading discussion- related posts could save his time instead of “trying wrong methods.” His habit of using online sources to resolve his academic questions, in fact, originates from his past experience of searching online sources via Google in college and the master’s program in Taiwan (see

Table 6.2, the row of “Technological Infrastructure”). His past habit of using online sources to solve his academic questions constitutes an important skill to help him adjust to the Western higher education. The above data also imply that given Tian-You’s specific needs and preferences currently, there were no better solutions that his CSE department and institution provided to deal with his daily-based questions on academic learning and programming. The particular virtual support he sought is a CSE online open discussion forum (Stackoverflow) which consisted of other CSE students, researchers, and programmers. Such virtual discussion forum enables him to interact with as well as learn from other students, programmers, and researchers in wider CSE communities. This is proved by “When facing some questions about programming or theories, I’ll go there to find answers. If I see someone’s questions and know the answers, I’ll also post my answer.” This description shows his agency as an active participant in both giving and receiving CSE related information.

However, his use of Starkoverflow is problematic. He said “I Google my questions, and the first or second search result always links me to Starkoverflow.” Mainly depending on “first or second search result” generated by Google might result in overlooking some useful web pages which went beyond the first and the second search results. Moreover, even though this forum has a feature where users can vote for answers to show they agree with the answers, it is unclear how he determined the accuracy of answers posted by online users. Although he argued that “Reading related discussion posts can avoid wasting [his] time on trying...”, it is uncertain whether the answers he selected from online discussion posts were correct or not.

In comparison with other online discussion forums (e.g., Piazza and CONSIDER; see Table 6.3), he utilized Starkoverflow more than twice the frequency of any other individual online discussion forum. This high-use of Starkoverflow might, hence, have a negative impact on his academic acculturation because of the lingering uncertainty of answers generated by users, the anonymity of users, the lack of clarity about their expertise in the CSE scholarship, and the absence of a need to justify votes through a transparent explanation. On the other hand, a positive impact of using this forum on his academic acculturation is that English is the main language of communication. Although he is a Chinese speaker, this forum gives him exposure to discipline-based English which might facilitate his further familiarity with CSE terms and expressions in English. When contributing to this forum, he voluntarily opted to participate in interactions that are English dominant. This choice positioned him as a willing learner of L2 English.

Taken together, Tian-You employed various online social interactional technologies to communicate with his CSE professors, advisor, research team members, classmates, and scholars immediate meaning in the school and non-immediate settings meaning outside of the school and in different countries respectively. Table 6.3 also reveals that the online social interactional technologies have the highest frequency use. Some of his use of these technologies were influenced by his professors (e.g., online discussion forums: Piazza and CONSIDER), advisor's research team (e.g., fast-paced email culture and Google Hangouts), and popular social interactional technologies used by certain groups of students (e.g., most Taiwanese students use Facebook). Particularly, in his advisor's research team, the choice of online social interactional technologies was not made by him but his advisor and senior researchers. This phenomenon implies a hierarchy between

novices (Tian-You) and experienced researchers. This might create a distance, especially with regard to communication with his advisor via email. In sum, his use of these social interactional technologies is complicated by interacting with different interlocutors and hence simultaneously negatively and positively impact his academic acculturation processes. However, after a close scrutiny of it, as shown in Table 6.4, the advantages far outweigh the disadvantages. Consequently, it could be inferred that his use of these online social interactional technologies positively influenced Tian-You's socialization into CSE communities.

Disadvantages	Advantages
<ol style="list-style-type: none"> 1. The inability to clearly express what he wanted to say in written English due to his insufficient English academic writing competence 2. The inability to see interlocutors' body language in asynchronous communication which could help him understand whether the interlocutors understood what he said or not 3. The inability to synchronously express his meanings (e.g., in asynchronous communication) to increase the interlocutors' comprehension 	<ol style="list-style-type: none"> 1. having more time to think, organize, and write up his thoughts than face-to-face communication, 2. reporting his updated research progress with his data analysis documents to his advisor and senior researchers, 3. facilitating collaborative work (e.g., the use of Google Hangouts with the post-doc to write a conference paper), 4. participating in multiple CSE communities, 5. maintaining relationships with CSE scholars, 6. obtaining CSE information to understand the current trends 7. receiving support from CSE wider communities

Table 6. 3 The Advantages and Disadvantages of Online Social Interactional Software

6.4.2 Note-taking and documenting technologies.

In comparison to his use of online social interactional technologies (288 times, see Table 6.3), note-taking and documenting technologies also have a high-frequency use (219 times). As a doctoral student, note-taking and documenting are important for him to

record, organize and remind him of his academic learning and research tasks. To achieve these goals, he employed technologies comprising Evernote, Google Keep, Google Sheet, Microsoft OneNote, and a voice recording app. Two of note-taking technologies, PDF and Google Doc, he did not mention in his weekly journals but in his survey responses and interviews. In his survey, he reported that he often utilized these technologies to take notes when attending classes, meetings, and conferences, reading academic articles, and other academic events.

PDF. In an interview, he stated that when taking notes during class time, he always wrote down his notes on lecture slides (in PDF format) which were uploaded by instructors to Carmen [the school online course management] before classes:

“Most of my professors put their slides on Carmen... I’ll download and read them to see what they’ll teach before class... During class, I directly take notes on the slides via my laptop. After class, I reread my notes when writing assignments.”
(interview transcript, May, 2015)

The above data reveal that his past learning habits (see Table 6.2) lasted until the time of this study. These habits include downloading and reading lecture slides before class, taking notes during class, and reviewing teaching content via reading lecture slides and his notes when writing assignments. His past learning habits serve as a bridge to help him transit to the new academic environment. Moreover, the above data disclose that CSE professors knew how to and were willing to integrate technology (Carmen, a course management) into instruction. Hence, he, as an L2 English learner, could download lecture slides and familiarize himself with English vocabulary and CSE terms before class. The data also disclose that he had the habit of digitizing his class notes as seen in “During class, I directly take notes on the slides.” On the account of digitizing his class

notes, he could look for information for his assignments as shown in “After class, I reread my notes when writing assignments.” Supplement 6-4 is a screenshot of his notes based on a lecture slide which he downloaded. His notes appear in orange font.

Evernote. In addition to taking notes during class, he also took notes through Evernote during his advisor’s team meetings and when attending CSE conferences:

“During team meetings, I always use Evernote to write down the things my advisor wants me to do. I just quickly list them out. I write in English without paying attention to grammar and usage. After the meeting, I’ll rewrite my notes... When attending conferences, I’ll take notes via Evernote on my laptop.”
(interview transcript, April & July, 2015)

The above data display that he utilized Evernote, note-taking software, to organize his research tasks and learning. Moreover, he grasped opportunities to practice his English as verified by “I write in English... After the meeting, I’ll rewrite my notes”. Although he said “without paying attention to grammar and usage” while writing his notes during a meeting, it is probably because the fast-paced discussion during a meeting and his insufficient English competence might make him care less about English grammar and usage while typing notes and listening to his advisor’s and members’ discussions. However, after a meeting, when rewriting his notes, he checked whether his writing was understandable. The more practice in writing English he had, the better English writing competence he stood a chance of developing. His motivation of seizing opportunities of using English might help him acculturate to the Western academic culture faster.

Google Doc. Besides taking notes during classes, meetings, and conferences, his survey responses show that he also took notes via software when reading academic articles. In an

interview, he explained that he utilized online spaces, such as Google Doc, to take notes, especially for sharing information with his advisor and research team members:

“I directly highlight or take notes on PDF while reading papers. But, sometimes I need to report something to my advisor and team members. Then I’d take notes on Google Doc and share my notes with them. Once my advisor wanted me to find some experiments. Then, I looked for and read papers. I copied and pasted their experimental data on my Google Doc and then shared with my advisor via emailing the link to my Google document. So, he could directly read my notes. Without using Google Doc, I need to attach my notes to emails and then send them out.” (interview transcript, April, 2015)

The above data demonstrate that Tian-You was positioned by his advisor as a novice who was learning how to identify useful information from other studies, which were conducted and written by experts in CSE communities, for research team projects. This is corroborated by “my advisor wanted me to find some experiments. Then, I looked for and read papers”. Through learning with his advisor, he found opportunities to read and apply published experimental data to his own research. The data also reveal his different reading purposes in form his selection of note-taking software. When requiring reporting to his advisor and team members, he chose to “take notes on Google Doc” which had the sharing function. When reading academic articles for his own purpose, he “directly highlight[ed] or] note[toke] on PDF”. This also exhibits that he was aware of each note-taking software’s characteristics. This awareness, thus, enables him to select an appropriate communicative channel to achieve his reading purposes.

Google Sheet. His awareness of the features of the different note-taking software is also shown when he took notes for his own research projects:

“I record my experimental data via Google Sheet and record experimental procedures, problems I faced, and possible solutions when running experiments via Evernote. Since Evernote doesn’t have the functions of calculating and drawing diagrams as Google Sheet does, I use Google Sheet to do those tasks.

Drawing diagrams is mainly for my advisor and senior researchers. They sometimes ask me to compare with something. Then, I run some experiments and have data. I created a template in my Google Sheet. So, I just throw the data into the template. It'll generate diagrams for me. Then, I share the link to my Google Sheet with them." (interview transcript, May & June, 2015)

The above data reveal that he understood the limitations of Evernote and adopted another software to compensate for the limitations to achieve his goals as seen in "Evernote doesn't have the functions of calculating and drawing diagrams... I use Google Sheet to do those tasks." Additionally, he knew how to employ technologies to avoid needlessly repeating drawing activities as confirmed by "I created a template in my Google Sheet. So, I just throw the data into the template. It'll generate diagrams for me." Knowing the limitations and features of technologies and ways of employing them to reduce his work might, hence, help him adjust more smoothly to the CSE academic culture. Furthermore, this and previous data sets disclose the emphasis on collaboration between novices and experienced researchers in his advisor's research team as verified by "my advisor wanted me to find some experiments... shared with my advisor via emailing the link to my Google document" and "[his advisor and senior researchers] sometimes ask me to compare something...I share the link... with them." This also shows that a hierarchy existed between Tian-You and experienced researchers. Within this hierarchy, the collaborative relationship enables him to cultivate his collaborative competence and learn experienced researchers' perspectives on research.

Google Keep. Table 6.3 shows that among note-taking and documenting technologies, Google Keep has the highest frequency-use (140 times). In an interview, he described employing it to record his tasks of academic learning and research every day:

“I always use Google Keep to record my research progress and to do list. Sometimes I read my notes via my cell phone and sometimes via my laptop. If I’m in the lab, I’ll use my laptop to open my Google Keep and use lab desktop to do work...Every day when I start to work, I’ll look at it to see what I did yesterday and what I should do today. The advantage of using it is that I can read and edit my notes anytime via my cell phone or laptop. It’ll synchronize on my both devices when updating my notes on one device... I can also set up reminders. But, the software itself has some problems about the reminder function. So, if I’ve important things, I won’t use Google Keep but Inbox by Gmail. (interview transcript, July, 2015)

The above data disclose that he employed multiple hardware (e.g., his cell phone, laptop, and office desktop) and software (e.g., Google Keep and Inbox by Gmail) to assist him in organizing and doing academic tasks. Moreover, this and previous data sets show that he understood functions and drawbacks of different software and thus could choose appropriate software to help him complete academic tasks. The features of Evernote (see Supplement 6-5) include the ability to write long texts so he utilized it to “record experimental procedures, problems [he] faces, and possible solutions when running experiments”. Google Sheet (see Supplement 6-6) is like Microsoft Excel which has calculating and drawing functions so he employed it to “record [his] experimental data”. Google Keep (see Supplement 6-7) is characterized by the feature allowing users to create short notes so he used it to “record [his] research progress and to do list”. Google Keep, Google Sheet, and Evernote have common features including easy to share files and access files on any technological devices. He knew these features well as seen in “Sometimes I read my notes [in Google Keep] via my cell phone and sometimes via my laptop” and “I share the link to my Google Sheet with them”. Because of these features, he did not need to worry about the incompatibility of different devices, and this convenience further enables him to easily use Google Keep to record academic and research tasks. In addition, he knew the drawbacks of these software and what the

software could be used to compensate for limitations of other software. This is verified by “the software itself has some problems... So, if I’ve important things, I won’t use Google Keep but Inbox by Gmail.”

A voice-recording app & Microsoft OneNote. In addition to the note-taking software used for his research and academic learning, he also utilized a voice-recording app to record his one-on-one ESL speaking classes and employed Microsoft OneNote to note down words and expressions in English that he was uncertain of when taking ESL speaking courses:

“I use my cell phone to audio record speaking classes. Then, I practice my speaking while listening to the recordings. The instructor also video recorded the lessons and said she’ll share the files with me after finishing the course. She also wrote down what I did well and what I should improve. Most of her suggestions focused on pronunciation... I feel the course doesn’t directly help me communicate with my team members. It just gave me more opportunities to speak English. Also, I don’t have many difficulties in talking with team members. We usually talk about research... When communicating with them and facing words I don’t know how to say in English, I record them via OneNote. Then, I take my notes to ask my instructor.” (interview transcript, July, 2015)

The above data show that he employed note-taking and documenting software to improve his English pronunciation. Although his instructor video-recorded the teaching, she gave the recordings at the end of the course so he could not practice his pronunciation after each class. In an additional interview, he stated that “I may not want to watch the videos after finishing the course.” This is probably the reason that he recorded the classes using his own cell phone. The above data also disclose that he made an effort to enhance his English speaking competence. Nonetheless, the English spoken classes mainly “focus[ed] on pronunciation” which made him “feel the classes don’t directly help [him] communicate with [his] team members.” Moreover, the previous sections mention that

his team members were from different countries, and each of them had their own accent. In such a multilingual working environment, native-like pronunciation is not the main communicative goal, but whether speakers could understand each other is. Therefore, the videos and his recordings which focused on pronunciation might ineffectively improve his English speaking ability, but his notes about how to say some words or expressions in English on OneNote might help.

According to these data, the use of these technologies gives him opportunities to practice English use. Notably, his approach toward learning English is to immerse himself in an entire English environment. Whenever he mentioned difficulties in English, he never brought up going back to use his L1 Chinese to assist him in learning and communication. This discloses that he believed immersing in an entire English environment could stimulate him to think in English all the time and have more opportunities to use English. In terms of his use of note-taking and documenting software, his understanding of the functionality of these technologies enables him to select appropriate technologies based on the features of the software and the demands of the tasks to achieve his academic and research goals. This understanding of the functionality of note-taking and documenting software might, therefore, assist him in socializing into CSE communities.

6.4.3 Reading and presentation software.

Based on his 14-week weekly journals, another high-frequency use of technologies is reading and presentation software (138 times, see Table 6.3), such as PowerPoint, PDF, and Rich Site Summary (RSS) reader.

PowerPoint. In an interview, he reported that “All my learning materials and academic papers are the electronic versions. I don’t read paper-based materials anymore” (interview transcript, May, 2015). Given that he read digitized learning materials, he had numerous opportunities to employ reading and presentation software. The following data is his description of reading lecture slides in PowerPoint format:

“Most of my professors put their slides on Carmen... I’ll download and read them to see what they’ll teach before class. They mainly use their slides to teach... The advantage of lecture slides is that instructors have put important points on them so I can quickly know which parts are important... The drawback is that the slides are too simple. After reading a textbook, I found there’re many things the slides don’t have. The extra information in the book provides contexts for these important points, and that could help me understand the points better. Sometimes I cannot understand some points on the slides. I need to read a textbook or additional learning materials to completely understand the points. But, sometimes I don’t have time to read all explanations in a book.” (interview transcript, November, 2015)

The above data reveal that the CSE department provides a technological learning environment for their faculty. Professors were also willing and knew how to integrate technologies into instruction. In this instance, the use of Carmen and PowerPoint is complimentary. Instructors utilized Carmen as a site for uploading and storing teaching materials. For Tian-You, this is the site for retrieval through downloading of lecture slides. This complimentary relationship enables him to access and read lecture slides before class. His habit of downloading and reading lecture slides before a class, in fact, derives from his past learning behavior in college and the master’s program (see Table 6.2 the row of “Learning Habits”). This habit could help him overcome his difficulties in English listening. The earlier section on “Difficulties in Listening and Speaking” mentioned that he sometimes could not understand what professors said during class, especially the beginning of his doctoral year. Reading lecture slides before class enables him to be familiar with vocabulary, terms, and topics in English that would be taught

during class as proved by “I’ll download and read them to see what they’ll [professors will] teach.” This action helped him reduce the uncertainty of not knowing what professors said during class. Furthermore, when his professors were teaching through using the slides, as an L2 English speaker, he could rely on visual aids (the slides which contain written words) to enhance his comprehension of the lectures. In his journals, he stated that “some professors gave lectures in a fast pace and I couldn’t follow it. Reading lecture slides while listening to the lectures helps me know what they are talking about” (14-week weekly journal, April, 2015). This shows that the lecture slides compensate for his inability to follow teaching content due to the fast-paced lectures. Additionally, he indicated that reading professors’ PowerPoint helped him grasp the gist of teaching materials as shown in “instructors have put important points on [the slides] so I can quickly know which parts are important.” Since the slides were made by professors, those points on the slides were what professors considered significant. Hence, reading lecture slides enables him to understand professors’ perspectives.

However, he noticed the drawback of only reading lecture slides as seen in “the slides are too simple.” In order to compensate for this drawback, he read the textbook which contained detailed explanations of teaching points on the lecture slides. This is corroborated by “I found there’re many things the slides don’t have...I need to read a textbook or additional learning materials to completely understand the points.” Although he took this approach, he admitted he sometimes did not have enough time to read all of the details in a textbook. It implies that he might not always have sufficient information about teaching content due to relying on lecture slides.

In addition to reading lecture slides via PowerPoint, he also employed PowerPoint to prepare for his presentations via the function of rehearsal. This function allows him to audio record and replay the recordings of his practice:

“It helps me record while I practice presenting my slides. If I’ve important presentations, such as conference presentations, I use that function and then hear the recordings to see where I can improve. While hearing the recordings, I also make notes via the function of the memo in PowerPoint. For general presentations, such as class presentations, I’m not very nervous like presenting at conferences so I don’t do that.” (interview transcript, April, 2015)

The above data show that when he had presentations, especially in front of an audience who could be experts in CSE communities, he employed the function of rehearsal in PowerPoint to help him improve his presentation techniques, expressions, and content. In addition, recording his practice enables him, as an L2 English speaker, to replay the recordings to check whether his pronunciation, intonation, and stress were correct or not and then further rectified his speaking errors. The more practice he had, the better English proficiency he developed. Moreover, the above data reveal that PowerPoint serves in an assistive role to help him gain more confidence through using the function of rehearsal.

PDF. PDF is another reading software he often employed. Since all of his learning and reading materials are digitized, he often utilized the PDF’s functions of highlighting and annotating as opposed to manually highlighting and annotating on printed texts:

“When reading articles, I use PDF’s highlighting and note-taking functions. I’ve different colors of highlights. Yellow means important; red means I don’t understand the words, terms, or sentences. I’ll finish reading a big section and then Google those highlighted in red. I don’t like to keep opening web pages to look up words or terms while reading because it’d interrupt my reading. So, I won’t Google an unfamiliar words or terms unless it impedes my comprehension of the text.” (interview transcript, May, 2015)

The above data disclose his electronic-text reading strategy when encountering unfamiliar words and terms during the reading process as seen in “Yellow means important; red means I don’t understand the words, terms, or sentences. I’ll finish reading a big section and then Google those highlighted in red.” In order to concentrate on the content of a text without being bogged down by unfamiliar words or terms, he employed the PDF’s highlighting function and the contextual cue to assist him in continuing reading the text so he could get a big picture of the reading. After understanding the gist of a section, he looked up further explanations of unfamiliar words or terms via Google to enhance his comprehension. When he said “an unfamiliar words or terms”, this description accounts for his unfamiliarity with L2 English, discipline-specific terms, and reading academic culture. This shows that his acculturation processes were complicated by layers of unfamiliar phenomena as manifested in this example of his engagement with reading software. The data also disclose that he strategically adopted PDF’s highlighting function to achieve his reading purposes as seen in “Yellow means important; red means I don’t understand the words, terms, or sentences.” In an additional interview, he further explained how his yellow marks on the electronic texts helped him in the rereading process:

“When I need to go back to the articles, I just read highlighted areas to remind me what the articles talk about. I don’t use a specific reading organizer software. I just go back to the articles to double-check whether the articles are what I want to cite while writing my papers...In my field, a paper usually has around 20 citations... I know it’s not a good habit. I hope I can improve the way I take notes while reading papers.” (interview transcript, May, 2015)

He took advantage of PDF’s functionality by developing a strategy to remind him of the content of academic articles he read as proved by “When I need to go back to the articles, I just read highlighted areas to remind me what the articles talk about.” Although

he perceived that “go[ing] back to the articles to double-check whether the articles are what I want to cite” is not an ideal method, these data suggest that this method helps him deal with his current writing demands. Since he reported that he did not need to cite many references in a paper, he could “just go back” to each cited article to reread highlighted areas. Nevertheless, going back to each article to check the content might not be an effective and efficient method when he had to cite various scholarly works in a paper, such as a dissertation. In other words, he knew and utilized PDF’s functions, but he still needs to devise a systematic way to record what he read and highlighted as important parts of academic articles. The ability to employ these technologies to achieve academic goals rather than blindly using the functions these technologies provide is significant for Tian-You.

Taken together, employing these reading and presenting software provide Tian-You convenience of accessing and learning about CSE information. For instance, reading lecture slides via PowerPoint enables him to be convenient to preview and review teaching content. Employing PDF functions allows him to highlight important parts and take notes in electronic academic articles and easily retrieve his notes for the academic articles he read. Without using those technologies, he might need to spend a great deal of time and effort on accessing and learning about CSE information.

6.4.4 Online lexical resources.

In comparison to his use of other technologies, his use of online lexical resources does not have a high frequency-use over 14 weeks (66 times, see Table 6.3). Nevertheless, his survey and interview data show that he often relied on online lexical resources to assist

him in reading and writing academic texts and participating in discussions. In his survey, he reported that during class discussions, meetings, or conferences, he often went online to check unfamiliar words, terms, or concepts that professors, students, or an audience mentioned. In an interview, he further described employing Google and an English dictionary to check unfamiliar words, terms, or concepts:

“If there is an internet, I’d use Google to check unfamiliar words, terms, or concepts the speakers or the audience mentioned. If there’s no internet, I just use my Mac which has an in-built English dictionary... Once I type a word, a term, or a concept in Google, I can get answers quickly.” (interview transcript, November, 2015)

The above data exhibit that he counted on online lexical resources generated by Google more often than his laptop’s in-built dictionary which consisted of Wikipedia and various English dictionaries, such as the New Oxford American Dictionary and Oxford American Writer’s Thesaurus. Through Google, he could access more lexical resources and explanations of CSE terminologies which were not included in the dictionary on his laptop. The above data also reveal that he attempted to employ online lexical resources to increase his comprehension of discussions during classes, meetings, and conferences. The earlier section of “Difficulties in Listening and Speaking” mentioned that he sometimes confronted difficulties in understanding lectures and what team members said during meetings. Searching online for further explanations of unfamiliar words, terms, or concepts speakers mentioned could help him understand the discussions and might further aid him in participating in discussions.

Besides employing online lexical resources during classes, meetings, and conferences, in his survey, he reported that when reading academic articles and confronting unfamiliar words, terms, and concepts, he always searched for online information to aid him in

understanding the content of the articles. The information included online dictionaries, professional CSE websites, and non-academic websites:

“I always use Merriam-Webster. I used Dr. Eye before. Now, I rarely use it. I try to read English explanations of unfamiliar English words... For professional dictionaries, I don't use a particular one. I just Google unfamiliar terms. Sometimes search results link to engineering dictionaries. For academic websites, I often use IEEE. If I don't understand a term or a concept, I search for papers via typing the term or the concept in IEEE to see if any researcher did this related topic. Then, I look at their explanations in their papers. For non-academic websites, I use Google and Wikipedia. I use the English version of Google, but sometimes when Googling unfamiliar words or terms, it'd come out Chinese. I look at search results in English first. If I still couldn't understand the explanations, I'll look at Chinese explanations.” (interview transcript, April, 2015)

The Merriam-Webster online dictionary is an American English dictionary (see Supplement 6-8) exclusively employing American English words and definitions whereas Dr. Eye is a Chinese-English dictionary (see Supplement 6-9) giving users explanations and translations of English words in Chinese. Although both dictionaries have their particular advantages, he “rarely us[ed] [Dr. Eye]”. This indicates that he had a tendency to mainly utilize English-based lexical resources to help him understand academic texts. His continuous exposure to English explanations could facilitate him to think in English and provide him with English vocabulary and expressions for use when needed. In addition, he searched for other CSE academic articles via IEEE to understand some terms or concepts that he encountered when reading CSE academic texts. By doing so, the explanations of the terms or the concepts he found come from credible sources. Meanwhile, he could observe how other researchers explained the terms or the concepts and what phrasing was utilized by the researchers to explain. The exposure to English explanations and CSE language might, hence, benefit him to adjust to the English-speaking dominant academic culture and CSE communities faster.

In an interview, he further described the procedure of searching for a word or a term via Google search engine and how he selected sources to help him understand academic texts:

“I use Google first. If it doesn’t give me a satisfying answer, I’d go to Merriam-Webster because I feel it’s more professional. I directly type an unfamiliar word and the word ‘define’ after it in the Google search bar. Then, explanations will turn up. If it’s a word, it’ll have its translation. If it’s a special term, it’ll link to Wikipedia or other websites. Sometimes Google would provide exemplifying sentences. Google is very convenient now. But, I usually look at all explanations from Google, Merriam-Webster, and Wikipedia.” (interview transcript, April, 2015)

In the data, when he mentioned “I use Google first...type an unfamiliar word and the word ‘define’ after it in the Google search bar”, this means that he utilized the Google dictionary (see Supplement 6-10). The above data reveal that he did not only depend on one source but also on others as corroborated by “I usually look at all explanations from Google [dictionary], Merriam-Webster, and Wikipedia.” He noticed each of the sources has its own characteristics. From his perspectives, the Google dictionary is convenient to use and has the translation function; the Merriam-Webster dictionary was created by lexicographers which might be the reason he believed it had more accurate information; Wikipedia (see Supplement 6-11) was used to search for “a special term” which he meant CSE terminologies. Nevertheless, there is no clear indication in the data to justify that the Merriam-Webster dictionary is more professional than the Google Dictionary. However, his combined use of the three lexical sources might compensate for the limitations of each source. The above data also display that he seems to believe that exposure to exclusive English sources could enhance his overall academic English competence as confirmed by “I always use Merriam-Webster. I used Dr. Eye before. Now, I rarely use it. I try to read English explanations of unfamiliar English words”.

However, these data are inconclusive in determining whether exclusively utilizing lexical resources in English could actually improve his English competence.

Besides employing online lexical resources for reading academic texts, he also utilized them for writing assignments and academic papers. In his survey, he reported that he always employed online sources, such as online English dictionaries, an English corpus (Corpus of Contemporary American English; COCA), and websites discussing English grammar, to look up unfamiliar English words, usage, and grammar. In an interview, he further explained how he used different lexical sources during writing:

“I use COCA to mainly search for grammatical and phrasal usage, such as what are the usual propositions after a word. For Treasure.com and the Google dictionary, I search for synonyms because I always use the same words. I want to make my papers look more professional so I try to use synonyms to replace the same words. My previous writing teacher mentioned using different words in writing. I usually type a word in Google search bar. Then, the first search result is always the Google dictionary and the second one is Thesaurus.com [see Supplement 6-12] I look at Google dictionary’s synonyms first, but it sometimes offers a few synonyms so I’d go to Thesaurus.com to look for more synonyms [see Supplement 6-13]. Thesaurus.com provides more synonyms.” (interview transcript, June, 2015)

The above data disclose that Tian-You perceived his weakness in English academic writing as verified by “I always use the same words.” Due to his insufficient English vocabulary, he repeatedly used the identical words to write his paper. He noticed this drawback and attempted to enhance his writing competence through employing Thesaurus.com and the Google dictionary to find “synonyms to replace the same words.” Therefore, these two online lexical sources serve in an assistive role to compensate for his English barriers and increase his knowledge of English vocabulary. The above data also demonstrate that he knew the features and limitations of each lexical sources and hence could select appropriate ones to achieve his writing goals. This is confirmed by “I use COCA mainly for searching for grammatical and phrasal usage... For Thesaurus.com

and the Google dictionary, I search for synonyms”. Unlike an English dictionary, COCA (see Supplement 6-14 & Technology glossary) has complicated design and contains millions of different genres of actual English texts, such as popular magazines, fiction, newspapers, and academic texts. Tian-You learned how to utilize it through an ESL writing course and noticed the differences between COCA and the online English dictionaries he employed. He described how he used COCA to write conference papers as follows:

“I usually use it when writing papers not class assignments... After typing a word, I click on links to different articles to see how the writers used the word... Sometimes the articles are related to my field. So, when searching in COCA, I check if the search word is used in my field. I don’t see this function in other dictionaries. Its search results are from academic journals so I think the credibility is very high... Once my ESL instructor typed a word in COCA and it showed low frequency use. Then, he clicked several texts of the search results to show us that the word is often used by Chinese speakers. He told us to avoid using this kind of words. So, when using it, I’d double-check who wrote the texts to decide to use which words.” (interview transcript, April & May, 2015)

He knew how COCA functions and could be used to double-check whether a word or phrase was utilized by more experienced CSE researchers. He, as a novice researcher, needed to learn discipline-specific language and know how to use the language in his academic writing. COCA contains disciplinary academic texts and thus enables him to learn how other researchers used the searched words within a context. The data also display that he determined which online lexical resources according to an audience as proved by “I usually use [COCA] when writing papers not class assignments.” When writing papers, such as conference papers read by other researchers in wider CSE communities, he chose COCA to polish his English writing so he could present his research using scholarly language. When writing class assignments read by instructors, he employed general online lexical sources, such as Merriam-Webster dictionary, to cope

with unfamiliar English usage. Another notable phenomenon is that the ESL writing instruction he received seemed to emphasize ‘Standard English’ as one way to communicate with scholars in academic fields. This is corroborated by “[ESL instructor] clicked several texts of the search results to show us that the word is often used by Chinese speakers. He told us to avoid using this kind of words.” Moreover, his ESL instructor implicitly expected students to view American English as a standard through encouraging them to employ COCA which mainly emphasizes American English. Such perspective on English learning and exposure to only American English might not be beneficial for him in the long-term to socialize into the global CSE communities. He involved in not only the CSE communities in the U.S. but also the global CSE communities. An example of the global CSE communities is IEEE International Conference on Computer Communications where he presented his research before and where a variety of English was used by wider audiences and scholars from different countries. In such global CSE communities, English for communicative purposes rather than American English is a more reasonable requirement for English users from different countries. Perceiving American English as the only way to communicate with others might make Tian-You harder to socialize into wider CSE communities in the long term.

Besides utilizing COCA to help him write English papers, he also employed WordReference.com, an online forum discussing English grammar, when being uncertain of some English grammar during the writing processes:

“If I’m not sure how to use certain English grammar, I’d Google it and the top one or two search results always link to the website called Word Reference. Many people ask grammatical questions there” (interview transcript, April, 2015).

He mainly relied on English grammatical information in WordReference.com which he knew via Google’s top one to two research results. In this forum (see Supplement 6-

15), users asked grammatical questions and other users provided answers to the questions. It remains uncertain whether users' English education background and the answers offered by the users are more precise than a website focusing on introducing English grammar and an English grammar book. Moreover, it is uncertain how he decided which answer on this forum was correct. He chose this forum to answer his grammatical questions probably because of convenience as seen in "I'd Google it and the top one or two search results always link to the website called Word Forum." Nonetheless, the convenience might not actually assist him in answering his questions about English grammar.

On the whole, Tian-You employed multiple online lexical sources to help him read and write academic texts and participate in discussions. The benefit of employing multiple sources is that he could cross-check searched information to not only receive more credible information but also gain further understanding of searched information. Nevertheless, some of his strategies to select lexical sources and determine proper information might undermine his academic learning. First, the lexical sources he selected were mainly written in English. This indicates his belief that immersing himself in an English-dominant environment could enhance his overall English competence and that using his L1 Chinese language would hinder his development of L2 English ability. His perspective on mainly receiving academic and lexical resources in English might be influenced by his ESL instructor's teaching viewpoint considering English texts written by English-native speakers as the only models to learn English vocabulary and usage. This perspective might impede him from obtaining information written in his native language that could improve his academic English competence and academic learning,

such as academic articles and English grammar written in Chinese. Additionally, this perspective might make him devalue a variety of English usage which is used by international scholars, including himself, in wider CSE communities. Second, he mainly selected the top one to two search results, such as WordReference.com, in Google search engine. This strategy might make him neglect some useful sources that came after the top one and two search results. Taken together, the benefits and drawbacks of using these online lexical resources might, hence, impact on his academic acculturation processes.

6.4.5 Academic search engines.

According to Tian-You's 14-week weekly journals, academic search engines are the fifth in terms of frequency use (45 times, see Table 6.3). The reason of the lower frequency use of academic search engines compared to other technologies (e.g., online social interactional technologies; 288 times) is probable that he was in his first doctoral year. He still took courses and had not started to write his dissertation when I interviewed him. In an interview, he stated that "I don't write conference papers recently because this semester I've more assignments. Those assignments are simple writing. I don't need to cite papers" (interview transcript, May, 2015). The academic search engines he reported in his weekly journals comprise Google Scholar, Google Books, Wikipedia, dblp, IEEE Xplore, Association for Computing Machinery (ACM) Digital Library, and AMiner. The first three are general search engines, whereas the rest of them are discipline-based search engines. One search engine he often employed but did not report in his weekly journals is Google search engine. The following data are his description of using Google and Google Books search engines to help him understand lectures and write assignments:

“When facing unfamiliar terms or concepts while writing assignments or during classes, I’ll go back to read lecture slides. I also search for slides or materials via Google and ebooks via Google Books...Some books are recommended by my professors; some books are found by myself via Google and Google Books. I don’t read entire books but the pages where unfamiliar terms or concepts are explained. Sometimes Google will generate search results linking to Wikipedia and Stackoverflow. I’ll also go there to read their explanations... Sometimes search results link to lecture slides provided by other universities.” (interview transcript, May, 2015)

Through Google search engine, he could obtain various types of learning sources, such as Wikipedia, Stackoverflow discussion forum, and other universities’ lecture slides. Reading multiple sources enables him to receive more completed information and cross-check information which increased the chance of obtaining credible information. If the sources were physical copies, it would have been difficult for him to access and cross-check information simultaneously, and this inconvenience might make him not want to read various sources. Although books were recommended by his professors as seen in “Some books are recommended by my professors; some books are found by myself via Google and Google Books”, these data show that he typified the use of e-books among other technologies. This points to the deliberate strategy where e-books and online learning resources play an assistive role in his academic socialization. The above data also disclose that he adopted a purposeful reading strategy to achieve his reading goals as verified by “I don’t read entire books but the pages where unfamiliar terms or concepts are explained.” Given the abundant resources, Google and Google Books search engines offered, adopting the purposeful reading strategy allow him to efficiently locate needed information to solve his learning problems. Moreover, he employed resources from multiple academic search engines to enhance his understanding of unfamiliar knowledge as seen in “I also search for slides or materials via Google and ebooks via Google.” Each academic search engine has its own characteristics. Google search engine provides links

to a variety of sources (e.g., websites, blog posts, academic articles, teaching slides, and open courses) whereas Google Books search engine offers links to various books showing the partial content of the books. Hence, through utilizing both of them he could compensate for their individual limitations.

Besides employing the two search engines, he also utilized CSE discipline-based search engines, such as IEEE Xplore, ACM Digital Library, and AMiner, to look for academic papers:

“IEEE Xplore has big databases so I often search for papers there. ACM Digital Library is another one I use to download particular conferences’ and journals’ papers...I knew them before my Ph.D. study. I also use AMiner. Once I read an article, the researcher said he found a computer program via it. So, I think I can also use it to find some programs... I often use it to learn about conference’s impact factor, which conferences are top ones in my field, and papers’ citation count. Sometimes my advisor or senior researchers mention some conference papers, but I don’t know the rank of the conferences. I’d use it to learn the rank of the conferences those researchers submitted to, decide to submit my papers to which conferences, and join in my advisor’s and senior researchers’ discussions. But, it doesn’t allow me to download papers. IEEE and ACM allow...I usually use the three search engines to find papers first. If I cannot find papers via them, I’d use Google Scholar. Oftentimes I can find needed papers through them.”
(Interview transcript, May, 2015)

The above data disclose that he utilized AMiner to learn the rank of conferences, what kinds of papers could be submitted to which conferences, and which conferences he could submit to. As a novice researcher, he was still learning CSE culture and ways of navigating within this culture. When hearing his advisor and senior researchers discussed some conference papers, he was uncertain ‘how good the papers [were]’, and one way to know it is to look at the rank of conferences the researchers submitted to via AMiner. Through learning the rank of conferences via AMiner, he then could realize the level of his own research and also have ‘basic CSE knowledge’ (the rank of conferences and levels of research) in order to participate in discussions with his advisor and senior

researchers. Additionally, the above data disclose that his prior experiences of academic learning and research in the master's program and research job in Taiwan prepared him for current doctoral study and for accommodating to the CSE culture as proved by "I knew [IEEE Xplore and ACM Digital Library search engines] before my Ph.D. study." The two search engines belong to the two computer science organizations (IEEE and ACM) which hold various conferences and publish several journals. The earlier section of his prior learning background described that he had experience in attending CSE conferences and participating in publications. These prior experiences enable him to learn where he could obtain disciplinary significant resources and hence serve as a source supporting him to acculturate to the present CSE culture. Moreover, he recognized features and constraints of each academic search engine as confirmed by "IEEE Xplore has big databases so I often search for papers there", "ACM Digital Library... to download particular conferences' and journals' papers", and "I often use [AMiner] to learn about conference's impact factor, which conferences are top ones in CSE, and papers' citation count...But, it doesn't allow me to download papers. IEEE and ACM allow...". On account of his understanding of these academic search engines' features and constrains, he could navigate among the search engines in his quest to achieve his academic goals.

Besides his past learning experience and recognition of these search engines' strengths and weaknesses, the above data also suggest that he perceived differences between discipline-based and non-discipline-based search engines and thus devised a strategy to prioritize the use of discipline-based search engines. This is proved when he said "I usually use the three search engines [IEEE Xplore, ACM Digital Library, and AMiner] to

find papers first. If I cannot find papers via them, I'd use Google Scholar." His discernment and strategy could, therefore, help him obtain needed and essential academic papers. A key aspect revealed by these data is that he successfully visualized connections between academic resources (e.g., AMiner discipline-based search engine, scholarly articles, and experienced CSE researchers) within his acculturative experience. He was able to identify opportunities for himself through connecting these academic resources. In other words, he connected the article he read with the comments given by the researcher on the search engine, AMiner, and concluded that he too could employ the same strategy to find computer programs. This is confirmed by "Once I read an article, the researcher said he found a computer program through [AMiner] so I think I can also use it to find some programs." Through this practice, he viewed experienced researchers whom he read as learning models and their strategies as having a potential to become his own. Thereby, this practice could enable him to socialize into CSE culture more smoothly.

Another disciplinary search engine he utilized is dblp which is a computer science bibliography search engine. When hearing an unfamiliar scholar's name, especially one that was mentioned by his professors and experienced researchers, he employed dblp to find the history of the scholar's publications:

"Sometimes I hear my professors, experienced doctoral students, or post-docs mention some scholars who are very excellent researchers and I didn't know before. Then, I'd type those scholars' names in dblp. All of the scholars' publications would come out, but it doesn't offer citation counts. Instead, it offers a link to Google Scholar so I can see information about the citation counts. Then, I'd read their papers with high citation counts. dblp's and Google Scholar's databases are probably different. Some papers can only be found in dblp; some papers can only be found in Google Scholar. I also use dblp to see my advisor's and experienced researchers' in my lab papers to understand what studies they do now." (interview transcript, May, 2015)

The above data reveal that he employed dblp to learn about notable scholars in CSE communities. Since he had studied in the doctoral program and participated in his advisor's research team less than a year during this study, he, as a novice, did not know much about the leading conferences and journals in the CSE, which scholars were pioneers, and what the present trends were in the field. Employing dblp listing out a scholar's publications enables him to recognize the scholars whom his professors and experienced researchers mentioned and know about the present CSE trends. Moreover, he employed dblp to familiarize himself with his advisor's and researchers' research. Doing this could further facilitate him to be able to participate in his advisor's and experienced researchers' discussions as well as view them as learning models. Furthermore, he realized the limitations of each academic search engine and hence employed all of them to counterbalance shortcomings of individual academic search engines. This is proved by "[dblp] doesn't offer citation count... dblp offers a link to Google Scholar so I can see information about citation count... Some papers can only be found in dblp; some papers can only be found in Google Scholar."

When employing these academic search engines to search for academic papers, he had a tendency to mainly read resources in English except on a few occasions. In an interview, he explained the reason he mostly read resources in English and described the occasions he would read resources in Chinese:

"I try to read resources in English. If I really cannot understand the resources in English, I'd look at sources in Chinese. Or, if I need to know a concept in a short time and don't have enough time to digest resources in English, I'd find resources in Chinese... Those studies written in Chinese are in Simplified Chinese... I rather read resources in English. I'm not used to its words and usage. The writers translated some terminologies in Chinese, but their translations confuse me... Reading resources in English is much clearer and my memory of the searched

concepts is much deeper, although I need to spend more time on reading resources in English.” (interview transcript, April, 2015)

The above data indicate the benefit of adopting his native language (Chinese) to read academic articles as proved by “if I need to know a concept in a short time and don’t have enough time to digest resources in English, I’d find resources in Chinese... I need to spend more time on reading resources in English.” This indicates that his insufficient English competence sometimes hindered him from reading texts in English as quick as reading texts in Chinese. Nonetheless, when there was limited time to read texts in English, his native language (Chinese) and equivalent texts in Chinese became useful tools to allow him to quickly understand the gist of the knowledge in order to meet pressing needs. Given that his constant exposure to CSE learning materials in English, he might better adjust to the Western academic culture in terms of reading. These data also show the influence of language on the functionality of academic resources presented via technologies. If academic materials presented via IEEE Xplore, ACM Digital Library, AMiner, dblp, Google, Google Scholar, and Google Books are in English, he would read them as seen in “I try to read resources in English.” If materials were in Chinese, he would opt not to read these as proved by “Those studies written in Chinese are in Simplified Chinese... I rather read resources in English.” In an additional interview, he explained that he tended to read academic papers in English not Chinese and in famous CSE conferences and journals rather than in theses or dissertations:

“I usually don’t cite them [academic papers in Chinese and in theses or dissertations] ... My advisor thinks those kinds of studies are not valuable. He wants us to cite articles from famous conferences and journals in English. In my field, no one would cite theses or dissertations. Usually, they published their studies in conferences or journals. People directly cite from there. Citing theses or dissertations is not persuasive enough. My previous and current professors also cited conference or journal papers not theses or dissertations. (interview transcript, April, 2015)

He had a mindset to employ academic search engines which only included studies written in English to look for CSE papers. His use of these academic search engines implies a hierarchy in the CSE academy as verified by “I usually don’t cite them”, “I often search for papers there [IEEE Xplore]”, and “ACM Digital Library is... to download particular conferences’ and journals’ papers”. The hierarchy based on language rather than the quality of studies was one of the criteria to select papers to be included in these CSE academic search engines. This shows his preference for choosing academic search which only include studies written in English. The data set also discloses that his decision of selecting which academic search engines is affected by his previous and present advisors who believed that citing studies from CSE journals is better than from dissertations. His preference and the influence of his prior and current advisors might, therefore, limit him to only read and consider research written in English and published in top CSE conferences and journals. This could also undermine his viewpoints towards CSE research written in his native language and other languages. As a result, he could neglect studies that could stimulate his thoughts about his own research and that were written in his native language and other languages and not published in top ranking conferences and journals.

Moreover, he mainly looked at conference and journal papers as seen in “no one would cite theses or dissertationsCiting theses or dissertations is not persuasive enough.” In fact, theses and dissertations contain more thorough descriptions of studies than conference and journal papers which are always constrained by a page limit. Such way of utilizing academic search engines might, hence, narrow his research horizon and lead him to be unable to thoroughly understand research.

On the whole, his use of academic search engines appears to have positive and negative influence on his socialization into CSE communities. The positive impact is that he habitually employed multiple academic search engines to obtain various types of CSE resources. The use of multiple academic search engines could compensate for shortcomings of each search engine and enables him to cross-check information and receive more completed information. The negative influence is that he limited himself to mainly read academic papers in English and cite sources from top CSE conference and journal papers which could narrow his research view, overlook significant research, and devalue studies conducted and written in other than English.

6.4.6 Online videos.

His 14-week weekly journals show that online videos have a lower frequency use (27 times, see Table 6.3). Nonetheless, his survey and interview data reveal that his use of online videos has a substantial impact on his academic life. This impact includes reading academic texts, preparing for his qualifying exam, and knowing the current trends in CSE field. The sources of online videos comprise Coursera, YouTube, and Intel webinars (web seminars). Two video sources he did not report in his weekly journals but in interviews are EngVid and TED Talks. In an interview, he described using EngVid to enhance his English competence:

“My English is not good so sometimes I watch English teaching videos via EngVid. Their videos are very short. If they post new videos, I’ll take a look at them. While watching videos related to speaking I’d practice my speaking. When preparing for the TOEFL test, I found the website and started to use it. Now, watching their videos becomes my habit. They’ve different topics, such as English listening, speaking, and reading.” (interview transcript, April, 2015)

The above data reveal that he was aware of his limited English competence and made efforts to improve his English. The earlier section focusing on his academic difficulties indicates that he confronted challenges of speaking during classes and group meetings. Notably, he especially endeavored to increase his speaking competence via watching English speaking video lessons in EngVid. Moreover, the above data disclose that his agency in enhancing his English competence is his past English learning experience. EngVid which derived from his prior experience of preparing for TOEFL test serves as a technological resource by playing an assistive role to ease language-based challenges during his academic acculturation processes.

Besides watching online videos to enhance his English competence, he also watched online videos via TED Talks and YouTube to help him understand CSE knowledge:

“I often watch videos in TED Talks. Their videos cross many disciplines, but I watch videos related to computer science. Sometimes I also search for teaching videos in YouTube. When I don’t understand certain concepts, I’d find some academic articles to read. But, sometimes I still couldn’t understand. Then, I’d search for videos.” (interview transcript, April, 2015)

The above data disclose that he constantly exposed himself to CSE information as seen in

“I watch videos related to computer science... I also search for teaching videos in YouTube.” This behavior enabled him to broaden his CSE knowledge. Moreover, for him, videos as learning materials are a go-to resource as proved by “sometimes I still couldn’t understand [certain concepts in academic articles]. Then, I’d search for videos.”

A video contains a speaker’s sound, images, body language, and simplified language (comparing to written academic texts) whereas an academic text consists of academic writing conventions, academic language and jargons, and static diagrams. Sound, images, body language, and simplified language reduce the degree of the sophisticated content of knowledge. Hence, he, as an L2 English learner, could better comprehend CSE

knowledge through watching video-based learning materials than reading written ones. Furthermore, another feature of a video, especially a scholar's presentation on his or her own research, is the kernels of a presentation that would be presented by the presenter. In an interview, he further stated how he used videos of researchers' presentations to help him understand their research:

“When preparing for class presentations, I'd search online to see whether there're some researchers' videos. Once I prepared a class presentation where I was asked to read a paper and present it. After reading it, I searched for the researcher's videos online. I found a video he presented at a conference. So, I watched it to see what points he mentioned. Since he is the author of the paper, at least in my presentation I needed to mention the points he made. Those points must be very important. I might not totally understand his paper, but at least I could know the points he made were important via watching his video. Then, I'd go back to the paper to reread the points he mentioned in the video to try to understand.”
(interview transcript, November, 2015)

The above data disclose that he, as an L2 English learner and CSE novice researcher, struggled to understand the pith of experienced researchers' studies as seen in “I might not totally understand his paper...” When reading academic articles in English, he confronted not only language but also discipline-specific knowledge challenges. Nevertheless, the videos of researchers' presentations comprise keynotes of the researchers' studies. This feature, hence, helps him quickly “know the points [the researchers] mentioned... via watching video[s]”. After realizing the kernels of the studies, he then “[went] back to the paper[s] to reread the points [the researchers] mentioned” to attempt to understand the relationships between the main points and the studies. Reading and utilizing online videos complement one and another in his effort to prepare for his academic presentations as shown in “After reading it, I searched for the researcher's videos online... Then, I'd go back to the paper to reread”. This shows that he had a reading habit where the content in the paper pointed him towards supplementary

technological resources, such as online videos. In other words, his strategy of employing videos to understand research could reduce his difficulties in reading and presentations during his acculturation processes.

Another online video resource he employed is Coursera containing videos, lecture slides, and discussion forums, created by universities. In several interviews, he described utilizing its teaching videos to prepare for his qualifying exam:

“I take some free courses on Coursera to review learned knowledge and push myself to continue learning CSE knowledge. The courses I enrolled in Coursera are similar to those I took in my program. I mainly watch their videos. It’s boring to review the school’s textbooks and articles. Watching videos makes me feel not so bored and less pressure...I watch videos first and take quizzes. If I’m unsure of some questions, I read their slides which have detailed teaching content. By doing this, I can save time. Since I learned some of the content before... Taking their quizzes helps me understand the courses... Their design is good. When I wrongly answered a question, it won’t directly offer a correct one, but offered a link connecting to the part of the slides helping me review the knowledge of it. After reviewing the slides, I did the question again. I don’t just watch their videos but also review the content of the courses I took in my program in preparing for the exam. Watching their videos is because their videos are short, under 15 minutes each.” (interview transcript, June,2015)

The data display the following characteristics of Coursera open courses:

- 1) Teaching videos are short, and the content of the videos is simpler than lecture slides,
- 2) Courses are free,
- 3) Lecture slides contain detailed teaching content, and
- 4) Quizzes are designed to assess whether students learn or not. If not, there is learning support (e.g., links back to the slides to the place where students are uncertain). The purpose of quizzes is not to eliminate students from learning but make sure students learn knowledge.

Given these characteristics, Tian-You employed Coursera to reinforce his previous knowledge with a different learning method as seen in “I take...courses on Coursera... to review learned knowledge...The courses... are similar to those I took in my program... I mainly watch their videos.” The different learning method is to watch teaching videos. His original learning method is “to review the school’s textbooks and articles” which consisted of text and which he thought “It’s boring”. Through this learning method, he could not know whether he understood the knowledge or not. Contrarily, watching Coursera’s videos which are short made him “feel not so bored and less pressure” because videos comprise sound, images, body language, and text. In addition, its quizzes enable him to double-check whether he understood the knowledge or not. In other words, for Tian-You, various learning styles enhanced his comprehension of teaching content as well as increased his learning motivation. These led to a positive impact on his academic acculturation.

Taken together, watching online videos is another means to cope with academic difficulties he encountered during the process of socializing into CSE communities. Moreover specifically, he employed online videos as supplementary learning materials to help him understand the kernels of academic texts, prepare academic presentations, and review prior knowledge.

6.5 The Relation between Tian-You’s Use of Technologies and His Definition of Successful Academic Acculturation

In the section of “Definition of successful academic acculturation”, Tian-You indicates that successful academic acculturation entails articulating CSE related research,

engaging with CSE researchers, recognition by CSE scholars, and publications. This success in academic acculturation is determined by the following conditions:

- 1) be able to demonstrate the competence in defending his arguments and discussing CSE related research with other researchers in oral and written forms, and
- 2) be able to make contributions through presenting and publishing research in CSE communities.

His use of technologies had direct and indirect impacts on his achievement of these conditions and which assisted him in adjusting to the Western academic culture and socializing into CSE communities. In regard to the first condition of successful academic acculturation, Tian-You, whose L1 Chinese academic culture emphasizes harmonization during discussions and modesty as an intellectual, was still accommodating to the L2 language and academic culture of verbally defending himself in English. Online asynchronous and written forms of communication, such as email, enable him to think, plan, and write his expressions at an own pace so he could completely state his opinions compare with face-to-face communication which required him to think and respond quickly. Therefore, asynchronous and written forms of communication could be a way where he practiced how to clearly express his thoughts and defend his research arguments in English during the transition from online to face-to-face interactions.

In addition to the characteristics of online asynchronous and written communication (e.g., providing more time to contemplate, organize, and write up) which help him overcome his difficulties in English speaking, his use of academic search engines, such as AMiner and dblp, enhanced his knowledge of CSE conferences, academic papers, and leading scholars. As a novice, Tian-You was still learning CSE culture, such as the rank

of conferences, which types of studies he could submit to which levels of conferences, and who were influential scholars in CSE communities. AMiner and dblp serve as an assistive role in providing the information so he could understand what his advisor and senior researchers discussed when they mentioned those top conferences, academic papers, and scholars. This could further help him participate in their discussions. Besides academic search engines, he also employed online videos to watch CSE scholarly presentations and which enables him to view those scholars as models to observe how they presented their research and defended their arguments.

The second condition requires English academic writing competence, knowledge of CSE conventions, such as hidden rules of conference papers, and research perspectives and skills. His use of academic search engines, LinkedIn, an open discussion forum related to English learning (e.g., WordReference.com), online lexical sources, and drawing software instantaneously and indirectly enhanced his competence in articulately writing CSE papers, including writing assignments for courses, conference papers, and journal articles. More specifically, his use of online lexical sources, Word Reference discussion forum, and drawing software compensated for his weaknesses in English academic writing. He employed Treasure.com and Google Dictionary to search for synonyms and which allowed him not to “always use the same words” and enabled him to feel “[his] papers look like more professional” (interview transcript, June, 2015). He also always utilized multiple lexical sources, such as Google Dictionary, Merriam-Webster English dictionary, and Wikipedia, to check unfamiliar words or terms when reading academic texts. This use of multiple online lexical sources to cross-check meanings of English vocabulary helps him increase opportunities to use English

vocabulary correctly. In addition to employing English dictionaries, when writing academic papers and confronting unfamiliar English grammar, he utilized Word Reference discussion forum to learn “how to use certain English grammar” (interview transcript, April, 2015). Nonetheless, it is uncertain about the English education background of the respondents who answered questions on Word Reference discussion forum. It is also unclear how he decided which respondents’ answers were accurate.

Moreover, he employed COCA to search for unfamiliar English words to determine “if the search word is used in [his] field” (interview transcript, April, 2015). This use of COCA enables him to be more familiar with discipline-specific language and further helps him socialize into the current doctoral program and CSE communities in the U.S. Nevertheless, his use of COCA and Merriam-Webster English dictionary both of which emphasize American English vocabulary and usage might not prepare him for being a global member in the wider CSE communities where scholars come from diverse countries and use a variety of English to discuss research and involve in academic tasks. Other than employing the above lexical sources to help him write academic texts, he also took advantage of drawing software, such as Lucidchart, to draw a diagram to compensate for his shortcoming in English written expressions. Although this strategy assisted him in coping with his present difficulties in writing assignments, it might not be a good strategy to write conference and journal papers which require articulate and persuasive descriptions of a study and presentation of data results.

In terms of understanding CSE writing conventions and improving research perspectives and skills, his use of academic search engines (e.g., IEEE Xplore, ACM Digital Library, AMiner, and dblp) and LinkedIn enables him to continuous exposure to

scholarly works. Through these technologies and reading scholarly research, he could learn discipline-specific knowledge, research perspectives and skills, know the current CSE research trends and gaps, and view scholars' writing as models to advance his English writing towards the standard of CSE writing conventions. For instance, he utilized AMiner search engine to "learn the rank of the conferences those researchers submitted to" and to "decide to submit [his] papers to which conferences" (interview transcript, May, 2015). He also used dblp search engine to know his advisor and "experienced researchers in [his] lab ... what studies they do now" (interview transcript, May, 2015). By reading his advisor's and senior researchers' studies, he could familiarize himself with their research and know his advisor's research orientations. This could further help him know the research direction and competence he needed to improve.

Nonetheless, he had a tendency to mainly utilize academic search engines, such as IEEE Xplore, ACM Digital Library, AMiner, and dblp, which only include academic papers written in English. Moreover, he mainly read and cited conference and journal papers rather than theses and dissertations. This searching behavior could narrow his research horizons and undermine his perspectives on research written in other languages as seen in "those kinds of studies are not valuable", "cite articles from famous conferences and journals in English", and "no one would cite theses or dissertations" (interview transcript, April, 2015).

Taken together, he utilized a variety of technologies to surmount his difficulties in L2 English, enhance his academic knowledge, and collaborate with other researchers in his advisor's research team. Overall, these technologies serve in an assistive role to directly

and indirectly help him achieve his academic goals in relation to his definition of successful academic acculturation.

6.6 The Evaluation of Tian-You’s Acculturation to the CSE Discipline

In order to evaluate how well Tian-You had acculturated to the CSE discipline, I adopted the self-developed evaluation approach (see Table 6.5), the percentage scale, and descriptive descriptions (see the detailed evaluation of the participants’ academic acculturation in the section on data analysis in Chapter 3).

Category	Indicators of Successful Academic Acculturation to a Doctoral Discipline	S, SS, DS, NP, NA
Tian-You’s definition of successful academic acculturation	1. Had the ability to demonstrate the competence in orally defending his arguments and discussing CSE-related research with other researchers	DS
	2. Had the ability to make contributions through presenting and publishing research in CSE communities	SS
Indicators from collected data on Tian-You	3. Had a productive relationship with his advisor and experienced researchers	S
	4. Continuously engaged in research and the scholarship in top-tier conferences and journals	SS
	5. Had the ability to understand CSE writing conventions	DS
	6. Had the ability to effectively use disciplinary language	DS
	7. Had the ability to navigate and properly use various technologies for academic purposes	S
	8. Had the awareness of ranking of CSE conferences and journals	SS
	9. Had the awareness of CSE leading scholars	SS
	10. Possessed good academic English competence	SS
Expectations & requirements of the academic department (CSE)	11. Obtained high-standard of disciplinary core knowledge (e.g., required students to take and pass core courses in three main CSE areas, with a GPA 3.3 or above)	S

Continued

Table 6. 4 The Evaluation of Tian-You’s Academic Acculturation

Table 6.5 Continued

Category	Indicators of Successful Academic Acculturation to a Doctoral Discipline	S, SS, DS, NP, NA
	12. Disciplinary conventions (e.g., passed a qualifying exam and a candidacy exam)	S
	13. Had the capacity to undertake independent scholarship (e.g., The candidacy exam was to examine whether students' dissertation proposal had the substantial depth to lead to quality research, whether students were well prepared to conduct the research individually, and whether students had overall breadth and depth in his major research area.)	NA
	14. Specialized competence (e.g., In the candidacy exam, students were required to defend his dissertation proposal and answer questions on a range of topics including the area of specialization and general fundamentals of computer science)	NA
	15. High quality of graduate work (e.g., required students to pass qualifying and candidacy exams and complete a dissertation and an oral defense)	S
Indicators from the scholarship of doctoral students' academic acculturation	Interpersonal relationships with peers, professors, & advisor	
	16. Had the ability to have (online and/or face-to-face formal and informal) conversations with scholars (Casanave, 2008; Hedgcock, 2008; Simpson & Matsuda, 2008; Morita, 2009), including peers, colleagues, professors, and other scholars in CSE communities	SS
	17. Knew old timers' expectations and had the ability to use effective strategies to satisfy those expectations (Hedgcock, 2008)	SS
	18. Had a healthy and sustainable advisor-advisee relationship (Gardner, 2007; Golde, 1998; Girves & Wemmerus, 1988; Simpson & Matsuda, 2008)	S
	19. Had a good relationship with the faculty (Gardner, 2007; Golde, 1998; Girves & Wemmerus, 1988; Weidman & Stein, 2003)	NP
	20. Had a good relationship with peers (Gardner, 2007 & 2010; Golde, 1998)	SS
21. Had the ability to write as an insider and write for a wider audience (Hedgcock, 2008; Li, 2008)	DS	

Continued

Table 6.5 Continued

Category	Indicators of Successful Academic Acculturation to a Doctoral Discipline	S, SS, DS, NP, NA
Indicators from the scholarship of doctoral students' academic acculturation	Tian-You's academic performance in CSE	
	22. Had the ability to write different writing genres for different academic purposes (Hedgcock, 2008) (e.g., class assignments, lab reports, conference proposals, qualifying exam(s), a candidacy exam, and a dissertation)	SS
	23. Had the ability to use disciplinary language, terms, and concepts in speaking and writing (Casanave, 2008)	SS
	24. Had the ability to thoughtfully and critically read scholarly texts (Casanave, 2008; Hedgcock, 2008; Li, 2008)	DS
	25. Had the ability to use strategies to purposefully read academic texts (Hedgcock, 2008) (e.g., read texts as sources of disciplinary knowledge and as models to recognize, analyze, reproduce, selectively reshape textual conversations)	SS
	26. Had the ability to have an argumentative voice and make scholarly arguments (Li, 2008)	DS
	27. Had critical thinking and synthesis competence (Gardner, Hayes, & Neider, 2007; Li, 2008)	DS
	28. Had the ability to independently conduct research and/or experiments (Gardner, 2007; Girves & Wemmerus, 1988)	SS
	29. Received awards related to academic performance (Mendoza, 2007)	DS
	30. Involved in professional activities (Li & Collins, 2014; Gardner & Barnes, 2007; Weidman, Twale, & Stein, 2001) (e.g., attend conferences, seminars, workshops, and scholarly talks)	S
	31. Acquired disciplinary core knowledge (Casanave, 2008)	SS
	32. Knew key figures in the field (Casanave, 2008; Hedgcock, 2008)	SS
	33. Knew which academic camp(s) he aligned with (Casanave, 2008; Hedgcock, 2008; Li, 2008)	SS
	34. Knew ways of constructing knowledge (Casanave, 2008) (e.g., knew how to interpret research and experimental data)	SS
35. Knew speakers' arguments when listening to speakers' talks (Simpson & Matsuda, 2008)	NP	

Continued

Table 6.5 Continued

Category	Indicators of Successful Academic Acculturation to a Doctoral Discipline	S, SS, DS, NP, NA
	36. Understood disciplinary culture (Gardner, 2007; Hirt & Muffo, 1998) (e.g., the important elements in a conference proposal and a journal article and the emphasis on innovation and collaboration)	SS
	Understanding of the Western academic culture and academic English competence	
	37. Had the ability to use English to do academic English speaking, reading, listening, and writing without difficulties (Sato & Hodge, 2009)	DS
	38. Understood course materials (Morita, 2009)	SS
	39. Understood and had the ability to participate in class discussions (Morita, 2009)	SS
	40. Understood the Western academic culture (Jones, 1999; Li & Collin, 2014; Robinson-Pant, 2009), such as the emphasis on the student-centered teaching, the ability to communicate and construct knowledge, critical thinking, independence, and class participation through oral discussions	SS

Among the 40 indicators of successful academic acculturation from Tian-You’s definition of successful academic acculturation, from collected data on him, from the expectations and requirements of his doctoral program, and from the scholarship, Tian-You received S 7 times (17.5%), SS 19 times (47.5%), DS 10 times (25%), NP 2 times (5%), and NA 2 times (5%). This result (17.5%; 1% - 20%, very poor) indicates that Tian-You’s academic acculturation condition is very poor.

Under the category of his definition of successful academic acculturation, for the 1st indicator, data reveal that he encountered difficulties in defending his research arguments and discussing CSE-related research with others in English. His difficulties might result from his unfamiliarity with the Western academic culture of defending one’s arguments and his insufficient English competence. Regarding the 2nd indicator (the ability to make contributions through presenting and publishing research in CSE communities), Tian-

You was able to get accepted and present at CSE conferences but not high-ranking ones. As for publications, since he was just in the first doctoral year and still learning disciplinary knowledge and culture, he had not been at that stage yet.

Under the category of indicators that emerged from collected data on Tian-You, in relation to the 3rd indicator, data disclose that he had a productive relationship with his advisor and experienced researchers in the research team. Since he worked in his advisor's research team, he had various opportunities to interact with his advisor and experienced researchers. These opportunities help him establish and maintain a constructive relationship with them. In addition, his advisor's research team had a unique culture which was that each novice worked closely with an experienced researcher who was assigned by his advisor. Hence, when having questions or confronting problems, Tian-You always consulted with the post-doc who worked closely with him. His conference proposals were also read and given suggestions by the post-doc first before his advisor read them. This relationship which an experienced member of the disciplinary communities guided a novice could help Tian-You smoothly adjust to CSE culture. In relation to the 4th indicator (continuously engaging in research and the scholarship in top-tier conferences and journals), as the previous paragraph mentioned, he constantly submitted and presented his research at non-top-tier conferences. Data display that even though he wanted to submit proposals to top-tier conferences, his advisor asked him to try small-scale conferences first. His advisor probably thought his research competence had not reached the level to present at top-tier conferences. Concerning the 5th indicator (the capacity to understand CSE writing conventions), data show that Tian-You struggled to clearly express his ideas in written English, meet CSE conference reviewers'

expectations, and internalize Western academic writing conventions. In regard to the 6th, 8th, and 9th indicators (the ability to effectively utilize disciplinary language and having the awareness of ranking of CSE conferences and journals, and the awareness of CSE leading scholars), he had not successfully achieved these indicators. Since Tian-You just enrolled in the doctoral program and joined his advisor's research team less than a year, he was still learning CSE core knowledge, key scholars in his research area, what levels of the conferences that renown scholars, his professors, experienced researchers submitted to, what research is considered good, and other significant disciplinary knowledge and skills. As for the 10th indicator (possessing good academic English competence), multiple data reveal that he encountered various difficulties in academic English listening, speaking, and writing. Regarding the 7th indicator (being able to navigate and properly use assorted technologies for academic purposes), data demonstrate that Tian-You understood the strengths and weaknesses of varied technologies and hence could select appropriate ones to achieve his academic goals. Moreover, he knew to employ different technologies (e.g., different academic search engines) to cross-check online information to increase the validity of the information he obtained from online sources.

Under the category of indicators that emerged from the CSE departmental expectations and requirements, for the 11th, 12th, and 15th indicators, Tian-You took and passed CSE core courses with a GPA 3.3 above and completed the qualifying exam at the end of his first doctoral year. However, he had not yet taken a candidacy exam when this study was conducted. With regard to the 13th indicator, he had conducted research with his advisor and experienced researchers for a year. Nevertheless, he had not developed

the capacity to undertake research independently. In relation to the 14th indicator, he had developed his specialized competence through taking relevant courses, reading scholarly works, and conducting research.

Under the category of indicators emerged from the scholarship of graduate students' academic acculturation, there are 25 indicators which were further divided into three sub-categories: 1) interpersonal relationships with peers, professors, and Tian-You's advisor, 2) Tian-You's academic performance in CSE, and 3) the understanding of the Western academic culture and academic English competence. Under the first sub-category of interpersonal relationship with peers, professors, and his advisor, for the 16th indicator, Tian-You was able to have online and face-to-face formal and informal CSE-related conversations with peers, professors, lab members, and his advisor. Nonetheless, his limited English competence and novice status, which he was still learning disciplinary core knowledge, sometimes precluded him from understanding professors', lab members', and his advisor's talks. As for the 17th indicator, he sometimes knew the expectations of old timers (e.g., experienced researchers in the research team and his advisor) and sometimes had the ability to use effective strategies to satisfy those expectations. Nevertheless, sometimes he could not understand old timers' expectations and did not know how to fulfil those expectations. For instance, in an interview (interview transcript, November, 2015), he mentioned that he did not exactly know the reason why his advisor told him to write a few related works in a conference proposal. In an additional interview (interview transcript, July, 2015), Tian-You stated that he thought that it was unnecessary to write a thesis statement in an essay, and this idea was questioned by his advisor about no thesis statement in his paper. Concerning the 18th

indicator, Tian-You had a healthy and sustainable advisor-advisee relationship. As mentioned in preceding paragraphs, since he worked in his advisor's research team, he had varied opportunities to discuss research with his advisor. These opportunities further help him establish and maintain a healthy relationship with his advisor. Furthermore, in an interview (interview transcript, April, 2015), Tian-You reported that his advisor inquired about his adjustment to the Ph.D. and the research team each semester. Such care given by his advisor shows his advisor's effort which is significant for Tian-You, as an international student, and which facilitates the sound advisor-and-advisee relationship. In relation to the 19th indicator (Having a good relationship with other faculty members), data do not show the prominence of his interactions with other professors and instructors in the doctoral program. Regarding the 20th indicator (having a good relationship with peers), as described in previous paragraphs, Tian-You had a good relationship with lab members and experienced researchers in his advisor's research team. He also had a good relationship with classmates from Taiwan. Nonetheless, data reveal that he has difficulty in making a connection with classmates from other countries.

Under the second sub-category of Tian-You's academic performance in CSE, for the 21st indicator, data disclose that he was unable to write as an insider and write for a wider audience. His conference proposals, especially in the introduction section, were often substantially revised by the post-doc who worked closely with him. In addition, in an interview (interview transcript, November, 2015), Tian-You stated that one of his conference proposals was rejected, and reviewers pinpointed that his proposal had insufficient related works (literature review), confused expressions, and less focus on research. Concerning the 22nd indicator, Tian-You was able to write different genres for

varied academic purposes (e.g., class assignments, lab reports, conference proposals, and the qualifying exam). However, sometimes he could not express his ideas clearly in written English due to his limited academic English competence. With respect to the 23rd indicator, data disclose that Tian-You sometimes used discipline-specific language, terminology, and concepts in speaking and writing. Nonetheless, he was a first-year doctoral student and still learning CSE core knowledge. He, thus, might be limited use or unable to be proficient in utilizing discipline-specific language, terminology, and concepts in English speaking and writing. This is proved when Tian-You said “I don’t [am unable to] write it from a big angle and then narrow it down to my main topic. He’s [The post-doc has] been in this research area for 10 years and knows lots of research so he can write from a big angle to the research problem that we are addressing...” (interview transcript, June, 2015).

Concerning the 24th and 25th indicators, data reveal that Tian-You was unable to thoughtfully and critically read scholarly texts. He sometimes adopted some strategies to read academic texts for different purposes, such as course assignments, reports for experienced researchers and his advisor, and conference proposals. Nevertheless, he did not have systematic ways to organize his academic readings. In an interview (interview transcript, May, 2015), he reported his strategy which was to return to each article he read when citing sources in his papers. This discloses his unskillful and non-purposeful reading strategy and also reveals that he did not thoughtfully and critically read scholarly texts. Among several interviews, he also did not report that he read academic texts as models for his academic writing as Cheng-Rui and Zhi-Kai did. In addition, he was always assigned by experienced researchers in the research team to read academic texts

for certain purposes. This implies that he did not have own reading goals when reading those assigned scholarly texts. Regarding the 26th indicator, data show that he was unable to have an argumentative voice and make scholarly arguments in both speaking and writing. This is verified by his inability to defend his research positions when an audience questioned his research. As for the 27th indicator, data disclose that Tian-You did not have critical thinking and had difficulties in synthesizing scholars' arguments. In relation to the 28th indicator, data reveal that he had not yet developed the ability to independently undertake research or an experiment. He always conducted research or experiments with the post-doc, other experienced researchers, and advisor in the team. The results of the 24th to the 28th indicators might be because Tian-You was still learning CSE core knowledge and fundamental research skills under experienced researchers' and his advisor's guidance. His novice researcher status, therefore, reflected on the outcomes of his academic acculturation.

With regard to the 29th indicator, data disclose that Tian-You did not receive any award related to CSE research. It is probable that he just studied in the doctoral program less than a year. Regarding the 30th, data show that he started to involve in professional activities in his first semester of doctoral study and continuously participated in professional activities, such as attending seminars and scholarly talks and presenting at CSE-related conferences. With regard to the 31st indicator, since he just enrolled in the doctoral program, he was still learning disciplinary core knowledge through taking core courses in the CSE and working with experienced researchers and his advisor in the research team. As for the 32nd indicator, he was still learning key scholars in the CSE field via reading academic texts and listening to experienced researchers' and advisor'

discussions. As regards the 33rd indicator, he knew which academic camp he aligned with. More specifically, he followed his advisor's research orientation. In an interview (interview transcript, April, 2015), Tian-You mentioned that the reason he joined his current advisor's research team because this team had a graduate assistant opening, and he needed the financial support to study the doctoral program. He stated that although his advisor's research orientation differed from his previous master's research orientation, he was also interested in his advisor's research topic. Financial support is important for a doctoral student since a doctoral program often takes several years to finish. Furthermore, working with experienced researchers and experts is also vital for novices. Luckily, Tian-You was interested in his advisor's research topic. Otherwise, he would be limited to the financial demand to choose a research topic that he was uninterested.

With respect to the 34th indicator, data disclose that Tian-You was still learning how to interpret experimental data and research results. Before submitting his conference proposals, the post-doc would check on his writing. In an interview (interview transcript, November, 2015), Tian-You stated that the post-doc and experienced researchers often drastically revised his conference proposals. The revisions included expressions in English and some crucial analysis and literature. Regarding the 35th indicator, data do not show the prominence that he knew speakers' arguments when listening to scholars' talks or presentations. Nevertheless, data disclose that when attending meetings and hearing experienced researchers mentioned some scholars' names or terminology, he would search for further information online after the meetings. Although he might not understand experienced researchers' discussions immediately, this search behavior could enhance his comprehension later, and which action could help him more understand their

discussions next time. As for the 36th indicator, data reveal that Tian-You was still learning discipline-specific culture through taking CSE core courses, partaking in CSE-related communities of practice, and working with experienced researchers and his advisor.

Under the third sub-category of the understanding of the Western academic culture and academic English competence, for the 37th to the 38th indicators, data display that Tian-You struggled to listen to, speak, and write in academic English. He sometimes understood course materials, which were written in English, but sometimes did not. On account of this difficulty, he relied on technologies to hurdle this difficulty. For instance, if he did not understand some parts of professors' lectures or course materials, he would search for online resources to increase his comprehension. In relation to the 39th indicator, data show that he did not often participate in class discussions. However, if he knew the answers what his professors and/or classmates asked, he would attempt to answer. As regards the 40th indicator, Tian-You knew some Western academic cultural aspects, such as the emphasis on the student-centered teaching and participation in class discussions. Nevertheless, some Western academic cultural aspects, especially those were different from his native academic culture, were difficult for Tian-You to adjust to, such as class discussions and defending own research positions in front of members of CSE communities who had more research experience than him. Moreover, for some Western academic cultural aspects, such as English academic writing conventions (a thesis statement in an essay), Tian-You seemed to not know or had the erroneous understanding of them. Those Western academic cultural aspects that especially differed from Tian-You's native academic culture need to be explicitly informed or taught and also require

an international student, like Tian-You, repeated practice in order to accommodate to the new cultural aspects.

In sum, among the 40 indicators of successful academic acculturation, Tian-You received S 7 times (17.5%), SS 19 times (47.5%), DS 10 times (25%), NP 2 times (5%), and NA 2 times (5%). This result (achieving 7 indicators in the satisfied level among the 40 indicators, 17.5%; 1% - 20%, very poor) indicates that Tian-You had not yet successfully acculturated to the Western academic culture and CSE communities. It is probable that he just enrolled in the CSE doctoral program and studied in the Western academic culture (U.S.). Meanwhile, this result shows that he encountered numerous academic challenges during his academic acculturation processes. In spite of his academic challenges, he was supported and guided by more experienced members and an expert in the CSE communities, and which could assist him in surmounting academic difficulties he encountered. In other words, while he adjusted to the new language and academic environment and CSE culture, he was nurtured discipline-based knowledge, research competence, and expertise in his research areas through learning from CSE courses, working with his advisor and experienced researchers in the team, and peripherally participating in significant CSE communities of practice. Such a supportive relationship between a novice (Tian-You) and experienced members (his advisor and experienced researchers) of the CSE communities could help Tian-You have smooth academic acculturation processes.

6.7 Summary

Tian-You's learning trajectory spans across three learning contexts (the college and the master's program in Taiwan and the doctoral program in the U.S.). The similarities include:

- 1) studying the same subject (computer science),
- 2) teaching styles (the use of slides),
- 3) involving in computer science research,
- 4) learning materials which were mainly written in English,
- 5) exposure to technological infrastructure, and
- 6) his learning habits (e.g., previewed teaching content via reading lecture slides before class, take notes during class, and reviewed teaching content via lecture slides and his notes).

The major differences across the three learning contexts contain:

- 1) the shift from L1 Chinese to L2 English language and academic culture,
- 2) a shift from fundamental to advanced CSE knowledge from the college to the doctoral program,
- 3) a shift from an individual research to collaborative research projects,
- 4) a shift from a distant relationship to a close relationship with senior researchers and his advisor,
- 5) more opportunities to participate in CSE conferences, and
- 6) a shift to various uses of technologies to conduct research and interact with his peers, professors, advisor, and research team members. In addition to these three

learning contexts, Tian-You also had experience in doing a research job in Taiwan.

Tian-You's definition of successful academic acculturation comprises 1) the ability to discuss CSE-related research with other scholars in CSE communities and to defend own research arguments and 2) the capability to make contributions to CSE communities through presenting and publishing his research. The two indicators of successful academic acculturation were explicitly described by Tian-You during interviews. After a close scrutiny, multiple data (survey, interviews, 14-week weekly journals, and field notes) also disclose some indicators of successful academic acculturation which were not directly identified in his definition. These indicators, which are essential to successful academic acculturation but were not explicitly identified in his interviews, include:

- 1) having a productive relationship with his advisor and experience researchers,
- 2) constantly involving in CSE communities of practice,
- 3) understanding CSE writing conventions,
- 4) effectively using disciplinary language,
- 5) having the ability to navigate and properly employ varied technologies for academic purposes,
- 6) being aware of ranking of CSE conferences and journals,
- 7) being aware of lead scholars in CSE discipline, and
- 8) possessing good academic English competence.

In addition to indicators from Tian-You's definition of successful academic acculturation and from collected data on him, the CSE departmental expectations and

requirements toward their doctoral students also emerged some indicators of successful academic acculturation. These indicators comprise to

- 1) acquire CSE core knowledge,
- 2) develop specialities,
- 3) independently conduct CSE-related research,
- 4) maintain high quality of graduate work, and
- 5) fulfil the disciplinary requirements, such as passing qualifying exams and a candidacy exam and completing a dissertation.

After evaluating Tian-You's academic acculturation through the indicators from the four sources, the result (achieving 7 indicators among the 40 indicators, 17.5%; 1% - 20%, very poor) shows that he had not yet acculturated to the Western academic culture and CSE communities. This negative result discloses that he struggled to adjust to the new language and academic learning environment and to wider CSE communities. His struggles could be seen in several circumstances.

During his academic acculturation processes, Tian-You confronted difficulties in understanding lectures, participating in face-to-face oral discussions, defending his own arguments, writing comprehensible expressions, and writing conference papers satisfying requirements of CSE communities. Some of these difficulties resulted from the language and academic culture shift from L1 Chinese to L2 English and the lack of exposure to English academic listening, speaking, and writing with feedback. In order to overcome these difficulties, he devised some strategies among which notably are the use of various technologies and online resources and support from peers, experienced researchers, and his advisor. These strategies lessened tension during his academic acculturation

processes. For instance, the shift from L1 Chinese to L2 English made him sometimes encounter unfamiliar English vocabulary when writing his papers. He utilized online lexical sources, such as Thesaurus.com, Merriam-Webster English dictionary, Google Dictionary, COCA, and Word Reference discussion forum, to check unfamiliar vocabulary, cross-check meanings of unfamiliar words, and certain searched words used by researchers in his field.

Although some of these strategies might yield some benefits for his academic acculturation, they might also prevent him from improving his English, learning disciplinary knowledge and research, and socializing into the Western academic culture and wider CSE communities. For example, his use of academic search engines which mainly included research written in English to only read conference and journal papers not including theses and dissertations might confine his research viewpoints and receive partial descriptions of other researchers' studies and findings. Meanwhile, it might also make him devalue research written in other languages, including research written in his native language. Another example is that his use of Merriam-Webster English dictionary and COCA which exclusively contain American English vocabulary and usage might not prepare him for global CSE communities where scholars come from various countries and use a variety of English. It might also make him deprecate other types of English, such as Indian English, Singapore English, and Chinese English, and lose the understanding of the main purpose of communication which is to reach a mutual understanding.

In addition to these strategies, multiple data also reveal that among these technologies Tian-You employed, there were some technologies, such as IEEE Xplore and AMiner,

which others outside of the CSE discipline might not utilize. Additionally, he utilized particular technologies for networking that depended on the most popular technology used by the group of interlocutors whom he interacted with. For instance, Facebook was the most popular communication technology used by Taiwanese students so he employed it to discuss academic tasks with his Taiwanese classmates. Google Hangouts was the common communication technology used by his senior researchers in his advisor's research team so he utilized it to interact with them. E-mail was often employed by his advisor so he utilized it to communicate with his advisor. Through using different communicative technologies, he was able to communicate with different groups of people whom could help him receive support from different groups of people during his academic acculturation processes. Moreover, data in this chapter disclose that Tian-You knew features and drawbacks of some technologies he used so he was able to utilize one technology to compensate for another technology's drawbacks. Another example is that he used Merriam-Webster dictionary to check the meaning of vocabulary, but it does not offer information about whether the vocabulary is used by CSE researchers. Hence, he employed COCA that included CSE academic texts to make sure whether the vocabulary he planned to use in his paper was also used by other CSE researchers. This understanding of the characteristics and limitations of the technologies he used could assist him in selecting appropriate technologies to achieve his academic purposes.

Besides utilizing technologies to surmount some academic challenges Tian-You encountered during his acculturation, the apprenticeship experience which he worked with experienced researchers and his advisor in the team is constructive. This experience enables him to learn discipline-based knowledge and research skills from experienced

members of CSE communities and to participate in significant CSE communities of practice with their guidance. Hence, even though Tian-You struggled to accommodate to the Western academic and CSE disciplinary culture, he was able to consult with experienced members of CSE communities (experienced researchers and his advisor) to solve academic difficulties he confronted.

The following chapter which is a cross-case discussion responds to research questions one to four based on data and analysis presented in case 1 (Cheng-Rui), case 2 (Zhi-Kai), and case 3 (Tian-You).

Chapter 7: Cross-Case Analysis

This chapter collectively reviews the three participants' (Cheng-Rui's, Zhi-Kai's, and Tian-You's) processes of acculturation to the Western academic culture and their particular disciplines through responding to the four research questions.

Research question 1: How did Chinese-speaking international doctoral students from different academic fields define successful academic acculturation?

Participant	Definition of Academic Acculturation
Cheng-Rui (Material Science and Engineering; MSE)	<ol style="list-style-type: none"> 1. Had the ability to discuss with others about MSE research 2. Presented own research at MSE conferences and received positive feedback from audiences 3. Received research awards for research and academic performance 4. Derived satisfaction from my advisor with my research and academic performance
Zhi-Kai (Statistics)	<ol style="list-style-type: none"> 1. Felt comfortable enough to discuss statistical research in English with anybody 2. Felt comfortable enough to study under the US educational system 3. Had the ability to independently formulate research problems and find solutions 4. Had the ability to develop new and useful statistical analysis 5. Published papers and solidified career prospects
Tian-You (Computer Science and Engineering; CSE)	<ol style="list-style-type: none"> 1. Had the ability to demonstrate the competence in orally defending his arguments and discussing CSE related research with other researchers 2. Had the ability to make contributions through presenting and publishing research in CSE communities

Table 7.1 The Three Participants' Definitions of Academic Acculturation

Although the three participants studied in distinct academic disciplines in the U.S., their definitions of successful academic acculturation share resembling indicators. These similarities (see Table 7.1) include 1) discussing disciplinary research with others, particularly researchers and scholars in the own field, 2) having the capacity to engage in scholarly communities of practice (e.g., through publishing in disciplinary journals and presenting at discipline-specific conferences), and 3) obtaining recognition in disciplinary communities. In addition to these similarities, some different indicators of successful academic acculturation exist across the three cases (see Table 7.1). These differences contain 1) advisor's satisfaction with Cheng-Rui's academic performance, 2) comfort in studying under the U.S. education system (Zhi-Kai) which he meant the ability to adjust to the culture of the advisor-advisee relationship, and 3) the ability to defend own research arguments (Tian-You). After a scrutiny, these differences stem from their own academic situations.

Their definitions of successful academic acculturation reveal common and different aspects. After a closer examination, their definitions show that they did not exclusively focus on acculturating to their current doctoral programs. They centered on socializing into both their doctoral programs and their wider discipline-specific communities. For instance, three of them designate the significance of discussing disciplinary research with researchers and scholars and making contributions in the fields. In addition, their definitions of successful academic acculturation disclose the significance of academic English competence. For instance, one of the common indicators among the three participants is able to discuss disciplinary research with other researchers and experts in their fields. To achieve this indicator, they required to be proficient in academic English

listening and speaking in order to discuss disciplinary research with other researchers and experts in their discipline-specific communities. Another example is the common indicator across all three participants which is to have the capacity to engage in scholarly communities of practice, such as publishing their research in disciplinary journals. In order to achieve this goal, they required being proficient in academic English reading and writing competence.

Moreover, their definitions reveal that the understanding of and the capacity to navigate in the Western academic culture and disciplinary culture (e.g., knowing the conventions of writing conference proposals, defending own research arguments, and interacting with other researchers and scholars formally and informally) are essential factors influencing academic acculturation processes. Furthermore, their definitions show their long-term academic trajectory goal which is to obtain recognition in their discipline-specific communities. In other words, successful academic acculturation for the three participants in this study comprises three major processes. The first and fundamental process is to adjust to their doctoral programs. The second process is to engage in communities of practice in their doctoral programs and wider discipline-specific communities. The third process is to receive recognition in their discipline-specific communities through making significant contributions in their fields.

Research question 2: What common and distinct technologies did Chinese-speaking international doctoral students from different academic fields use for academic acculturation?

Table 7.2 exhibits common and distinct technologies during their academic

acculturation processes. From the large categories of the technologies they employed, the common technologies they utilized include:

- 1) academic search engines,
- 2) citation software,
- 3) online lexical resources,
- 4) online social interactional software,
- 5) reading software,
- 6) presentation software,
- 7) document preparation software, and
- 8) online videos

Nevertheless, after a careful look, data reveal that the specific technologies the participants employed under these categories are largely different for each of them. In addition, some of the ways how they used these technologies to do which academic tasks are divergent. For example, Cheng-Rui mainly utilized Taiwan online Yahoo Chinese-English dictionary to look up vocabulary, whereas Tian-You employed several English dictionaries to look up vocabulary and cross-check meanings. These differences are described in each of the eight categories in the later sections.

Participants	Common Categories of Technologies Used by the Participants
The three participants	<ul style="list-style-type: none"> • Academic search engines • Citation Software • Online lexical resources • Online Social Interactional Software • Reading software • Presentation software • Document preparation software • Online videos
Different Technologies Used by the Participants	
Cheng-Rui (Material Science and Engineering; MSE)	<ul style="list-style-type: none"> • Online storage software–Dropbox • Course Management software – Carmen
Zhi-Kai (Statistics)	<ul style="list-style-type: none"> • Statistical analytical software • MATLAB, R, GAP, and Microsoft Excel • Note-taking software – LaTeX • Drawing software –MATLAB and Excel
Tian-You (Computer Science and Engineering; CSE)	<ul style="list-style-type: none"> • Online storage software – Google Drive and Dropbox • Note-taking and documenting software— Evernote, Google Keep, Google Sheet, Google Doc, Microsoft OneNote, a voice recording App, and PDF • Course Management software – Carmen • Drawing software – Gnuplot, Lucidchart, PowerPoint, and Coggle

Table 7.2 Common and Different Technologies the Participants Used during Their Academic Acculturation

Academic search engines.

A Participant	Academic Search Engines
Cheng-Rui (MSE)	Google, Google Scholar, the school library search engine, and Web of Science (rarely use)
Zhi-Kai (Statistics)	Google, Google Scholar, and the School library search engine
Tian-You (CSE)	Google Scholar, Google Books, Wikipedia, dblp, IEEE Xplore, ACM Digital Library, and AMiner

Table 7. 3 The Three Participants’ Use of Academic Search Engines

Under the common category of academic search engines, Cheng-Rui and Zhi-Kai both used Google and Google Scholar search engines to search for and download academic

papers. Moreover, they adopted the school library search engine but mainly employed it to download academic papers that they could not obtain from Google and Google Scholar search engines. In addition to these search engines, Cheng-Rui also utilized Web of Science to locate scholarly texts for a short period to meet his need to import citation information into his EndNote (citation software) account. This function had not been developed by Google Scholar at that time. After the Google company improved their service to incorporate this function into Google Scholar, he switched back to use it. Tian-You also utilized Google Scholar to search for academic papers, but it was not his top preference. Instead, he employed discipline-based academic search engines, such as dblp, IEEE Xplore, ACM Digital Library, and AMiner, to seek academic papers first. If he could not find needed papers through these search engines, he then located the papers through Google Scholar. Nevertheless, he reported that the discipline-based academic search engines he employed often could supply him needed scholarly texts.

Other differences in their use of academic search engines are the using process and academic purposes they employed the search engines for. Cheng-Rui used Google and Google Scholar to look for scholars' names and papers when hearing presenters mentioned some scholarly works related to his research during conferences. In addition, if he encountered questions about research or experiments, he would employ Google Scholar to look for scholarly texts and find possible answers in the texts to aid him in tackling the questions. Moreover, when reading significant research papers, he would look for "the most important works cited in the reference list via Google Scholar and then read them" (interview transcript, May, 2015). While searching for scholarly papers through Google Scholar, he decided which academic "papers are good or not" via looking

at citation counts generated by Google Scholar (interview transcript, May, 2015). In other words, he believed that academic papers with higher citation counts were considered good research. Then, he exclusively read those ‘good’ academic papers. Furthermore, he was inclined to read “the first 10 web pages on Google [Scholar] search because “After 10 web pages, [he would] lose [his] patience” (interview transcript, May, 2015). In brief, Cheng-Rui favored Google and Google Scholar than other academic search engines.

Like Cheng-Rui, Zhi-Kai also adopted Google Scholar. Nevertheless, when not having an idea for a research topic, he employed Google to look for statistical terms and concepts that were associated with the topic first and then utilized Google Scholar to locate relevant scholarly works. During the process of searching academic texts in Google Scholar, he would “set up the ranking system... and then start to read papers from higher citation numbers... I usually will read all web pages Google Scholar generates in case those are related to my dissertation” (interview transcript, July, 2015). Moreover, before attending statistical conferences, Zhi-Kai would determine which scholars’ sessions he was going to attend and then utilized Google Scholar to look for the scholars’ works. He reported that the reason he had this action was to confirm whether the scholar’s studies were similar to his research as well as to familiarize himself with their studies and terminology and concepts they would mention in their presentations. Furthermore, when confronting unfamiliar statistical terminologies while reading academic articles, Zhi-Kai would search for them via Google and Google Scholar to read more explanations. Additionally, in his early doctoral years, when encountering math questions in assignments that he was uncertain the answers, he would rely on Google Scholar to search for academic papers which could help him answer the questions.

Unlike Cheng-Rui and Zhi-Kai, Tian-you preferred discipline-based search engines (e.g., dblp, IEEE Xplore, ACM Digital Library, and AMiner) to general search engines (e.g., Google and Google Scholar) for various academic purposes. These purposes include

- 1) familiarizing himself with significant scholars whom his advisor and research team members mentioned,
- 2) knowing what kind of studies his advisor and research team members conducted and their research orientations,
- 3) learning about conference rankings that scholars, his professors, advisor, and experienced researchers in the research team submitted to,
- 4) understanding which conferences he should submit his research proposals to, and
- 5) learning unfamiliar computer programs that could be employed within his own studies.

Compared with Cheng-Rui and Zhi-Kai, Tian-You adopted various discipline-based search engines. This strategy of using discipline-based search engines might efficiently help him find needed CSE-related academic articles. The search results might also be more valid than employing general search engines (e.g., Google Scholar). In addition, Tian-You's use of discipline-based search engines discloses that he knew these discipline-based search engines' features and drawbacks well. Thus, he was able to utilize one search engine to compensate for another search engine's drawbacks and choose proper ones to achieve his academic goals. Moreover, data show that his acquaintance with some of these discipline-based search engines (e.g., IEEE Xplore and ACM Digital

Library search engines) derives from his past learning and research experiences in Taiwan. That is to say, his past learning and research experiences positively influenced his present academic acculturation processes.

On the whole, the three participants' use of academic search engines discloses several marked points. First, three of them adopted academic search engines to look for scholars' works to learn scholars' research and broaden their research horizons. Cheng-Rui, for instance, would search for unfamiliar scholars' names and papers via Google and Google Scholar during conferences. Zhi-Kai would look for and read presenters' papers, especially those presenters who undertook resembling research as he did, via Google Scholar before attending conferences. Tian-You would seek scholars' bibliographies through dblp search engine and scholars' papers via IEEE Xplore, ACM Digital Library, and AMiner search engines when hearing unfamiliar scholars and studies mentioned by his experienced researchers and advisor. By searching for and reading information about scholars and their research through academic search engines, the three participants could also familiarize themselves with discipline-specific terms and gain mastery of academic English. This exposure could further increase their participation in scholarly discussions and their understanding of others' discussions.

Second, their past learning and research experiences positively influenced their present academic acculturation processes. For example, when studying in the master's program, Cheng-Rui had the habit of utilizing Google to look for unfamiliar disciplinary concepts and terms while writing his assignments. During his doctoral study, when confronting questions about research and experiments, he would look for possible solutions through searching for academic papers in Google Scholar. Tian-You learned

about IEEE Xplore and ACM Digital Library when studying in the master’s program in Taiwan. His use of the two discipline-based search engines endured during his doctoral study. Third, some of the three participants’ use of academic search engines is problematic. Cheng-Rui and Zhi-Kai, for example, mainly utilized one academic search engine (Google Scholar) to seek academic papers. However, each academic search engine has its strengths and shortcomings. It might be better to employ multiple rather than only one academic search engine to look for and learn scholarly works. Like Tian-You, employing multiple academic search engines could counterbalance individual academic search engine’ shortcomings.

Citation software.

Participant	Citation Software
Cheng-Rui (MSE)	EndNote
Zhi-Kai (Statistics)	Mendeley
Tian-You (CSE)	BibDesk

Table 7. 4 The Three Participants’ Use of Citation Software

The second common category of technologies they utilized is citation software which they employed to organize their academic readings and generate in-text citations and bibliographies for their academic writing. Especially, when their discipline-specific conferences or journals do not follow a particular citation style, adopting citation software during the process of writing such conference and journal papers could save their time and reduce the challenges of learning different citation styles. A close scrutiny of their use of citation software reveals that they adopted different citation software. Cheng-Rui employed EndNote; Zhi-Kai utilized Mendeley; Tian-You used BibDesk.

Online lexical resources.

Participant	Online Lexical Resources
Cheng-Rui (MSE)	Google Dictionary, Google search engine, COCA (rarely use), Taiwan Yahoo online Chinese-English dictionary (often use), Dictionary App (rarely use), and academic articles related to MSE
Zhi-Kai (Statistics)	Google dictionary, Google search engine, Google Translate, and academic articles related to statistics
Tian-You (CSE)	Google Dictionary, Google search engine, COCA, Mac laptop's in-built English dictionary, and Merriam-Webster English dictionary, Treasure.com, an English discussion forum (WordReference.com for English grammar), and academic articles related to CSE

Table 7. 5 The Three Participants' Use of Online Lexical Resources

The third common category of technologies they utilized is online lexical resources. Table 7.5 reveals that all three participants employed Google Dictionary and the Google search engine as lexical resources. Even though the Google search engine is not a dictionary, it provides the function of an online dictionary (also known as Google Dictionary). Hence, when the participants said they utilized Google to look up English vocabulary, meaning to use Google Dictionary. Data show that three of them employed Google Dictionary to find synonyms while writing their academic papers. Their use of Google Dictionary for synonyms also discloses that they lacked sufficient English vocabulary and thus relied on an additional support (Google Dictionary) to help them cope with their weakness of the English academic writing. Unlike Tian-You, Cheng-Rui and Zhi-Kai also employed Google to learn unfamiliar English grammar and punctuation. Interestingly, Cheng-Rui did not initially look for English grammar through Google when encountering unfamiliar English grammar. Instead, he used to inquire his American colleagues in his lab, but later he found that they sometimes offered him confusing answers. Therefore, he switched to use Google search engine to look for answers for his

English grammatical questions.

In addition to Google Dictionary and the Google search engines, the participants, in particular Cheng-Rui and Zhi-Kai, also employed discipline-based academic articles as their lexical resources to learn the discipline-specific language and ways of writing academic papers in English. Cheng-Rui stated that “My method is to find a research paper which focuses on an area related to my research interest. Then, I look at how s/he wrote his/her paper, such as structure, words, and usage, so I’d know how to write my paper” (interview transcript, May, 2015). This is analogous to the way Zhi-Kai sometimes imitated scholars’ writing when writing his dissertation. This could be seen when Zhi-Kai said “For my dissertation... Sometimes I copy some sentences from scholarly works” (interview transcript, June, 2015)”. However, the way how he imitated scholars’ words was through the copy-and-paste method rather than synthesizing their words. Zhi-Kai’s advisors consequently told him that ““It’s obviously not your writing style. Those sentences were not written by you”” (interview transcript, June, 2016). After his advisors’ reminder, Zhi-Kai attempted to not imitate scholars’ writing through the copy-and-paste method. Viewing discipline-based academic papers as models to learn how to use English and discipline-specific language could be helpful for international graduate students to write their academic papers in English. Nonetheless, if they, as Zhi-Kai, are unable to internalize scholars’ writing styles, their writing would look inharmonious and awkward for readers. It might also lead to the plagiarism issue.

Besides these, Cheng-Rui and Tian-You also employed COCA, but data display that Cheng-Rui only utilized it for a semester when his ESL instructor introduced it and requested students to use it for assignments. Cheng-Rui stated that “I feel it has too many

entries. I don't want to find out an answer from the big data. I don't have time to do that” (interview transcript, March, 2015). COCA is not a dictionary which usually generates brief explanations of vocabulary and examples of usage. When typing a keyword in COCA, it generates thousands of examples of the searched word through displaying excerpts from various genres of actual writing. Cheng-Rui had a tendency to receive solutions to his online lexical queries quickly and to read Chinese explanations of English vocabulary which provided him with this rapidity. Such abundant lexical examples in English that COCA provides require Cheng-Rui time to figure out English usage by himself which made him feel “it has too many... I don't have time to do that” (interview transcript, March, 2015). On the contrary, Tian-You often employed COCA and appreciated its unique feature whereby its databases contain discipline-specific academic texts that other English dictionaries do not provide. This is proved when he said “when searching in COCA, I check if the search word is used in my field. I don't see this function in other dictionaries” (interview transcript, April & May, 2015). In other words, using COCA enables him to learn words and phrases that scholars in his discipline utilized and how to use those words and phrases in his academic writing. He also employed it to learn English grammar and collocations.

In addition to these online lexical resources, the three participants also adopted other different online lexical sources for writing their English academic papers. Cheng-Rui utilized Taiwan Yahoo online Chinese-English dictionary which was his favorite dictionary. Initially, he also employed Dictionary app on his cell phone when hearing some unfamiliar English vocabulary during his research group meetings. Nevertheless, toward the end of his interview process, he reported that “I don't use it [Dictionary app]

anymore. It's very bad" (interview transcript, April, 2016). Based on multiple data, one possible reason he did not use it anymore is that he had a tendency (as mentioned earlier) to read Chinese explanations of English vocabulary, like in Taiwan Yahoo online Chinese-English dictionary. This could be seen in "It's very fast to find out the meaning of a word via using Taiwan online Yahoo dictionary. I'm just lazy to use an English-English dictionary" (interview transcript, April, 2015). He thinks "very fast" when utilizing this dictionary because he could employ his native language (Chinese) to understand unfamiliar L2 English vocabulary and explanations.

Notably, these participants did not use the identical online lexical sources. Unlike Cheng-Rui and Tian-You, Zhi-Kai employed Google Translate to help him read medical articles. The reason he did not use his preferred Google Dictionary in this case is that "[He] just want[s] to know their Chinese meanings [of medical vocabulary in articles] but not usage so using Google Translate is faster...typed all English vocabulary in one column and it translated them into Chinese in the other column" (interview transcript, July, 2015). That is to say, it is faster for Zhi-Kai to read Chinese translations of English vocabulary than reading English-to-English explanations in an English dictionary or Chinese-to-English explanations in a Chinese-English dictionary.

Conversely, Tian-You used his Mac computer's in-built English dictionary, Merriam-Webster English dictionary, Treasure.com, Dictionary.com, and WordReference.com discussion forum to help him read and write academic papers and understand speakers' talks. More specifically, during reading and writing processes when confronting unknown English vocabulary, he employed both Merriam-Webster English dictionary and Google Dictionary to learn and cross-check the meanings of the vocabulary. If he was to look for

synonyms, he employed both Treasure.com and Google Dictionary to solve his problem of using the identical words. The reason he utilized the two dictionaries for synonyms is because “[Google Dictionary] sometimes offers a few synonyms so [he] go[es] to Thesaurus.com to look for more synonyms” (interview transcript, June, 2015). Tian-You’s use of varied online lexical sources as reported here reveal that he did not depend on one lexical source but multiple sources to compensate for individual lexical source’s shortcomings and to cross-check the validity of online lexical resources. His use of these online lexical resources also shows an interesting phenomenon that is his tendency to utilize lexical resources that are solely in English. Merriam-Webster English dictionary and COCA especially mainly contain American English. Utilizing online lexical resources in American English might help him adjust faster to American academic culture and computer science communities in the US. Nonetheless, this might not assist him in acculturating to wider computer science communities where scholars come from different countries and use a variety of English to communicate in oral and writing. Another interesting phenomenon is that he seemed to not cross-check the online resources about English grammar but would do so for English vocabulary. When encountering English grammatical questions, he only employed WordReference.com discussion forum to see whether someone asked similar English grammatical questions and how users of this discussion forum answered the questions. Although through this manner he might find answers to solve his immediate English grammatical questions, the accuracy of the answers remains uncertain because one could not determine English educational backgrounds of users of WordReference.com.

In sum, the above data disclose several noteworthy points. First, Cheng-Rui and Zhi-

Kai were inclined to mostly count on one lexical source (Cheng-Rui's use of Taiwan Yahoo online Chinese-English dictionary; Zhi-Kai's use of Google Dictionary) to learn English vocabulary. Contrarily, Tian-You employed various dictionaries to learn English vocabulary and cross-check meanings. Utilizing varied lexical sources seems to be the better strategy to learn English vocabulary since it enables users to obtain more complete explanations and usage of English vocabulary than using only one lexical source which is subject to its own limitations. Second, they, in particular Cheng-Rui and Zhi-Kai, relied on online resources about English grammar, but it is uncertain whether the resources they obtained were accurate or not. Moreover, Tian-You employed COCA for English grammar. Nonetheless, it is unclear whether he was able to figure out English grammatical rules, especially those he was unfamiliar with or had not yet learned, from plentiful examples of usage. Third, their use of online lexical resources for learning English vocabulary, synonyms, and English grammar shows that they lacked sufficient knowledge of English vocabulary and grammar to deal with difficulties in English academic writing they confronted. Even though three of them took required ESL writing courses, they reported that the courses did not provide needed English learning but taught them citation styles and not to plagiarize someone's works. Fourth, three of them utilized discipline-based academic articles as models of learning the discipline-specific language. Cheng-Rui and Zhi-Kai also sometimes viewed the academic articles they found as models to learn how to organize their papers and to write sentences in English. This learning behavior could help them adjust to disciplinary writing culture smoothly.

Online social interactional software.

Participant	Online Social International Software
Cheng-Rui (MSE)	Email, Facebook (including Facebook Messenger), LinkedIn, WeChat, cell phone texts, and Glassdoor
Zhi-Kai (Statistics)	Email, Facebook, Skype, PTT, Google Talk, Line, AT&T Connect, QQ, and a phone
Tian-You (CSE)	Email, Facebook, LinkedIn, Google Hangouts, Online discussion forums (Starkoverflow, Quora, CONSIDER, and Piazza)

Table 7. 6 The Three Participants' Use of Online Social Interactional Software

The fourth common category of technologies across the three participants is online social interactional software. All the participants employed email and Facebook during their academic acculturation processes. Cheng-Rui utilized email to a) communicate with professors in his doctoral program, b) discuss research, and c) share information with scholars, particularly professors, whom he met at conferences and some of whom were in different countries. He also used email to discuss coursework and research with international student peers (not including Taiwanese students). The reason he employed email to communicate with the two groups of the interlocutors is because he viewed “email [as a] more official [communication manner]” (interview transcript, January, 2016). Like Cheng-Rui, Zhi-Kai also used email to interact with his professors in school and scholars and other doctoral students whom he met at conferences and some of whom are in different countries. One notable phenomenon is that in his early doctoral years, writing emails to his advisors took him a couple of hours to finish an email because “While writing [email], [he] was looking up words in an online dictionary and thinking about which sentence structure [he] should use” (interview transcript, July, 2015). This reveals that the use of email in Zhi-Kai’s early doctoral years served as a transition to familiarize himself with writing emails in English and communicating with his advisors.

Like Zhi-Kai, Tian-You also employed email to communicate with his professors in school and scholars outside of the school and in different countries, including his prior professors in Taiwan and scholars whom he learned through reading their academic papers or dissertations.

In brief, utilizing email in the way the three participants did is advantageous. First, using email enables them to interact with professors, doctoral students, and scholars outside of their school and cross borders. Second, employing email which features asynchronous and written communication enable the three participants, as L2 English speakers, to have more time to think, organize, and write their expressions in English. These features are not present in face-to-face communication which requires them to understand and respond to interlocutors' talks immediately. For L2 English speakers, like the three participants who had insufficient exposure to English speaking and listening in their native country, asynchronous and written communication reduces their stress to understand and respond to interlocutors immediately and allows them to have more time to check English dictionaries while reading and writing their emails.

Nonetheless, effective asynchronous communication necessitates good English writing skills. Without sufficient English writing competence, expressions in emails could perplex readers. Tian-You reported that he sometimes confronted miscommunication while emailing his professors due to his unclear expressions in English. He also indicated that email communication did not enable him to see interlocutors' facial expressions which could increase his understanding of interlocutors' utterances, know whether interlocutors understood what he said, and decide whether he should change his expressions or not. In other words, asynchronous communication

weaknesses include the lack of paralanguage (e.g., facial expressions and body language) and the inability to back-and-forth immediate interaction. Even though advantages and disadvantages of asynchronous communication coexist, in the three participants' interviews and survey responses, they reported that they felt they could express their ideas in English more clearly through online asynchronous and written communication than face-to-face.

In addition to using email, three of them also utilized Facebook to interact with Taiwanese international students at their institution. It is because there was a Taiwanese student Facebook group, and most Taiwanese students studying in this institution would join this Facebook group upon their arrival. Tian-You in particular often utilized Facebook to discuss coursework with his Taiwanese classmates. One noteworthy phenomenon shown in the data is that Tian-You mostly interacted and discussed coursework with Taiwanese classmates. He said "Some of [his] international classmates [who] are from China and India... often form their own groups so it's hard for me to join their groups" (interview transcript, August, 2016). For Cheng-Rui and Zhi-Kai, they reported that they were the only Taiwanese students in their programs so they used Facebook not for coursework but for communicating with student alumni, their former peers and professors in Taiwan, and doctoral students in different universities. Cheng-Rui used Facebook to build and maintain relationships with Taiwanese alumni who worked in his current advisor's research team before, his college's peers in Taiwan, and MSE doctoral students studying in other institutions whom he met at conferences. Zhi-Kai employed Facebook to maintain relationships with his previous master's peers in Taiwan.

Besides utilizing Facebook for these purposes, the three participants also adopted

Facebook to receive discipline-based information. For instance, Zhi-Kai participated in two Facebook groups (Hwa-Fan and R groups) created by his prior master's peers in Taiwan. When encountering statistical questions, he would ask his former peers in Taiwan through the Facebook groups. If the group members had statistical questions, he would also attempt to answer their questions. Additionally, he regularly learned new ways of operating R statistical analytical software through his former peers' video posts in the R group on Facebook. Like Zhi-Kai, Tian-You joined a Facebook group created by his previous master's professor. The professor regularly posted computer science related articles and information in the group, and Tian-You would regularly read them. Cheng-Rui also frequently read MSE-related online posts in a Facebook group created by members of his advisor's lab.

Other than email and Facebook, the three participants also employed distinct online social interactional software to interact with different groups of people. Cheng-Rui employed WeChat to discuss coursework and research with his peers from China and used Facebook Messenger and phone calls with his American peers. Moreover, he utilized LinkedIn and Glassdoor to read discussion posts related to MSE topics and establish relationships with industrial workers and scholars in his discipline. Nevertheless, multiple data disclose that he acted as a novice researcher and rarely participated in discipline-based online discussions on Facebook, LinkedIn, and Glassdoor. Contrarily, Zhi-Kai more actively partook in discipline-based online discussions. He, for instance, sometimes visited a statistical discussion board in PTT (a famous online Taiwanese university discussion forum) to answer users' statistical questions. When encountering statistical questions, he would seek help from his previous

master's peers through the Facebook groups he joined. Furthermore, Zhi-Kai utilized QQ to discuss assignments with peers from China in his first doctoral year. When preparing for his qualifying exam, he also used QQ accompanying email to discuss exam related questions with his doctoral peers. One noteworthy phenomenon is that he seemed to mostly interact with peers from China. Although he mentioned most of the international students in his department were from China, the department also enrolled some local students. This phenomenon implies that he might confront difficulties in interacting with local students. Besides PTT and QQ, he sometimes utilized Skype to discuss research with his two retired advisors when they were not in the school and when he was out of the US. In addition, he employed AT&T Connect accompanying phone calls especially for his graduate assistantship job to communicate with his research collaborators.

Like Zhi-Kai, Tian-You also discussed research with others, but he employed Google Hangouts with the post-doc, who worked close with him, and members in his advisor's research team. Additionally, he used the identical technology to discuss conference papers with the post-doc. His use of this communication software, in fact, was influenced by his research team members and the post-doc: "When I just joined the team, the post-doc and other researchers asked me to use Google Hangouts... We use it especially when approaching the deadlines of conference papers or research projects" (interview transcript, June, 2015). This reveals that employing Google Hangouts was necessitated by the need for immediate responses. Interestingly, when discussing research or conference papers with his advisor, he utilized email. This choice was also affected by his advisor because his advisor only used email to communicate with him and other group members. This shows the hierarchical use of online social interactional technologies in his advisor's

research team. This hierarchy also implies a distance between novices (like Tian-You) and experts (his advisor and senior researchers) in his advisor's research team. Besides Google Hangouts, Tian-You also employed LinkedIn which was introduced by his advisor through sending him the link to scholarly papers. He utilized it to read "articles [that] are published by outstanding researchers" (interview transcript, May, 2015). This kind of readings enables him to develop the ability to distinguish good and bad research and further cultivate his research competence by reading those 'good' research as models. Another online social interactional technology he often employed is online discussion forums, in particular Starkoverflow. When encountering questions about computer programming or theories, he visited this discussion forum to see whether another user also confronted similar questions and how other users of this forum answered the questions. In addition to reading the posts on this forum, he also contributed his ideas when seeing another user's questions.

In all, the three participants' use of online social interactional software reveals several notable points. First, they attempted to utilize online social interactional software to receive peer-to-peer support outside of class. For instance, Cheng-Rui used WeChat, Facebook Messenger, and phone calls to discuss coursework and research with peers. Zhi-Kai employed QQ and email to discuss the qualifier exam with peers. Tian-You utilized Facebook to discuss assignments with peers from Taiwan. Receiving peer-to-peer support was the learning habit which originated from their past learning behavior. In other words, their past learning backgrounds positively influenced their present academic adjustment. Second, they used online social interactional software to interact with other doctoral students, professors, and scholars in different institutions and countries. On

account of the feature of online social interactional software which is cross-border communication, they were able to establish and maintain relationships with scholars in different locations. This cross-border scholarly communication and relationships might assist the three participants in acculturating to their wider disciplinary communities smoothly. Third, their use of online social interactional software, especially software which enables them to have asynchronous and written communication (e.g., email), shows several advantages for international students like the three participants. These advantages include giving them more time to think, organize, and write their expressions in English. Fourth, their use of online social interactional software displays that they might confront challenges of interacting with peers from the target culture and from countries other than Taiwan. Especially, Zhi-Kai and Tian-You seemed to mostly interact with peers from Taiwan and China. Therefore, this interaction that they only communicated with Chinese-speaking peers might not help them adjust to their doctoral programs and disciplinary communities well.

Reading software – PDF.

The fifth common category of technologies the three participants employed is PDF reading software. Since most academic papers have been digitized into the PDF format, three of them often searched for and downloaded discipline-based scholarly papers in PDF. Although all of them employed PDF, they used it differently from each other. Three of them did not report their use of PDF in their 14-week weekly journals but in their survey responses and interviews. In an interview (interview transcript, March, 2015), Cheng-Rui reported that he utilized the function of highlighting in PDF while initially

reading academic articles. After this, if he thought the article was important, he would print it out and then read it again while highlighting and note-taking by hand. Data from document collection (some samples of his academic readings) further disclose that he merely highlighted a few places in the three samples of academic papers in PDF documents he read. His paper-based notes for the academic articles he read also show that he contentiously utilized his previous learning habit, taking notes by hand, in the new and digital learning environment.

Cheng-Rui's reading habit of printing electronic academic papers is analogous to Zhi-Kai's reading habit. Zhi-Kai reported that "I usually like to print them [academic papers in PDF] out. Then, I highlight and take notes by hand while reading them. This is my reading habit from the past" (interview transcript, July, 2015). Interestingly, after reading the printed texts, he would type significant sentences excerpting from the readings into a Word file in order for him to refer to while writing his academic papers later (interview transcript, July, 2015). This phenomenon of the mixture of adopting technologies and non-technological reading habit, reveals Cheng-Rui and Zhi-Kai had not yet completely accommodated to the digital environment. Unlike Cheng-Rui and Zhi-Kai, Tian-You employed various technologies to do non-academic and academic tasks. This is proved when he said "All my learning materials and academic papers are the electronic versions. I don't read paper-based materials anymore" (interview transcript, May, 2015). He always employed the functions of highlighting and note-taking in PDF during the processes of reading academic materials. He even utilized different color codes which helped him retrieve needed information in academic papers later and achieve his reading goals. In sum, three of them employed reading software to aid them in increasing

understanding of academic texts in PDF they read by highlighting and taking notes and to assist them in retrieving needed information later quickly.

Presentation software.

Participant	Presentation Software
Cheng-Rui (MSE)	PowerPoint
Zhi-Kai (Statistics)	LaTeX
Tian-You (CSE)	PowerPoint

Table 7.7 The Three Participants' Use of Presentation Software

The sixth common category of technologies is presentation software. Both Cheng-Rui and Tian-You employed PowerPoint, but Zhi-Kai used LaTeX. Cheng-Rui and Tian-You would go to the institutional course management (Carmen) to download instructors' PowerPoint slides and preview the teaching content before class and review learned knowledge after class. In an interview (interview transcript, November, 2015), Tian-You stated that utilizing PowerPoint slides to preview and review instructors' teaching content was advantageous for him. He reported that reading lecture slides enabled him to quickly understand the gist of instructors' teaching and increase his comprehension when instructors were giving the lectures. Since PowerPoint slides consist written English words, diagrams, images, and/or video clips, the visual support help him, as an L2 English learner, to follow instructors' lectures and enhance his understanding of the lectures through reading the slides. Tian-You described that he sometimes could not catch up instructors' fast-speed teaching, but "[r]eading lecture slides while listening to the lectures helps [him] know what [instructors] are talking about" (14-week weekly journal, April, 2015). For Tian-You, the disadvantage of PowerPoint lecture slides is that they lack sufficient details. He mentioned he sometimes needed to read books or other learning materials in order to "completely understand the points [on the slides]"

(interview transcript, November, 2015).

On the other hand, Cheng-Rui found the feature of brief explanations on slides is an advantage. Cheng-Rui utilized PowerPoint to create slides and reported his research progress when meeting his advisor. Since his advisor was too busy to have sufficient time to read his dissertation, he employed PowerPoint slides which consisted short and brief descriptions rather than his lengthy dissertation to attempt to receive his advisor's feedback during the meetings with his advisor. Nevertheless, this strategy of using PowerPoint slides could not actually help him receive constructive feedback on English academic writing and on discipline-specific content from his advisor in the long run. Cheng-Rui participated in discipline-specific communities of practice (e.g., conducting research, presenting at conferences, writing his dissertation, and publishing journal articles). However, without an expert's (his advisor's) sufficient and appropriate guidance, a novice (Cheng-Rui) might be unable to actually learn significant disciplinary conventions (e.g., how to conduct 'good' research, how to write a journal article that is accepted by experts' perspectives, and how to respond to reviewers' feedback).

In addition to using PowerPoint for the above purposes, Cheng-Rui and Tian-You employed PowerPoint to create slides for their class and conference presentations. In an interview (interview transcript, June, 2015), Cheng-Rui reported that using PowerPoint enabled him to clearly express his research results by incorporating diagrams, images, and videos. For conference presentations, Tian-You particularly used the function of rehearsal in PowerPoint to aid him in practicing his oral presentation in English and establishing his confidence. Tian-You, as an English learner, did not have many opportunities to present academic research in English in Taiwan and did not receive

explicit training in oral academic presentations in English in his present institution.

PowerPoint's rehearsal feature (which offers him the functionality of practicing his oral presentations through recording his own practice, listening to the recordings, correcting his mistakes, and repeating the process) enables him to practice his oral presentations until he felt he could present his research in front of experts at conferences.

By and large, the three participants' use of presentation software reveals some benefits for them as international students who are L2 English speakers. These benefits include:

- 1) allowing them to quickly understand the important points of instructors' lectures,
- 2) enabling them to follow instructors' pace while reading PowerPoint teaching slides,
- 3) providing them a way to review teaching content through reading instructors' PowerPoint slides,
- 4) rehearsing English oral presentations through the rehearsal feature in PowerPoint, and assisting them in giving clear oral presentations in English through integrating diagrams, images, and/or videos into their PowerPoint slides.

Document preparation software.

Participant	Document Preparation Software
Cheng-Rui (MSE)	Microsoft Word
Zhi-Kai (Statistics)	LaTeX and Microsoft Word
Tian-You (CSE)	TeXShop and ShareLaTeX

Table 7.8 The Three Participants' Use of Document Preparation Software

The seventh common category of technologies they utilized is document preparation software. As shown in Table 7.8, although three of them all employed document preparation software, each of them used disparate software to prepare their academic

documents. Both Cheng-Rui and Zhi-Kai employed Microsoft Word but not Tian-You who used different document preparation software. Even if both Cheng-Rui and Zhi-Kai used Microsoft Word, the purposes of utilizing it for are different. Cheng-Rui employed Microsoft Word to write his assignments, academic papers, and dissertation, whereas Zhi-Kai utilized Microsoft Word to write meeting notes and reports for his graduate assistant job.

In addition to Microsoft Word, Zhi-Kai also utilized LaTeX but used it to prepare for his own academic documents, such as assignments, conference papers, and journal articles. In an interview, he mentioned “I knew many researchers in statistical academy use LaTeX, so I forced myself to use it at that time [when he studied master’s program in Taiwan]” (interview transcript, June, 2016). In other words, in order to be part of “many researchers in statistical academy”, Zhi-Kai decided to “force [himself] to use” LaTeX. Data also disclose that his present two advisors also utilized LaTeX to write their journal articles, conference papers, and books (interview transcript, June, 2016). It is probable that his earlier participation in communities of practice via utilizing LaTeX while studying in Taiwan assisted him in adjusting to this unique disciplinary academic culture (the use of LaTeX for academic documents in statistics communities).

Unlike Zhi-Kai, Tian-You employed TeXShop and ShareLaTeX. In an interview, he stated that most researchers, including the post-doc, in his advisor’s research team used TeXShop, ShareLaTeX, or LaTeX to compose their documents. That is to say, Tian-You utilized the two document preparation software because most researchers in computer science communities employed them. In order to academically communicate with other researchers, Tian-You employed these software to prepare for his academic documents.

Cheng-Rui described that he was trying to use LaTeX before but found that most of his colleagues in the lab and advisor utilized Microsoft Word rather than LaTeX. He pointed out that if he used LaTeX, he would need to go through more steps (e.g., converting LaTeX files into Word files) in order to read, write, and share documents with his colleagues and advisor.

In sum, the three participants' use of document preparation software was influenced by their colleagues, professors, and researchers in their particular academic disciplines. In order to be part of their communities, they selected the most common document preparation software in the fields to interact with other researchers.

Online videos.

Participant	Online Videos
Cheng-Rui (MSE)	Instructors' teaching videos on the institutional course management (Carmen) and videos related to material science and his research on YouTube and the World Wide Web
Zhi-Kai (Statistics)	His previous advisor's teaching videos on his advisor's personal website
Tian-You (CSE)	Coursera, YouTube, EngVid, and Intel Webinars

Table 7.9 The Three Participants' Use of Online Videos

The eighth and last common category of technologies the three participants employed is online videos. Although Cheng-Rui and Zhi-Kai did not report their use of online videos in their weekly journals, they reported this use in their survey responses and interviews. Table 7.9 shows that unlike Zhi-Kai, Cheng-Rui and Tian-You employed YouTube to search for discipline-related videos. In his survey, Cheng-Rui stated that he often went to YouTube to watch videos related to material science. In an interview, he described that "Some concepts or knowledge are easier understood through watching videos so I would search for related videos online" (interview transcript, March, 2015). In

other words, a video simplifies the sophistication of written descriptions in a research article. Presenters often use simpler language, more explanations, and diagrams in their video presentations. This feature of a video also helps Tian-You deal with the challenge of not understanding some concepts in academic articles he read. When reading academic articles and encountering some concepts he could not understand, he would search for related videos on YouTube and watch them to enhance his understanding. In addition, when preparing for class presentations, he would search for specific scholars' presentation videos on YouTube and watch them to increase his understanding of the scholars' research and to know scholars' significant points in their research.

Besides YouTube, video sources that the three participants searched for are quite different. Cheng-Rui always downloaded his instructors' teaching videos from the institutional course management (Carmen). In an interview, he described his use of instructors' videos:

“I don't watch the teaching videos all the time but would download them after class. Those're related to what I study. When I need them, I could watch them... When preparing for my candidacy exam, I watched a teaching video of a course I took before for a least 5 to 6 times. Although I could read its lecture slides, I could not remember what the professor said [via reading the slides].” (interview transcript, April, 2015)

These data disclose the advantages of employing videos for Cheng-Rui include 1) easily understanding a concept or knowledge via watching videos than reading texts, 2) reserving details of professors' lectures, so watching teaching videos could remind him of some teaching content, and 3) being able to repeatedly play videos in the situation where he did not understand lectures in English.

For Zhi-Kai, he stated that he sometimes would watch teaching videos that were recorded and uploaded by his previous advisor in master's program in Taiwan. Those

videos were teaching statistical knowledge, concepts, and analysis and mainly in Chinese.

For Tian-You, in addition to watching videos related to CSE on YouTube, he also watched CSE-related teaching videos on Coursera to help him prepare for his qualifier exam. Moreover, he sometimes watched Intel Webinars to understand Intel's new designed methods for hardware. Furthermore, he sometimes watched English learning videos on the EngVid website to enhance his English competence.

In brief, the three participants' use of online videos shows that watching videos related to their disciplinary knowledge and research in either English (in the case of Cheng-Rui and Tian-You) or Chinese (in the case of Zhi-Kai) helped them enhance their understanding of discipline-specific knowledge and research comparing to reading written academic texts. It is probable that videos simplify sophisticated written language and diagrams, and this feature enabled the three participants as L2 English speakers to understand sophisticated written academic concepts.

Different Technologies Used by the Participants.

The three participants employed the above eight common categories of technologies for academic purposes during their processes of acculturating to the Western academic culture, their particular doctoral program culture, and disciplinary culture. The following section discusses the different technologies they utilized during the processes.

Participant	Different Technologies Used by the Participants
Cheng-Rui (MSE)	<ol style="list-style-type: none"> 1. Online storage software–Dropbox 2. Course Management software – Carmen
Zhi-Kai (Statistics)	<ol style="list-style-type: none"> 1. Statistical analytical software MATLAB, R, GAP, and Microsoft Excel 2. Note-taking software –LaTeX 3. Drawing software –MATLAB, and Excel
Tian-You (CSE)	<ol style="list-style-type: none"> 1. Online storage software – Google Drive and Dropbox 2. Note-taking and documenting software— Evernote, Google Keep, Google Sheet, Google Doc, Microsoft OneNote, a voice recording app, and PDF 3. Course Management software – Carmen 4. Drawing software – Gnuplot, Lucidchart, PowerPoint, and Coggle

Table 7.10 The Three Participants’ Use of Different Technologies

In Cheng-Rui’s 14-week weekly journals, he mentioned the use of online storage software (Dropbox) where he could store his electronic files online and share the files with others. He often used it on his different electronic devices (his Mac laptop, office PC, and cell phone) and shared with his advisor. Tian-You also reported that he often utilized online storage software (Google Drive and Dropbox) with his advisor and research team members through sharing his academic notes related to research projects, research progress reports, experimental data and analysis, diagrams, and other documents. Zhi-Kai did not particularly mention his use of online storage software.

Besides the use of this software, Cheng-Rui also reported his use of the institutional course management (Carmen) during interviews. As mentioned in his case analysis (Chapter 4), he always went to Carmen to download instructors’ teaching slides and videos to preview and review them before and after class. Tian-You also reported his use of Carmen as Cheng-Rui did. Zhi-Kai did not express this use, and this is probably influenced by his professors. In an interview (interview transcript, July, 2015), Zhi-Kai described that most of his professors in the present doctoral program were inclined to

adopt traditional teaching approaches whereby instructors wrote notes on a board and students quietly listened to lectures. That is to say, whether instructors integrate technologies into their teaching could impact students' use of technologies for their learning. In addition, Cheng-Rui's and Tian-You's use of Carmen display that they, as English language learners, took advantage of the course management to access teaching materials before class. This advantage enabled them to be familiar with teaching content and which could increase their comprehension of instructors' lectures. Moreover, due to Carmen, teaching materials were required to be digitized. This digitization visualizes instructors' lectures enabling English language learners who have insufficient listening English ability to read during lectures. Furthermore, this digitization enables them to retrieve the teaching content when they write assignments, papers, or other academic purposes.

In an entirely different use of technologies from Cheng-Rui and Tian-You, Zhi-Kai utilized discipline-based statistical analytical software to analyze his data all the time. More specifically, he employed MATLAB, R, and GAP statistical analytical software to analyze his collaborators' and own dissertation's data. He learned how to use R program when studying in the master's program and how to utilize CAP when working as a research assistant in Taiwan. Multiple data show that being able to use R program was required in his doctoral program since many statistical examples given by instructors during class used R program. CAP was the statistical analytical software he used to analyze his personal collaborator's biological data because, based on his previous research experience, he knew this software could be utilized to analyze this type of data. That is to say, his past learning and research experiences of R and GAP assisted him in

adjusting to his current statistical doctoral program.

Multiple data also disclose that the statistics department seemed to not provide sufficient academic support, particular support in statistical analytical software and training (see more details in Chapter 5, Table 5.2). More specifically, his department only provided courses in how to use SAS statistical analytical software and an introductory course in R program but not MATLAB which he utilized to analyze and program for his dissertation research. Hence, he relied on online resources to teach himself how to operate MATLAB. Even though searching for online resources about operating MATLAB seemed to be able to solve his immediate questions he confronted, it is uncertain whether those online resources offered him appropriate answers and whether he completely understood those online resources about how to use certain functions in MATLAB to run statistical analysis. His past learning and research experiences might somewhat help him decide which online resources were more reliable and understand descriptions of online resources about MATLAB. Nonetheless, the departmental academic support is necessary for both international and local students in order to prepare them to be successful in disciplinary communities. Academic programs play an important role during international (and even domestic) students' academic acculturation processes. Especially for hardware and software for discipline-specific knowledge and research competence, without necessary academic and professional support from academic departments, both international and domestic doctoral students would experience difficulties in adjusting to their particular academic disciplines.

Zhi-Kai employed MATLAB, and this use was influenced by one of his advisors who also utilized it. Interestingly, in an interview (interview transcript, June, 2015), he stated

that that advisor used MATLAB but did not know how to code statistical programs through it. He, thus, taught his advisor how to program, and his advisor taught him statistical theories and logical concepts of how to analyze data. In other words, his advisor acted as an expert in the statistical discipline to teach Zhi-Kai, as a novice, statistical communities' conventions (e.g., concepts of statistics). Meanwhile, Zhi-Kai brought his new skill (coding statistical programs) and sometimes taught his advisor how to code statistical programs. This demonstrates the mutual learning between a novice (Zhi-Kai) and an expert.

Other than statistical analytical software, Zhi-Kai employed drawing software (MATLAB and Microsoft Excel) which Cheng-Rui and Tian-You did not use. MATLAB and Microsoft Excel are also statistical analytical software, but Zhi-Kai sometimes employed them to draw plots for his statistical data. More specifically, he utilized Microsoft Excel for his collaborators of his graduate assistant works and used MATLAB for his own research.

Tian-You also employed drawing software but not MATLAB and Microsoft Excel that Zhi-Kai utilized. Tian-You used Gnuplot, Lucidchart, Coggle, and PowerPoint. One of the reasons he used drawing software is to clarify his written explanations in his writing. He described that once he received a big question mark on an assignment from his professor due to his unclear written expressions in English. Given that experience, he devised a strategy which was to provide examples via drawing diagrams. In addition to clarifying his written explanations in English, he employed drawing software for several reasons. In Chapter 6, the section of his use of technologies for academic purposes did not describe his use of drawing software. Hence, the following paragraphs briefly

introduce it. In an interview, he described his use of Lucidchart for the purposes of clearness, simplification, remembrance, and preservation:

“I often need to write computer programs, drawing flowcharts of the process of a program is much clearer for readers to understand. Also, it could help me remember the processes of computer programs. Some programs are complicated, and I couldn’t remember...If I draw them on papers, I often lose them. I’d like to preserve them so I draw in my laptop... Like my current lab is doing a big computer program. It’s really complicated because the lab has been doing it for 10 years. There’re many things from the past, and experienced researchers also asked me to read some articles here and there. I couldn’t remember all of them so I drew some flowcharts.” (interview transcript, April, 2015)

In another interview (interview transcript, June, 2015), he stated he changed to utilize PowerPoint rather than Lucidchart to draw flowcharts or diagrams due to its limitations which were unable to export the electronic format he wanted and had fewer functions he could use. For Coggle, he employed it to draw a mind map to help him think about the relationships among the components in the map:

“Experienced researchers [in his advisor’s research team] asked me to read papers and survey one of our collaborative companies’ newest software. So, I read the papers and information about the software and tried to understand how they designed the software, what functions the software have, and how we could use some of the functions into our research projects. Then, I drew a map via Coggle to help me think of the relations between the software’s functions and our projects.” (interview transcript, May, 2015)

His weekly journals also display his use of Gnuplot drawing software for some of his assignments. In an interview, he further described the reason he preferred to use it rather than other drawing software for some of his assignments:

“For some of my assignments I need to use Gnuplot to draw coordinate plots to make my assignments look professional. Many dissertators in computer science use this software to make their data plots.” (interview transcript, April, 2015)

The data set reveals that he knew this drawing software that was prevalent among researchers in computer science, and he attempted to be part of the scholarly communities through utilizing the drawing software most researchers used. Moreover, he knew the

strengths and weaknesses of different drawing software so he was able to choose a suitable one to achieve his goals. Furthermore, the above data sets show the advantages of drawing diagrams, flowcharts, or mind maps for Tian-You. These include making his writing clear, simplifying a complicated process, easily remembering designing processes of computer programs, visualizing the relationships among different components, and stimulating his thinking. Additionally, the data also disclose that his advisor's research projects were lengthy and contained plenty of stages. These projects also emphasized team work among novices, experienced researchers, and previous researchers in the team. Furthermore, the data reveal the hierarchical relationship between a novice (Tian-You) and experienced researchers in the team. These are verified by "experienced researchers also asked me to read some articles here and there" and "Experienced researchers asked me to read papers and survey one of our collaborative companies' newest software". This type of team projects was mingling between previous researchers, the current experienced researchers, and novices. This hierarchical relationship with experienced researchers provided Tian-You scaffolding enabling him to learn prior and present experienced researchers' research perspectives and ways of designing computer programs. More specifically, experienced researchers provided scaffolding through not directly requesting him to give his ideas on their research projects but through asking him to read "some articles here and there" and "survey one of [their] collaborative companies' newest software". Through reading articles that experienced researchers assigned and pointing what he should explore, Tian-You could learn experienced researchers' perspectives and ways of designing computer programs.

In addition to Tian-You' use of drawing software described above, another

technologies he often adopted are note-taking and documenting software – Evernote, Google Keep, Google Sheet, Google Doc, Microsoft OneNote, and a voice recording app. These are different from Cheng-Rui’s and Zhi-Kai’s use. Some of these software utilized by Tian-You were influenced by an audience whom he shared documents with. For instance, he employed Google Sheet and Google Doc to share his reading notes of academic papers related to their team projects, progress reports of his research, and the results of running experimental data with his advisor and experienced researchers in his advisor’s research team. He utilized Evernote, Google Keep, Microsoft OneNote, and a voice recording App for his own academic purposes, such as recording and tracking his academic tasks and research progresses, audio-recording English spoken classes, and recording unfamiliar English usage and words. Multiple data also disclose that he knew features and drawbacks of each note-taking and documenting software so he was able to select suitable ones to achieve his academic goals. For example, he knew Google Sheet like Microsoft Excel has the functions of calculation and drawing diagrams so he created a template which “[He could] just throw the data into the template. It’ll generate diagrams for [him]” (interview transcript, May & June, 2015). He knew the hallmark of Google Keep is its short and brief notes so he employed it to write his class and research to-do lists and share his lists on his different technological devices (his cell phone, office computer, and his laptop).

Summary of the participants’ use of common and different technologies.

The three participants’ use of common and different technologies during academic acculturation reveals several noticeable points. First, they employed assorted

technologies for various academic purposes during their academic acculturation processes. This phenomenon indicates that technologies are a necessary tool during their academic acculturation processes. Second, they utilized technologies to help them surmount some difficulties in language barriers and academic learning they encountered during acculturation processes. For instance, all three participants employed online lexical resources to assist them in writing English academic papers. They also used online social interactional software (e.g., Facebook, WeChat, QQ, Google Hangouts, and online forums) to look for answers to their assignments or research and to discuss coursework and research with their peers, experienced researchers, and their advisor(s). Third, they adopted technologies, in particular online social interactional software, to establish and maintain relationships with their peers, professors, and scholars in their discipline-specific communities. For example, Cheng-Rui used Facebook to contact his Taiwanese peers and other doctoral students whom he met at conferences. He also utilized LinkedIn and Glassdoor to maintain relationships with scholars and industry-based workers in his MSE discipline. Zhi-Kai employed email and Skype to discuss research with his professors in Taiwan and scholars whom he met at conferences. Tian-You adopted Facebook to discuss assignments with Taiwanese peers, Google Hangouts to discuss research with the post-doc, and a Facebook group to receive computer science updated information posted by one of his previous professors in Taiwan.

Fourth, the three participants' use of some technologies also discloses that they adopted technologies not only for their own academic purposes but also for sharing and co-editing documents with their colleagues and advisors. For example, Cheng-Rui used Dropbox storage software to share his documents with his advisor. Tian-You utilized

email with his advisor and Google Hangouts with the post-doc to discuss and edit his conference proposals. Zhi-Kai and his advisors used LaTeX to co-edit their collaborative journal academic papers. These sharing and collaboration phenomena also display that the academic disciplines the three participants stayed emphasize teamwork and collaboration. Many technologies possess the features of sharing and co-editing which enable the participants, researchers, and scholars to have long-distance research collaborations. Without employing the technologies, they might have difficulties in and take more time to share and co-edit papers.

Fifth, their use of technologies was sometimes influenced by an audience, by other scholars in their discipline-specific communities, and by their peers, professors, advisor(s), experienced researchers whom they worked with. In order to be part of a group or their discipline-specific communities, they adopted the software that was prevalently utilized in the group or the communities. For instance, all three participants employed Facebook to communicate with Taiwanese international students because Facebook is the most popular social interactional software among this group of students. Another example is that Zhi-Kai employed QQ to discuss coursework and his qualifier exam with his peers from China because QQ was often adopted by this group of students. He also utilized LaTeX to write his academic papers because most statisticians, including his advisors, employed it to write their papers. Likewise, Tian-You employed Google Hangouts because most colleagues in his advisor's research team used it for quick communication. Sixth, the three participants' use of technologies was sometimes affected by their discipline needs, such as Zhi-Kai's use of the statistical analytical software. This phenomenon also shows that most academic disciplines are somewhat integrating

technologies into learning and research. Seventh, the three participants' use of technologies was sometimes influenced by their instructors' use of technologies. For instance, Cheng-Rui and Tian-You used the institutional course management software (Carmen) because their instructors integrated Carmen into their teaching. Hence, they were able to download lecture slides from Carmen and preview and review teaching content via reading the slides. On the contrary, Zhi-Kai's instructors tended to adopt the traditional teaching method so Zhi-Kai did not report his use of the institutional course management software.

Research question 3: In what ways did their use of technologies relate to their own definitions of successful academic acculturation?

The previous data on the three participants' technology use reveal that generally technologies acted as an assistive role during the three participants' academic acculturation processes. Through responding to this research question, I aim to investigate the role of technology during the three participants' acculturation to the Western academic culture and their particular disciplines. Table 7.11 juxtaposes similar and different indicators of successful academic acculturation across the three participants and their use of technologies for academic purposes. Information in the table and multiple data reveal that technologies were an indispensable means of assisting them in acculturating to the Western academic culture and their particular disciplinary communities. Nevertheless, multiple data also disclose that their use of technologies could not completely help them successfully acculturate to the Western academic culture and their discipline-specific communities.

Similar and Different indicators	Definitions of Successful Academic Acculturation	Technology Use Corresponding with Indicators of Successful Academic Acculturation
Similar indicators across the three participants	<ol style="list-style-type: none"> 1. Discussed disciplinary and own research with others, particularly researchers and scholars in the fields 2. Had the capacity to engage in discipline-based scholarly communities of practice (e.g., publish in disciplinary journals and present in disciplinary conferences) 3. Made contributions to academic fields and obtained recognitions in disciplinary communities 	<ol style="list-style-type: none"> 1. a) Academic search engines, b) online social interactional software, c) online lexical resources, d) reading software, e) online videos 2. a) Academic search engines, b) citation software, c) online lexical resources, d) online social interactional software, e) reading software, f) presentation software, g) document preparation software, h) online videos, i) Tian-You: drawing software; Zhi-Kai: statistical analytical software, drawing software 3. They were unable to use any technologies to achieve the indicator 3.
Different indicators	<p>Cheng-Rui</p> <ul style="list-style-type: none"> - Derived satisfaction from his advisor with his research and academic performance <p>Zhi-Kai</p> <ul style="list-style-type: none"> - Felt comfortable enough to study under the U.S. educational system <p>Tian-You</p> <ul style="list-style-type: none"> - Had the ability to demonstrate the competence in orally defending his arguments and discussing CSE related research with other researchers 	<p>Cheng-Rui</p> <ul style="list-style-type: none"> - He was unable to use any technologies to achieve this indicator. <p>Zhi-Kai</p> <ul style="list-style-type: none"> - He was unable to use any technologies to achieve this indicator. <p>Tian-You</p> <ul style="list-style-type: none"> - He was unable to use any technologies to achieve this indicator.

Table 7.11 The Participants' Definitions of Successful Academic Acculturation and Their Use of Technologies for Academic Purposes

Their first identical indicator is to possess the capability to discuss discipline-specific and own research with others, particularly researchers and scholars in one's academic field. Being able to discuss disciplinary research, including own studies, with researchers and scholars in the field for international doctoral students requires not only sufficient discipline-specific knowledge but also good enough English competence in order to understand scholarly works and articulately discuss research. Therefore, their use of the following technologies (see Table 7.11) directly and indirectly aided them in achieving the first common indicator: 1) academic search engines, 2) online social interactional software, 3) online lexical resources, 4) reading software, and 5) online videos. In terms of English competence, online lexical resources could help them learn unfamiliar English vocabulary and grammar so they could understand academic texts and discuss scholarly works with others.

In terms of disciplinary knowledge, academic search engines enabled them to locate scholarly works, know significant and current trends of disciplinary research, learn conference ranking, and familiarize themselves with studies that their professors, experienced researchers, advisors, and other scholars conducted. Being able to do those could help them equip with a reservoir of discipline-specific knowledge and research, so they could understand and participate in other researchers' discussions. Reading software (PDF) enabled them to highlight places that they considered important in academic articles and to electronically take notes in PDF files. Even though utilizing reading software did not directly benefit them to discuss research with others, it could help them quickly retrieve academic texts they read and enhance their memory of the content of the

academic texts. Remembering scholarly works could further assist them in understanding what studies other researchers mentioned and in taking part in their discussions.

In addition, watching online videos related to discipline-specific knowledge and research could facilitate their comprehension of discipline-specific knowledge and scholarly works especially written in English. Only by understanding scholarly works could they understand and partake in other researchers' discussions. Moreover, their use of online social interactional software, such as LinkedIn and Facebook groups related to the academy, enabled them to read latest scholarly publications and present trends of industrial and academic information. It also allowed Zhi-Kai and Tian-You to discuss disciplinary knowledge and research with users of online social interactional software through seeking academic assistance and sharing their knowledge with users who had discipline-based questions. Such online discussions could boost their confidence in their academic competence. Their use of online discussions, in particular in English, could also serve as a transition from asynchronously discussing academic topics in written English to publicly and instantly discussing academic topics in oral English.

In addition to their use of technologies to achieve the first common indicator of successful academic acculturation, the second similar indicator across the three participants is to possess the ability to engage in discipline-specific scholarly communities of practice. This engagement includes writing disciplinary conference proposals and journal articles. As the first indicator, being able to participate in scholarly communities of practice requires not only discipline-specific knowledge but also English proficiency in order for them to express the processes of undertaking their research, arguments, and contributions to their fields in oral and written academic English. Their

use of the following technologies (see Table 7.11 above) directly and indirectly assisted them in achieving this goal. These technologies include 1) academic search engines, 2) online social interactional software, 3) online lexical resources, 4) reading software, 5) online videos, 6) citation software, 7) presentation software, and 8) document preparation.

In terms of English proficiency, as the previous paragraphs described, online lexical resources, such as English dictionaries, helped them read and write English academic texts (e.g., checking for synonyms to replace their overused words in their writing and looking up explanations of English vocabulary that they only knew in Chinese). Nonetheless, online lexical resources could not entirely aid them in writing well their academic papers, conference proposals, dissertations, and publications. Writing English academic papers well requires not only knowing English vocabulary and grammar but also being able to internalize Western academic and disciplinary writing conventions (e.g., conventions of writing conference papers and academic journal articles).

Although the three participants took the ESL writing courses provided by the institution, they reported that the courses stressed plagiarism and citation styles. Furthermore, the courses were offered in their first doctoral year, when they did not have opportunities to write long prose but answered math questions or wrote the step-by-step processes of programming computer programs. When learning could not correspond to actual practice, learners might be unable to value the purposes and the significance of the learning. In addition, even though instruction in plagiarism and citation styles is necessary for international students who do not know them, some English grammar, usage, and writing conventions that international students are unfamiliar with still need to

be explicitly taught and repeatedly practiced until the learners internalize them. Especially, the three participants had limited exposure to academic English writing in their native country and merely studied English for standardized language tests, such as TOEFL and GRE, before studying their doctoral programs. They need instruction in unfamiliar English grammar and usage and how to integrate the knowledge into their writing. Moreover, being able to write disciplinary conference proposals and journal articles well requires the capacity to know the discipline-specific language and to internalize it. This competence could not be obtained through utilizing English dictionaries but through reading varied disciplinary papers and being guided by experienced researchers or experts in the field.

In terms of enhancing the three participants' discipline-specific knowledge, their use of academic search engines indirectly helped them participate in discipline-specific communities. Academic search engines are essential means for them to access academic articles. For Tian-You, his academic discipline in computer science and engineering had even digitized "all [their] learning materials and academic papers" so he "[didn't] read paper-based materials anymore" (interview transcript, May, 2015). The three participants employed academic search engines to not only look for academic journal articles but also locate relevant books, including e-books and print-based books. This search and reading habit (reading academic articles accompanying relevant books) are effective strategies, especially for novice researchers. Most academic articles, which authors often assume readers who have known fundamental disciplinary knowledge, contain jargon and lack sufficient explanations of fundamental disciplinary knowledge. If the three participants only read academic articles, they might not completely understand the content and feel

frustration during the reading process. On the contrary, books often contain detailed explanations and the history of significant disciplinary knowledge. Through reading both academic articles and relevant books, they could gain a better understanding of what they read. Although their use of academic search engines could facilitate their learning of disciplinary knowledge, they also had problematic use of academic search engines, especially for Cheng-Rui and Zhi-Kai. Both of them mainly employed Google Scholar to search for academic papers. Nevertheless, Google Scholar, like other academic search engines, has its limitations. Exclusively employing Google Scholar to seek scholarly works might, therefore, narrow their research perspectives.

In addition to the relation between the second common indicator and the three participants' use of academic search engines, there is another relation between the second common indicator and their use of the online social interactional software. Utilizing online social interactional software enabled them to discuss their research and exchange academic information with experienced researchers and scholars in and outside of their school. For instance, Cheng-Rui read MSE-related discussion posts on LinkedIn through its automatic email notifications. This behavior could keep him being informed of the newest topics in his field. Zhi-Kai used email to communicate with a professor whom he met at a statistical conference to discuss his research and share relevant academic articles and statistical program codes. These interactions aided him in answering a question for his dissertation research. Zhi-Kai employed Facebook groups to discuss statistics-related questions with his previous master's peers. Tian-You utilized Google Hangouts to discuss research and his conference papers with the post-doc and utilized LinkedIn to read academic articles published by outstanding scholars in CSE. These could directly and

indirectly increase his competence in conducting research, writing academic papers, and presenting his research at conferences.

In brief, these social academic interactions with experienced researchers and scholars could expedite their intellectual development and enhance their research competence which could further help them participate in conference proposal writing, academic presentations, and publication writing.

Additionally, the three participants' use of reading software (PDF) and online videos had an indirect relationship with the second indicator because those assisted them in engaging in discipline-specific communities of practice, such as reading scholarly papers. As the previous sections mentioned, reading software and online videos aided the participants in increasing their comprehension and memory of academic texts they read. These indirectly advantaged them to undertake research and partake in writing conference proposals and publications.

The relation between the second indicator and the three participants' use of citation software is that it helped them organize academic texts they read. Citation software also helped them generate in-text citations and bibliographies with an appropriate citation format, such as for their disciplinary conferences and journal articles. Through these activities, they engaged with discipline-based communities of practice. As for the relation between the second indicator and their use of document preparation software (e.g., Microsoft Word, TeXShop, and ShareLaTeX) and presentation software (e.g., PowerPoint and LaTeX), they are indispensable tools for the participants to electronically present their research and arguments in written and oral forms in their academic communities.

The above described the relations between the second indicators and the three participants' use of academic search engines, citation software, online lexical resources, online social interactional software, reading software, presentation software, document preparation software, and online videos by the three participants. Besides these, Tian-You and Zhi-Kai also employed additional technologies to achieve the second indicator of successful academic acculturation. Tian-You employed drawing software (e.g., Gnuplot, Lucidchart, PowerPoint, and Coggle) to draw diagrams to make his written expressions clearer. Using the drawing software also stimulated his thinking about relations among existing studies, new computer programs, and his advisor's research projects. Moreover, drawing software assisted Tian-You in digitizing the processes of designing computer programs to remind himself and to keep track of the long process of his advisor's research projects. That is to say, his use of drawing software indirectly helped him participate in discipline-based communities of practice.

Like Tian-You, Zhi-Kai also employed additional technologies to achieve the second indicator. He utilized statistical analytical software (e.g., MATLAB, R, and CAP) which directly assisted him in engaging in statistical communities of practice. This technology is indispensable for him to analyze his data, design own statistical programs, and generate statistical plots for his papers. In order to employ the statistical analytical software, he also required knowing how to operate the software to achieve his goals. Nonetheless, he did not learn how to operate the statistical analytical software, especially for MATLAB which he often utilized for his doctoral research, from courses. His doctoral program did not offer courses to instruct in the operation of MATLAB. Instead, he learned it through reading online resources by himself. Multiple data show that he was still learning some

functions of MATLAB via online resources by himself when this study was conducted. This means he had not been proficient in operating MATLAB to analyze data, run simulations, and design statistical programs. Even though MATLAB itself helped him take part in statistical communities of practice, he still needed experienced users or experts of MATLAB to teach him how to appropriately operate the software to do varied analytical tasks.

The above technologies the three participants employed during their academic acculturation processes directly and indirectly aided them in participating in their discipline-specific communities of practice in certain levels. Generally, the use of technologies is essential for them to partake in disciplinary practice. However, these technologies could not fully assist them in conquering challenges they confronted during the processes of participating in their disciplinary practice. For instance, Tian-You utilized academic search engines, several English dictionaries, and document preparation software to write his conference proposals. Nevertheless, as shown in chapter 6, he confronted difficulties in clearly expressing his ideas in English and in understanding conference reviewers' expectations. Those technologies could help him write conference proposals but could not absolutely assist him in enhancing his overall English academic writing competence and understanding reviewers' expectations. Instead, his interactions with the post-doc (experienced researcher) and his advisor (expert) could aid him in gradually increasing his English academic writing ability and learning disciplinary writing conventions. In other words, technologies that the three participants utilized serve as indispensable and assistive tools to help them accomplish their academic tasks. Nonetheless, these technologies could not enhance their overall research and English

academic competence and their understanding of the Western academic and disciplinary culture. These require insiders, experienced members, and/or experts in the Western culture and disciplinary communities to guide them, as outsiders and novices, to navigate in the Western academic and disciplinary culture.

The third similar indicator and three different indicators of successful academic acculturation (see Table 7.11) across the three participants are

- 1) making contributions to academic fields and obtaining recognitions in disciplinary communities,
- 2) (Cheng-Rui) getting satisfaction from his advisor with his research and academic performance,
- 3) (Zhi-Kai) feeling comfortable enough to study under the US educational system, and
- 4) (Tian-You) being able to orally defend his arguments and discuss discipline-related research with other researchers.

For these four indicators, it is impossible to achieve these goals through only utilizing technologies. Making contributions to academic fields and obtaining recognition in discipline-specific communities entail both domestic and international doctoral students to understand discipline-specific knowledge, know contributions of other researchers' studies, and possess excellent research competence. Achieving these goals also necessitates proficiency in academic English for international students, like the three participants in this study. Unlike domestic students, international students often need to surmount academic English difficulties they encountered while achieving these academic goals during their acculturation processes. Even though online lexical resources could

provide the participants English vocabulary and grammar, their overall English academic competence could not be enhanced through exclusively employing online lexical resources. To increase their overall academic English competence necessitates training in academic English that meets their learning needs and requires them to constantly practice English knowledge and skills that they learned in their discipline-based writing. Another example of the limitations of their use of technologies is their use of academic search engines. Utilizing academic search engines enables them to locate scholarly works, but could not teach them what kinds of research is considered ‘good’ from experts’ points of view and could not entirely enhance their research and experimental skills. Improving these knowledge and skills needs guidance from more experienced and/or experts in the field to teach them how to conduct good research and write good conference proposals and journal articles to meet reviewers’ (experts’) expectations.

Moreover, Zhi-Ki’s indicator is to feel comfortable to study under the US educational system, and Tian-You’s indicator is to be able to defend his arguments and discuss discipline-related research with other researchers. Before achieving these indicators, they needed to know what the expectations of the U.S. educational system were and the Western academic culture of defending own research positions. The understanding of those could not be gained through exclusively employing technologies. These necessitate experienced members in the Western academic communities to explicitly explain or even teach the participants, as ‘outsiders’ of the Western academic communities. (‘Outsiders’ here do not mean that the communities see them as outsiders but mean people who do not know the communities’ culture.) Furthermore, it requires international students, like the three participants, to step out of their comfort zones to accept the Western and

disciplinary academic culture, especially cultural aspects which are opposite to their native academic culture. Without realizing the rules (target cultural aspects) of the game (the Western academic culture), they would not even be able to peripherally participate in the game.

On the whole, the three participants' use of technologies directly and indirectly helped them attain their academic goals. Nonetheless, their use of technologies needed to accompany support from experienced members and experts in the Western academic culture and in their discipline-specific communities. This support is to guide the participants, as international students, to understand and learn the Western academic culture, disciplinary culture, and necessary knowledge and skills in order for them to peripherally participate in communities of practice. Without explicitly informing or teaching them aspects of Western academic and discipline-specific culture, they might not even perceive that they need to take some actions to respond to the new culture. Moreover, without explicitly and effectively teaching them the necessary knowledge and skills that the new communities expect, they might be unable to even *peripherally* participate in the communities of practice.

Research question 4: How well did Chinese-speaking international doctoral students acculturate to their particular academic disciplines?

In the individual case report (Chapter 4, 5, and 6), each participant was evaluated how well he had acculturated to his academic discipline which includes the Western academic culture through the indicators from four major sources:

- 1) own definition of successful academic acculturation,

- 2) individual participant's data,
- 3) the expectations and requirements of the individual participant's doctoral program, and
- 4) the scholarship of domestic and international students' socialization into graduate school

The evaluation approach reveals that Zhi-Kai had a better condition of academic acculturation processes. Even though he confronted several academic difficulties, such as being unable to interact with unacquainted scholars in informal occasions and to clearly express own ideas in written academic English, his advisors as members of the Western academic culture and as experts in statistics communities steadily provide him necessary guidance, support, and encouragement. Consequentially, Zhi-Kai was able to learn discipline-specific knowledge and research skills and continue to engage in significant statistics-related communities of practice (e.g., presenting own research at conferences and publishing in academic journals). In addition to his advisors' support, Zhi-Kai's previous master's study and research experience in Taiwan also assisted him in academic acculturation processes, such as understanding graduate school culture and deciding which academic camp he aligned with in early doctoral years. With Zhi-Kai's past discipline-specific learning and research experiences and the current well apprenticeship experience with his advisors, overall he had acculturated to the Western academic culture and statistics communities.

On the contrary, Cheng-Rui's and Tian-You's academic acculturation conditions are moderate and very poor respectively. That is to say, they had not socialized into the Western academic culture and their academic disciplines. Tian-You had the worst

academic acculturation condition. However, his condition could be understood because he just studied in the doctoral program less than a year. For Cheng-Rui, both Zhi-Kai and he had studied in their doctoral programs around four years when I interviewed them. When Cheng-Rui's academic acculturation condition is compared to Zhi-Kai's one, Cheng-Rui had a worse condition. Although Cheng-Rui also had experience of studying in a master's program as Zhi-Kai did, Cheng-Rui did not gain much research experience as Zhi-Kai did. In an interview (interview transcript, July, 2015), Cheng-Rui reported that he conducted research with his master's advisor but did not undertake own research and write a master thesis. Nevertheless, the notable advantages of his master's study in the U.S. are that he had acclimated to the English environment, especially listening to lectures in English, and to some Western academic cultural aspects (e.g., participation in class discussions) before his doctoral study. Other than these advantages, he confronted academic difficulties in reading, speaking, and writing as Zhi-Kai did during his study in the MSE doctoral program in the US. Besides these academic challenges, Cheng-Rui also encountered the difficulty in maintaining a healthy and sustainable relationship with his advisor. On account of his advisor's busy schedule, Cheng-Rui received insufficient academic support. When facing questions about research and experiments, he often relied on online resources or consulted with colleagues in the lab rather than his advisor. Although Cheng-Rui unceasingly participated in various MSE communities of practice throughout his doctoral study, the absence of regular guidance from his advisor as an expert in the MSE communities could lead him to continue peripherally not fully participating in MSE communities of practice. In the last interview (interview transcript, January, 2016), he disappointedly stated that he had given up asking his advisor advice

on his dissertation and journal articles. Data also reveal that from his first doctoral year until his last interview he had not published his research in MSE-related journals.

As for Tian-You, since he just transferred from L1 Chinese and academic culture to L2 English and American academic culture, he encountered various academic difficulties. These difficulties include being unable to understand professors', classmates', and lab members' conversations, unable to partake in discussions in English during class and lab meetings, and unable to clearly express his ideas in English. Nevertheless, he was still learning and accommodating to the Western academic and the CSE disciplinary culture with guidance from his advisor and experienced researchers in his advisor's research team. This guidance is essential for him as a novice and enables him to swim in the vast ocean with a life buoy. He, for instance, learned how to conduct research through doing tasks assigned by experienced researchers and his advisor, such as running some computer programs and reading academic texts given by experienced researchers and his advisor. Another example is that he learned how to write conference proposals through collaboratively writing the proposals with the post-doc whom he closely worked with and receiving writing feedback from the post-doc and his advisor. Moreover, Tian-You employed assorted technologies to help him cope with some of the academic challenges he confronted. For instance, he utilized several online lexical resources to assist him in writing papers in English. He also employed several discipline-based academic search engines to look for scholarly works, learn CSE conference ranking, and familiarize himself with prominent scholars whom experienced researchers and his advisor mentioned during meetings. Even though Tian-You struggled to adjust to the Western academic culture and CSE communities, his use of varied technologies and support from

experienced researchers and his advisor could help him have smooth academic acculturation processes.

The following chapter is a discussion reviewing significant research findings emerged from individual case reports and cross-case analysis.

Chapter 8: Discussion

8.1 Introduction

This chapter discusses significant research findings through exploring the Chinese-speaking international doctoral students' use of technologies for academic purposes and their academic acculturation processes. Although their technology use is a part of their academic acculturation processes, discussing them separately could provide more detailed findings. The first section of their use of technologies during academic acculturation, hence, is explored through 1) their use of technologies for academic English and discipline-specific learning, 2) their use of technologies influenced by their past experience of technology use, 3) benefits and shortcomings of using technologies for international students, and 4) their problematic use of some technologies. The second section of their academic acculturation processes is discussed through the following subsections: 1) signs, tools, and learning, 2) legitimate peripheral participation, 3) the influence of their prior discipline-specific knowledge and research skills, 4) the influence of peers, 5) the impact of academic programs and the institution, 6) Adjustment to English and the Western academic culture, 7) participation in multiple discipline-specific communities, and 8) linear or interactive socialization.

8.2 Discussion

8.2.1 Use of technologies during academic acculturation.

One of the notable phenomena is that the three participants as Chinese-speaking international doctoral students utilized assorted technologies for various academic purposes during their academic acculturation processes. Several findings emerged from their use of technologies. These findings are divided into the following categories to discuss in this section: 1) their use of technologies for academic English and discipline-specific learning, 2) their use of technologies influenced by their past experience of technology use, 3) benefits of employing technologies for international students, and 4) their problematic use of technologies.

8.2.1.1 Use of technologies for academic English and discipline-specific learning.

The three Chinese-speaking international doctoral students in this study utilized assorted technologies for varied academic purposes during the processes of acculturating to the Western academic culture and their particular academic disciplines. Their use of technologies reveals their purposes of employing technologies to enhance not only their English academic competence but also their discipline-specific knowledge and research abilities. All of them, or instance, utilized an online Chinese-English dictionary, English-English dictionaries, a corpus (e.g., COCA), and/or translation software (e.g., Google Translate) to learn unfamiliar English words, usage, and/or disciplined-specific language during their reading and writing processes. Prior research has also shown that utilizing L2 dictionaries (Knight, 1994; Tang, 1997) and English corpora or concordances (Kaur &

Hegelheimer, 2005; Varley, 2009; Yoon, 2008) could help English learners acquire English vocabulary, enhance their reading competence, and improve their writing quality. In addition to dictionaries and corpora, the participants in this study also utilized online lexical resources, such as online discussion forums and discipline-based scholarly texts from academic search engines, to hurdle difficulties in English grammar they confronted and to imitate scholars' writing styles. Studies have explored English learners' learning of English grammar through English grammar textbooks accompanying with corpora (Vannestål & Lindquist, 2007), language learning websites which content includes English grammar exercises (Levy, 2009), learner writing diagnosis software which offers writing feedback to learners (Levy, 2009), or social media via discussing grammatical questions with peers and instructors (Suthiwartnarueput, 2012). These studies were either the discussion of integrating technologies into teaching English grammar or empirical research which researchers designed an instructional approach integrating technologies into teaching English grammar. Nevertheless, these studies did not investigate how English learners coped with English grammatical questions they encountered and what resources they attempted to employ to tackle the questions outside of teaching contexts. Moreover, these studies focused on English learners rather than international graduate students. The former learns English grammar for the general English purposes, whereas the latter learn English grammar for academic English purposes which are more challenging. This present study, hence, contributes to this line of research by examining what English grammatical resources international doctoral students adopted and how they utilized the resources to deal with English grammatical questions they encountered when writing their academic papers. Moreover, this current study contributes to this line of the

literature through offering the research result that the international doctoral students in this study employed discipline-based academic articles to help them master the disciplinary language and ways of writing academic papers in English for their particular disciplines.

Besides the use of technologies to improve English academic competence, the participants in this study also employed technologies to increase their discipline-specific knowledge and research competence and participate in their discipline-specific communities of practice. Three of them, for instance, utilized academic search engines to search for scholarly works to broaden their research perspectives, learn what studies leading scholars undertook and how they conducted research, be familiar with the discipline-specific language, terminology, and concepts, and observe how scholars structured their writing and described their research processes and findings. Moreover, the three participants employed online social interactional software, such as WeChat, QQ, Facebook, and Skype, to discuss assignments and research with their peers, professors, and/or scholars of their discipline-specific communities. They also used online social interactional software to receive discipline-related information from their prior peers and professors and to establish and maintain relationships with scholars in their fields. Another example is that they employed discipline-specific technologies to accomplish their research tasks (Cheng-Rui: technologies in the lab to conduct MSE-related experiments; Zhi-Kai: statistical analytical software to analyze data; Tian-You: Gnuplot drawing software to draw plots for his research data).

In this line of the literature, a few studies (Hughes, 2013; Sin, Kim, Yang, Park, and Laugheed, 2011) have investigated international students' use of technologies for

academic purposes other than English learning. Sin, Kim, Yang, Park, and Laugheed (2011) adopted a survey to explore what acculturation information international students sought. Approximately 66 percent of the participants were either international doctoral or master's students. Their finding reveals that the international students in their study obtained needed acculturation information (e.g., education, work/career, finance, and health) through the following channels in descending order of frequency: online search engines (e.g., Google), official institutional websites (e.g., the international student office's website), general websites, social network sites (e.g., Facebook), blogging tools (e.g., Twitter), and print sources from libraries. However, Sin et al. (2011) did not examine which technologies they utilized to receive which kinds of acculturation information and how they used the technologies to obtain the needed information. Unlike Sin et al.'s (2011) study, Hughes (2013) adopted qualitative research methods to explore how international undergraduate and postgraduate students in business or information technology courses employed online information for their academic learning. Their finding discloses that the international students in the study utilized online search engines (e.g., Google), journal databases, discipline-specific databases, online reference recourses, and online library catalogue to obtain needed information for course requirements (Hughes, 2013). The needed information included company information, statistics, background information, academic information, definitions, and legal information (Hughes, 2013). Nonetheless, Hughes's (2013) research only centered on international students' use of search engines and databases rather than the use of other technologies for academic purposes.

Another line of research did not explore international students' use of technologies for academic development but concentrated on this group of students' relationships with their family and friends in native countries during their acculturation processes (Cemalcilar, Falbo, & Stapleton, 2005; Fan, 2008; Hodis & Hodis, 2012; Kim, Yun, & Yoon, 2009; Kim, 2010; Kline & Liu, 2005) and with other groups of students in the target culture (Cao & Zhang, 2012; Fan, 2008; Hodis & Hodis, 2012; Kim, 2010; Kim et al., 2009). Nonetheless, these studies did not examine how international students utilized technologies, in particular computer-mediated communication (CMC), for academic purposes, such as discussing class assignments and research, as the three participants in this study did. This present study, therefore, extends this line of the literature to provide insights into how international doctoral students employed various technologies to accomplish numerous academic tasks and goals during their acculturation processes.

8.2.1.2 Use of technologies influenced by their past experience of technology use.

The three participants in this study adopted manifold technologies to attain varied academic tasks and goals during their academic acculturation processes. Some of their technology use were affected by their peers, lab members, advisor(s), and scholars in their disciplines. Take Tian-You for example. He employed Google Hangout (online social interactional software) because most of the members and experienced researchers in his advisor's research team utilized it to discuss team projects. However, some of the three participants' technology use were influenced by their past experience and habit of using technologies. For instance, Cheng-Rui's use of Taiwan online Chinese-English

dictionary during his doctoral study derives from his previous habit of employing this online dictionary during his college and master's study. Zhi-Kai knew how to use CAP and R statistical software to analyze his data during the doctoral study because he learned how to operate the two software when studying in the master's program and working in a governmental research organization in Taiwan. Tian-You employed IEEE Xplore and ACM Digital Library search engines when studying in the master's program and working in a governmental research organization in Taiwan. This habit of utilizing the two discipline-based search engines endured in his doctoral study. This research finding aligns with former research (Cheung & Limayem, 2005; Limayem & Cheung, 2008) on information systems indicating that past behavior of using information systems, such as search engines, would continue the previous usage when users utilize current information systems. Nevertheless, these studies more emphasize factors that might impact on users' satisfaction with information systems rather than the influence of users' past behavior of using information systems on their academic learning. This present study, hence, contributes to this area of research through offering the insight that the participants' preceding behavior of employing some technologies carried on the usage to help them surmount academic challenges they encountered, fulfil discipline-specific requirements, and undertake academic tasks.

8.2.1.3 Benefits and shortcomings of using technologies for international students.

Course management systems.

This study reveals several advantages of utilizing technologies for international students. Course management systems, PowerPoint, videos, and social media appear to be beneficial for the participants. The course management system (Carmen) in this study was provided by the institution as the vital technological infrastructure. Most of Cheng-Rui's and Tian-You's professors employed this system to upload their instructional slides and/or videos, offer grades, and provide an online space for students to upload their assignments and download feedback from instructors. Cheng-Rui and Tian-You took the advantage of this course management system through frequently downloading lecture slides and/or teaching videos and previewing and reviewing the slides and/or videos. Owing to being able to access the teaching content before class, they could familiarize themselves with knowledge, English words, and discipline-specific terminology and concepts that instructors were going to introduce during classes. Moreover, as Tian-You reported that teaching slides enabled him to follow instructors' fast-pace lectures during class.

The line of research on online course management systems reveals that students mostly employ course management systems to obtain course information, including announcement, course materials, and grades (Caruso & Kvavik, 2005; Lonn & Teasley, 2009; Marchewka, Liu, & Kostiwa, 2007). Nonetheless, these studies collected data through surveys and did not examine how participants employed the received course information from the course management systems. Furthermore, the participants of these

studies were not international students. This present study, therefore, contributes to this line of research through describing how international doctoral students utilized the course manage system (Carmen) and the advantages of using it for non-native English speakers.

Cheng-Rui's and Tian-You's use of Carmen also disclose that their instructors did not employ the function of discussions on Carmen. In the case of Zhi-Kai, his professors adopted the traditional teaching method so he did not use Carmen. Previous research also found that instructors tend to use course management systems to supply course information but do not use the discussion function in the systems (Lonn & Teasley, 2009). Studies further suggest that support or training in how to utilize functions in a course management system fully needs to be given to faculty members in order to further facilitate teaching and learning (Caruso & Kvavik, 2005; Lonn & Teasley, 2009).

PowerPoint lecture slides.

In addition to the advantages of employing the institutional course management system, the participants' use of PowerPoint also advanced their academic learning. For example, Tian-You downloaded lecture slides in the PowerPoint format through Carmen. He read the lecture slides before class to familiarize himself with the teaching content, unfamiliar words, and terminology in English. This previewing behavior helped him reduce the uncertainty of not knowing what instructors said during classes. During classes, he used the lecture slides to take notes. This note-taking process could assist him in paying attention to the lectures and reviewing the teaching content later. Moreover, PowerPoint slides including visual aids (e.g., written words, graphics, and/or videos) aided Tian-You, as an L2 English speaker, in enhancing his comprehension of the

lectures and in following the fast-paced lectures in English. Additionally, he indicates that PowerPoint slides created by instructors contain important points of the teaching content, so reading the slides could help him understand instructors' perspectives. Besides employing PowerPoint slides before, during, and after classes, Tian-You also employed the lecture slides accompanying textbooks while writing assignments and preparing for exams. These findings extend this line of literature on PowerPoint (Ahmadi, Dileepan, & Raiszadeh, 2007; Apperson, Laws, & Scepanisky, 2008; Babb & Ross, 2009; Burke & James, 2008; Chen & Lin, 2008; Gurrie & Fair, 2010).

Prior studies have disclosed that students prefer to receive lecture slides ahead of time (Apperson et al., 2008; Gurrie & Fair, 2010). Furthermore, providing lecture slides positively influences students' attendance and participation in class (Apperson et al., 2008; Babb & Ross, 2009; Burke & James, 2008) and improves their learning (Ahmadi et al., 2007; Chen & Lin, 2008; Gurrie & Fair, 2010). Nonetheless, these studies were conducted through surveying students' perspectives on the use of PowerPoint lecture slides. These studies did not adopt qualitative methods like this present study did to explore how students use PowerPoint lecture slides and what they employ the slides for. The participants in these studies were also not international students. This current study, thus, contributes this line of research through offering the insights of how international students employed PowerPoint lecture slides before, during, and after classes and benefits of employing the slides for L2 English learners.

Although utilizing PowerPoint lecture slides is valuable to international students, this present study discovers a possible drawback of employing PowerPoint lecture slides for learning. The shortcoming is that PowerPoint lecture slides contain simplified teaching

content (Gabriel, 2008). On account of this weakness, Tian-You reported that he sometimes needed to read textbooks or additional learning materials to help him understand the lecture slides and the teaching content. That is to say, a proper manner to employ PowerPoint lecture slides is to supplement with textbooks or additional learning materials. Otherwise, PowerPoint lecture slides might perplex learners.

In addition to using PowerPoint for the above academic purposes, the three participants in this study also utilized this software to prepare for class or conference presentations. Specifically, Tian-You used the rehearsal function in PowerPoint to practice his oral presentations in English and build confidence. This finding, hence, contributes to this line of the literature through indicating international doctoral students' use of PowerPoint to enhance their English speaking competence and confidence.

Videos.

Besides the use of PowerPoint, the findings of this study also reveal the benefits of employing videos for international students like the three participants. Cheng-Rui, for instance, utilized some lecture videos downloaded from Carmen to review the teaching content and prepare for his candidacy exam. Even though he attended the classes, he might not remember detailed teaching content and not comprehend the entire lectures due to language barriers. However, the features of teaching videos could help him surmount the learning difficulty. These features include capturing real-time lectures and having the functions of play, pause, back forward, and stop. Cheng-Rui reported that he repeatedly played some teaching videos that he downloaded from Carmen when preparing for his candidacy exam. Through repeatedly playing the videos which were in English, he, as an

L2 English learner, could review the lectures over and over again and meanwhile use additional online lexical sources. These actions could further increase his memory and understanding of the lectures. As Berk (2009) pinpoints, integrating videos into instruction could increase learners' memory and understanding of teaching content.

Like Cheng-Rui, Zhi-Kai sometimes employed teaching videos created by his previous master's advisor in Taiwan. The feature of capturing real-time lectures that videos possess allows Zhi-Kai to review some statistical concepts for his doctoral research. Additionally, these videos were mainly in Chinese, so watching these videos reduced Zhi-Kai's difficulty in academic English listening. Tian-You also employed videos to hurdle some learning difficulties he encountered. For example, when he could not understand scholars' academic papers in English, he would search for and watch scholars' presentation videos to enhance his comprehension of these scholars' research articles. Since scholars in this type of presentation videos use oral language and visual images which simplify complicated research concepts or processes, Tian-You was able to understand the gist of the scholars' research first. Then, with the gist in mind, he reread the scholars' written academic articles again to increase his comprehension. In addition to scholars' presentation videos, Tian-You also watched discipline-specific teaching videos offered by Coursera to review discipline-based knowledge and prepare for his qualifier exam. He mentioned employing short teaching videos in Coursera to review discipline-based knowledge was not boring as reading textbooks. As Berk (2009) indicates, integrating videos which include multimodal elements into teaching could reduce students' learning stress. It is probable that videos on Coursera which consist of a short-

time frame, oral language, and images, unlike academic articles containing written sophisticated concepts in English, made Tian-You feel relaxed while learning.

As former studies on videos have shown, integrating videos into teaching increases students' learning motivation (Copley, 2007; Romanov & Nevgi, 2007) as well as assists them in learning (Romanov & Nevgi, 2007; Whatley & Ahmad, 2007; Zollman & Fuller, 1994). Nevertheless, the researchers in these studies utilized designed videos and did not recruit international students in their research. In addition, another group of research on videos (Garza, 1991; Herron, Cole, Corrie, & Dubreil, 1999; Herron, Dubreuil, Cole, & Corrie, 2000; Herron, York, Corrie, & Cole, 2006; Mekheimer, 2011; Grgurovic & Hegelheimer, 2007; White, Easton, & Anderson, 2000; Winke, Gass, & Sydorenko, 2010) centers on employing videos to learn a foreign or a second language but no other academic purposes. This present study, therefore, contributes to this line of research through providing insights of what videos sources the international Chinese-speaking doctoral students used to overcome which learning difficulties they encountered and how they utilized the videos resources.

CMC technologies or social networking sites.

In addition to employing videos, the three participants' use of CMC technologies or social networking sites also reveals a positive influence on their academic acculturation. They utilized CMC technologies or social networking sites, such as email, Facebook, WeChat, QQ, LinkedIn, and PPT, to establish and maintain relationships with their peers and professors in former schools and current institution and with scholars from different countries. Moreover, they used these technologies to discuss assignments and research

with their prior and present peers, experienced researchers in their research teams, professors, advisor(s), and scholars of their wider discipline-specific communities. Furthermore, they utilized social networking sites to unceasingly receive and share discipline-related information. Zhi-Kai and Tian-You also participated in communities of practice through sometimes providing discipline-specific knowledge to online users who asked discipline-related questions.

Their use of these technologies shows the characteristics of CMC technologies and social networking sites. These characteristics include cross-border communication, expediency, and the function of written and asynchronous communication. Owing to these characteristics, the three participants were able to establish and maintain professional social networks with their peers, professors, and scholars in different institutions and countries. The feature of written and asynchronous communication also allows them, as international students, to have more time to think, write, and organize their writing in English before sending out their messages. These advantages are absent in the face-to-face communication. Nevertheless, this study also discovers that such written and asynchronous communication might sometimes cause miscommunication or confusion. The reason for causing miscommunication or confusion could be the affordance of CMC technologies and social networking sites and interlocutors' insufficient English competence. Tian-You, for instance, reported that he had the experience of asking professors questions via emails, but his professors did not know what his questions were due to his unclear English writing in his emails. He also stated that he sometimes could not understand professors' emails because of lacking

paralanguage (e.g., gestures and facial expressions) and instant back-and-forth interaction.

The line of research on students' use of social networking sites (e.g., Kirschner & Karpinski, 2010; McCarthy, 2010) has shown positive and negative results of utilizing social networking sites in teaching and learning. Some studies have revealed that most students possess accounts of social networking sites (e.g., Facebook and MySpace), but rarely employ them for academic purposes (Jones, Blackey, Fitzgibbon, & Chew, 2010; Roblyer, McDaniel, Webb, Herman, & Witty, 2010). They mainly use social networking sites to communicate with peers and friends and do job networking (Jones et al., 2010; McCarthy, 2010; Roblyer et al., 2010). Some studies concluded the negative relationship between students' use of social networking sites or CMC technologies and their academic performance (Kirschner & Karpinski, 2010; Paul, Baker, & Cochran, 2012), whereas some studies obtained the positive relations between their use of these technologies and their academic performance (McCarthy, 2010; Pasek, More, & Hargittai, 2009). Nonetheless, these studies did not particularly explore international students' use of CMC technologies or social networking sites.

A group of research (e.g., Cemalcilar et al., 2005; Hodis & Hodis, 2012; Kim, 2010) has investigated international students' use of CMC technologies or social networking sites. These studies disclose that many international students employ this type of technologies to maintain the relationships with their friends and family in their home countries during acculturation processes (Cemalcilar et al., 2005; Fan, 2008; Hodis & Hodis, 2012; Kim et al., 2009; Kim, 2010; Kline & Liu, 2005). This connection helps them reduce the stress of accommodating to a new culture and provides them emotional

support in a new country (Cemalcilar et al, 2005; Fan, 2008; Kim, et al., 2009; Kim, 2010; Kline & Liu, 2005). Former research also reveals that international students are inclined to use CMC technologies or social networking sites to make connections with people from the same ethnic group (Cao & Zhang, 2012; Fan, 2008; Kim, 2010; Kim et al., 2009) and from local communities (Fan, 2008; Hodis & Hodis, 2012; Kim, 2010; Kim et al, 2009) in the target culture. This connection could offer them emotional and practical support during their acculturation processes (Cao & Zhang, 2012). However, these studies did not examine how international students employ CMC technologies or social networking sites for academic purposes and advantages and disadvantages of using these technologies for them as non-English-native speakers like this present study did. This current study, hence, makes contributions to this line of research through offering the insights of 1) what CMC technologies or social networking sites the international doctoral students in this study utilized to interact with whom and for which academic purposes and 2) benefits and shortcomings of employing written and asynchronous communication for them as non-English-native speakers.

8.2.1.4 Problematic use of some technologies.

The three participants in this study utilized assorted technologies to undertake various academic purposes, surmount some academic challenges they confronted, and enhance their academic English competence and discipline-based knowledge and research abilities during their acculturation processes. Nevertheless, their use of some technologies, especially for Cheng-Rui and Zhi-Kai, appear to be problematic and might negatively influence them to socialize into the Western academic culture and their discipline-

specific communities. The two noteworthy questionable using behaviors are their use of online bilingual or monolingual dictionaries and search engines.

Use of online dictionaries.

Cheng-Rui exclusively employed Taiwan online Yahoo Chinese-English dictionary, and Zhi-Kai mainly used Google Dictionary. Exclusively utilizing one dictionary would be subject to its limitations and thus might not successfully help them achieve their goals of English vocabulary searches. Laufer and Levitzky-Aviad (2006) indicate the limitations of L1-L2 bilingual dictionaries which include rarely differentiating L2 translations of L1 words and providing information about the usage of the L2 translations. In addition, a monolingual L2 dictionary might not help language learners understand complete L2 words, but help them check or recall L2 words that learners are familiar with (Ard, 1982; Miller & Gildea, 1985). In such monolingual L2 dictionaries, definitions of L2 words are entirely in L2 which may comprise words that learners do not understand (Gipe, 1979). This meaning-making process by L2 learners, like the participants in this study, may lead them to guess the meanings of the searched L2 words wrongly. In order to deal with this issue, it is probable that employing multiple online dictionaries which include a bilingual and a monolingual dictionary might compensate for the drawbacks of individual dictionaries. Besides this issue, researchers in this line of the literature also suggest that training in how to use dictionaries could assist learners in correctly selecting meanings of L2 words in dictionaries. Nesi and Hail (2002) investigated international undergraduate students' use of monolingual English dictionaries. Their finding discloses that more than half of the participants failed to look

up right meanings of English vocabulary even though they had experience of employing English dictionaries before (Nesi & Haill, 2002). The three participants in this study did not report receiving training in how to employ dictionaries correctly to assist them in reading and writing L2 texts. Their writing data also show some misused English vocabulary. Hence, receiving appropriate training in using dictionaries might aid them in correctly employing dictionaries and choosing precise meanings of English vocabulary. Besides their problematic use of online dictionaries, their use of academic search engines also reveals some questionable behaviors.

Their use of academic search engines.

The three participants in this study all utilized academic search engines to search for academic texts to solve questions about their research, enrich their discipline-specific knowledge, and write their academic papers. Nevertheless, multiple data disclose that Cheng-Rui's and Zhi-Kai's use of academic search engines shows some problematic behaviors. First, Cheng-Rui and Zhi-Kai mainly adopted one academic search engine, Google Scholar, to look for academic texts. Nonetheless, each academic search engine has its limitations, and exclusively one academic search engine to seek scholarly works could narrow their research horizons. Prior studies on academic search engines reveal that academic search engines differ in their size of databases and coverage of types of academic texts (Bakkalbasi, Bauer, Glover, & Wang, 2006; Bar-Ilan, 2008; Falagas, Pitsouni, Malietzis, & Pappas, 2008; Harzing & Alakangas, 2013; Jacso, 2005a, b; Meho & Yang, 2007; Orduña-Malea, Ayllón, Martín-Martín, & López-Cózar, 2014; Sember, Utrobčić, & Petrak, 2010). Orduña-Malea, Ayllón, Martín-Martín, and López-Cózar

(2014), for instance, queried to Web of Science, Microsoft Academic Search, and Google Scholar academic search engines about the number of registered items from 1700 to 2014. The result shows that Web of Science generated 56,980,000 records; Microsoft Academic Search came out 48,336,884 records; Google Scholar emerged 59,600,000 (Orduña-Malea et al., 2014). This result demonstrates different sizes of academic search engines. In terms of the coverage of types of academic texts, Google Scholar indexes not only academic articles from academic journals, conferences, and books, but also technical reports, manual scripts, encyclopedia entries, and academic texts from websites which authors created or shared with (Bar-Ilan, 2008 & 2010). In addition, Google Scholar includes academic texts written in different languages (Orduña-Malea et al., 2014). Contrarily, Web of Science and Microsoft Academic Search are oriented to gather academic texts in English rather than in other languages (Orduña-Malea et al., 2014). Moreover, Falagas, Pitsouni, Malietzis, and Pappas (2008) discovered that Scopus academic search engine indexes a greater amount of medical related journals than PubMed, Web of Science, and Google Scholar do. Web of Science contains the oldest publications; PubMed includes open access articles and only focuses on medicine and biomedical sciences (Falagas, Pitsouni, Malietzis, & Pappas, 2008).

Besides the issue of size and coverage of academic search engines, prior studies also disclose some flaws in Google Scholar (Beel, Gipp, & Eilde, 2010; Falagas et al., 2008). Since Google Scholar indexes academic texts not only from academic journals but also from websites, Beel, Gipp, and Eilde (2010) experimented ways to optimize this academic search engine. They manipulated their published academic articles through adding advertisements, modifying the content, and revising the bibliography and then

published the revised articles on several websites. They found that Google Scholar indexed their manipulated academic articles (Beel et al., 2010). Another drawback is that Google Scholar cannot index an electronic file exceeding 5MB (Orduña-Malea et al., 2014). In other words, an electronic academic text, such as a thesis or a dissertation, over 5MB is not indexed in Google Scholar. Furthermore, the exact size and the coverage of Google Scholar are always questionable. Google Scholar never offers this information (Jacsó, 2005a, 2006), so users could not know whether they overlook academic articles from some sources that Google Scholar does not cover. These shortcomings of Google Scholar could make Cheng-Rui and Zhi-Kai omitted reading some significant academic texts. Most importantly, they heavily counted on Google Scholar to look for scholarly works but were unaware of its drawbacks. Their unawareness could exacerbate their academic acculturation. Since each academic search engine has its size and coverage of academic texts, this present study suggests that employing multiple academic search engines to look for needed academic texts might compensate for individual academic search engines' shortcomings.

In addition to relying on Google Scholar, the three participants in this study also depend on citation counts generated by academic search engines to make a decision on reading which academic texts. More specifically, they were inclined to read academic texts with high citation counts. Nevertheless, the literature on citation analysis reveals that different academic search engines calculate citation counts for an academic text differently (Bakkalbasi, Bauer, Glover, & Wang, 2006; Meho & Yang, 2007). Moreover, citation counts in Google Scholar are inconsistent (Falagas et al., 2008) and have errors (Harzing & Van der Wal, 2007; Jacsó, 2006). Google Scholar often reports higher

citation counts than other academic search engines (Harzing & Van der Wal, 2007; Jacsó, 2006). That is to say, utilizing citation counts generated by academic search engines to determine to read which academic texts could make the three participants in this study miss reading crucial academic texts. In order to not miss reading important academic texts, this present study suggests that selecting academic texts in academic search engines according to relevance to searched goals and the quality of academic texts would be more appropriate.

On the whole, although the three participants' use of some technologies is problematic, overall technology serves as an assistive role to help them acquire discipline-specific knowledge, undertake research, hurdle some academic challenges they encountered during their academic acculturation processes.

8.2.2 Academic Acculturation

Technology has been widely utilized in higher education (Bates, 2000; Fry, Ketteridge, & Marshall, 2008; Hung & Yuen, 2010; Kim & Bonk, 2006; Williams & Jacobs, 2004). It was also widely utilized by the three participants to help them socialize into their doctoral programs and discipline-specific communities. Therefore, in this section, the three participants' academic acculturation is initially discussed through Vygotsky's (1978 & 1986) concept of signs and tools (e.g., technology), and sociocultural theory. Next, their learning and relationships with more experienced members and experts of discipline-specific communities are explored through Lave and Wenger's (1991, 1998) communities of practice (COP) and legitimate peripheral participation. After this exploration, I discuss the influence of their prior discipline-

specific knowledge and research skills, peers, departmental culture, and institutional culture on their academic acculturation, their adjustment to L2 (English) and the Western academic culture, and their participation in multiple discipline-specific communities. Lastly, linear or interactive socialization is discussed to overall look at the three Chinese-speaking doctoral students' academic acculturation within the social context where consist of their academic programs, institution, and wider discipline-specific communities.

8.2.2.1 Signs, tools, and learning.

Vygotsky's (1978 & 1986) sociocultural theory emphasizes that learners' development results from the processes of involving in learning activities through using signs and tools and through socially interacting with peers and instructors. Signs and tools include language, gestures, and symbols (Vygotsky, 1986). Since the technology has been prevalently utilized in education nowadays (Rogers, 2000), Shaffer and Clinton (2006) extend Vygotsky's concept of tools to contain technology. Through utilizing signs and tools, learners could acquire knowledge and skills in their "actual development level, that is, the level of development of [a learner's] mental functions that has been established as a result of certain already completed developmental cycles" (Vygotsky, 1978, p. 85). In this present study, signs and tools comprise the participants' native language (Chinese), a second language (English), discipline-specific language, symbols (e.g., signs in statistics, material science, or computer science fields), and technologies. The three participants in this study came from Taiwan, where English is viewed as a foreign language, and had limited exposure to English outside of English classes in

Taiwan. This limited English exposure is one of the factors resulting in various academic challenges they encountered during the processes of acculturating to the Western academic culture and their particular disciplines. In order to tackle the challenges, they employed their native language (e.g., using a Chinese-English dictionary and Google Translate), insufficient English competence, discipline-specific knowledge and skills they had learned before the doctoral study, and assorted technologies. Particularly, they utilized various technologies to undertake varied academic tasks, including conducting research, learning discipline-specific knowledge, finding solutions for assignments and research, looking up the meanings and usage of English vocabulary and grammar, and establish and maintain relationships with peers, professors, and scholars in their discipline-specific communities.

Nevertheless, not all of discipline-based knowledge, research skills, and academic difficulties could be accomplished through exclusively employing these signs and tools. Especially for knowledge, research skills, and academic challenges beyond their actual development level (Vygotsky, 1978), they would have difficulty in acquiring or surmounting by themselves. Vygotsky (1978) put forward Zone of Proximal Development (ZPD) which describes how learners acquire knowledge and skills above their actual development level through guidance given by instructors or in collaboration with more capable peers. For doctoral students' socialization, guidance derives from formal instruction in class and informal learning in their research teams. The formal instruction is what Lave and Wenger (1991) called "a teaching curriculum" which supplies "and thereby limits—structuring resources for learning, the meaning of what is learned ... is mediated through an instructor's participation, by an external view of what

knowing is about” (p. 97). On the contrary, informal learning is what Lave and Wenger (1991) called a learning curriculum which is “a field of learning resources in everyday practice viewed from the perspective of learners” (p. 97). Informal learning occurs in situations where learners acquire vital knowledge and skills through not only observation and imitation but also involvement with “participation as a way of learning –of both absorbing and being absorbed in – the ‘culture of practice’ (Lave & Wenger, 1991, p. 95). In this study, the three participants acquired discipline-specific knowledge and research skills through both teaching and learning curricula. They received the formal instruction when taking took discipline-based core courses where instructors provided guidance for them to learn fundamental discipline-based knowledge. They also got informal instruction through working in their advisor(s)’ laboratory to learn discipline-specific knowledge and research skills from more experienced researchers and/or their advisor(s). Though three of them received both formal and informal instruction, the condition of their academic acculturation differs from each other due to the quality the instruction they received and the length of their acculturation to the Western academic and their disciplinary culture.

8.2.2.2 Legitimate peripheral participation.

The informal instruction which the three participants worked in their advisor(s)’ research team constituted a significant part in their academic acculturation processes. Working in their advisor(s)’ research team provided them more opportunities to interact with and learn from experienced researchers and their advisor(s) than in the classroom. Researchers also designate that graduate assistantships provide students learning

opportunities outside of class (Austin, 2002; Weidman, Twale, & Stein, 2001), build confidence in their research competence (Austin, 2002), and facilitate them to actively participate in their academic communities (Ethington & Pisani, 1993). In De Valero's (2001), the faculty from several academic disciplines also reported that the purpose of discipline-based courses is to prepare students to acquire a fundamental theoretical background in the academic field, whereas directly working in laboratories for research projects is the way to learn how to independently undertake research. Hence, in this study, the three participants' relationships with old timers (experienced researchers and their advisor(s)) is crucial to their academic acculturation.

Lave and Wenger's (1991, 1998) communities of practice also emphasize the relationships among novices, experienced members, and experts, namely apprenticeship, in professional communities. In COP, learners are considered as apprentices. Learning is the process of taking part in communities of practitioners and mastering knowledge and skills that are required new learners (newcomers) to move from peripheral participation to full participation in the communities (Lave & Wenger, 1991, 1998). During this process of legitimate peripheral participation in communities of practice, learners master the knowledge and skills with guidance provided by masters in the communities (Lave & Wenger, 1991).

In this current study, the three participants were newcomers in their discipline-specific communities and worked as research assistants and as apprentices to learn important discipline-specific knowledge and research in their advisor(s)' research teams. Owing to the research assistantship, the participants, especially Zhi-Kai and Tian-You, enabled to observe how old-timers participated in communities of practice. Meanwhile, the

participants could also legitimately peripherally participate in the practice with old-timers' guidance. The practice includes knowing which academic camp(s) they aligned with, who were leading scholars in their research area(s), how to undertake research, which academic conferences were important to attend, how to write conference proposals and journal articles, how to present and defend own research perspectives, and how to interact with scholars in formal and informal occasions.

Although the three participants worked as apprentices in their laboratories, the quality of their apprenticeships was distinct from each other. Tian-You worked in the laboratory which consisted of doctoral apprentices, experienced researchers, and his advisor. His advisor's research team had a unique culture. That is, a newcomer, like Tian-You, was closely guided by an experienced researcher (the post-doc), whereas more experienced researchers worked closely with Tian-You's advisor. Such a close relationship with the post-doc enabled Tian-You to absorb substantial discipline-specific knowledge and research skills and consult with the post-doc when he encountered academic difficulties. Unlike the post-doc, Tian-You's advisor usually served as the final gatekeeper for paramount documents, such as conference proposals. As Lave and Wenger (1991) indicate, "an apprentice's own master is too distant, an object of too much respect, to engage with in awkward attempts at a new activity" (p. 92). Therefore, closely working with and learning from the post-doc might make Tian-You feel less distant and awkward while engaging in communities of practice. Moreover, on account of the close relationship with the post-doc, Tian-You could learn more discipline-specific knowledge and research skills from the post-doc than his advisor.

Unlike Tian-You, Zhi-Kai was the only doctoral student whom his two retired advisors had. Although he had doctoral peers to discuss course content, assignments, and qualifier exams, no other doctoral peers specialized in Zhi-Kai's research area and were supervised by his advisors. Zhi-Kai, hence, did not have other apprentices or experienced researchers in the laboratory whom he could learn from. It is probable that directly working with his advisors made him often solve research problems by himself first in order to reduce possible tension in such a close advisor-advisee relationship. On the other hand, directly working with his advisors enabled him to learn vital discipline-specific knowledge and research skills from experts (his advisors) in statistics communities. He, for instance, learned how his advisors discussed research with collaborators and resolved their problems. He also learned how to respond reviewers' questions for a statistical journal article which he co-authored with his advisors.

In the case of Cheng-Rui, he worked in his advisor's research team. Nevertheless, he did not have a close relationship with other members or experienced researchers in the team in terms of learning discipline-specific knowledge and research skills. Once Cheng-Rui reported that he was the only one student who specialized in his current research area so he always carried out experiments by himself even though he worked with around ten research members in the lab. The post-doc he often mentioned during interviews mainly served as a proofreader to check Cheng-Rui's English writing rather than offering discipline-specific advice. In relation to Cheng-Rui's advisor, data show that his advisor had a busy schedule and thus did not provide him sufficient discipline-specific support. Wenger (1998) designates that "practice resides in a community of people and the relations of mutual engagement..." (p. 73). The lack of mutual engagement and the loose

relationships with members and expert (advisor) in the research team, therefore, made Cheng-Rui always individually solved research problems he confronted. Although both Zhi-Kai and Cheng-Rui were in their fourth doctoral year when this study was conducted, the evaluation of their academic acculturation discloses that Cheng-Rui's condition is worse than Zhi-Kai's. Lave and Wenger (1991) pinpoint that

“the key to legitimate peripherality is access by newcomers to the community of practice and all that membership entails...To become a full member of a community of practice requires access to a wide range of ongoing activity, old-timers, and other members of the community; and to information, resources, and opportunities for participation” (p. 100-101).

The lack of access to old-timers in Material Science and Engineering (MSE)

communities, thus, negatively influenced Cheng-Rui to become a full member of the communities. He made a great effort to participate in MSE communities of practice, such as presenting own research at conferences from his first doctoral year. Nonetheless, until graduating from the MSE doctoral program, he had not yet had opportunities to learn correct processes of undertaking research from more experienced researchers and his advisor like Zhi-Kai did. Cheng-Rui's advisor's eminent reputation in the MSE discipline and the well-equipped research technologies in the doctoral department did attract some local and international scholars to conduct collaborative research. However, he reported that most of the scholars came to the lab to utilize the research technologies to carry out their experiments or remotely asked him help to run their experiments. This type of collaboration might help Cheng-Rui establish a social network in the field but not actually learn about research from the processes. In addition to this, Cheng-Rui also endeavored to utilize his dissertation as resources to publish in MSE journals. Nonetheless, data reveal that his advisor provided insufficient support for his dissertation, let alone potential publications. In other words, the absence of access to old-timers in

MSE communities further negatively impacted on Cheng-Rui to access crucial “information, resources, and opportunities for participation” in vital MSE communities of practice (Lave & Wenger, 1991, p. 101). Owing to this absence of access to old-timers in MSE communities, Cheng-Rui participated legitimately but not peripherally in MSE communities of practice. Contrarily, Zhi-Kai had access to old-timers (his advisors) and vital discipline-specific information, resources, and opportunities to participate in essential statistics communities of practice. The practice includes collaboratively conducting research with his advisors and other professors and co-authoring with his advisors for book chapters and journal articles. Zhi-Kai, therefore, had more opportunities to become a full member of disciplinary communities than Cheng-Rui did during their academic acculturation processes.

Figure 8.1 represents novices’ learning progress from legitimate peripheral participation to full participation in discipline-specific communities with experienced members’ and/or experts’ guidance. The curved and uneven line represents rough academic acculturation processes where the three Chinese-speaking international doctoral students encountered various academic difficulties and had to surmount these difficulties in order to achieve their goals becoming experts in their discipline-specific communities.

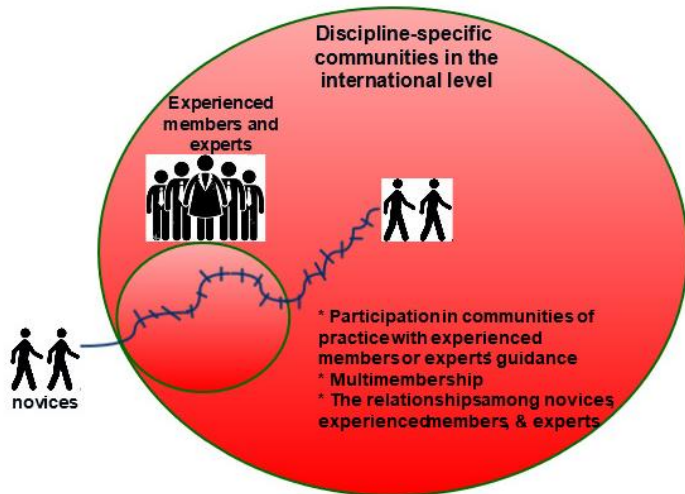


Figure 8. 1 Legitimate Peripheral Participation

Researchers claim that the relationship between doctoral students and their advisor(s) are paramount for doctoral students' academic acculturation (Austin, 2002; de Valero, 2001; Dong, 1998; Ellis, 2001; Gardner, 2007, 2010a; Grives & Wemmerus, 1988; Hung & Hyun, 2010; Le & Gardner, 2010; Li & Collins, 2014; Sato & Hodge, 2009). However, the present study shows that not only doctoral students' advisor(s) but also experienced researchers in a research team could influence doctoral students' socialization into their discipline-specific communities. In some occasions, working with experienced researchers in a team might enable doctoral students, like Tian-You, to learn more than with advisor(s) due to the distance between novices and experts (Wenger, 1999). In order to gain this learning benefit, it is also necessary to develop a healthy team culture where both of novices and experienced researchers are willing to share and learn from each other, like Tian-You's case.

8.2.2.3 The influence of prior discipline-specific knowledge and research skills.

In addition to the relationships with experienced researchers and advisor(s), this study also found that the three participants' academic background positively impacted on their academic acculturation. All of them studied in college and a master's program in the identical discipline before their doctoral study. This discipline-specific learning background made them confront less difficulty in learning discipline-specific knowledge which contained terminology and concepts they learned before. Moreover, Zhi-Kai and Tian-You had the experience of conducting master's research, writing a master's thesis, and working as a research assistant in a Taiwan governmental research organization before their doctoral study. These research experiences helped them understand the processes of undertaking research and of presenting research results in a formal written form and the unique culture of advisor-advisee relationships in graduate school.

Unlike Zhi-Kai and Tian-You, Cheng-Rui's master's study experience in the U.S. did not greatly assist him in academic acculturation in terms of research like the other two participants did. In the master's program, Cheng-Rui merely carried out a small partial his advisor's experiment. This experience might help him individually undertake his experiments in the doctoral program. Nonetheless, he did not learn how to conduct own research and write up a formal research report, such as a master's thesis. The absence of this experience coupled with insufficient research support from his current advisor might deteriorate his academic acculturation processes. Bauer and Green (1994) also found that doctoral students in their study who studied in undergraduate programs in the identical institution and had past research experience showed more involvement in their doctoral

programs, engagement in doctoral research, feeling of belonging to the programs, and productive academic outcomes (e.g., publications). However, the participants in their study were local doctoral students rather than international students. This present study, therefore, contributes to this line of the literature by revealing that international doctoral students' prior discipline-specific learning and research experience have a positive influence on their socialization into their doctoral program and disciplinary communities.

8.2.2.4 The influence of peers.

Besides the influence of prior discipline-specific learning and research experience, peers also placed an important role during the three participants' academic acculturation. For example, Cheng-Rui employed the face-to-face mode, WeChat, Facebook Messenger, cell phone texts or calls, and email to discuss course assignments and research with international and local peers. Zhi-Kai utilized QQ, Facebook groups, PTT, and email to prepare for qualifier exams and discuss research with his previous master's and current doctoral peers. Tian-You employed the face-to-face mode and Facebook to discuss course assignments and research with peers. This finding aligns with former research on doctoral students which designates that peers' support positively influences students to adjust to their graduate programs (Angelova & Riazantseva, 1999; Austin, 2002; Gardner, 2007, 2010a; Gildersleeve, Croom, & Vasquez, 2011; Hung & Hyun, 2010; Kim, 2011; Kwon, 2009; Le & Gardner, 2010; Li & Collins, 2014; Morita, 2009; Sato & Hodge, 2009). One noteworthy point is that data on Zhi-Kai and Tian-You reveal that peer support they received mainly from Chinese-speaking peers rather than local and international students from countries other than Taiwan and China. This phenomenon

implies that they encountered the challenge of academically connecting with local and international students from other countries. Besides peers, academic programs' and institutional culture also play significant roles during doctoral students' academic acculturation.

8.2.2.5 The impact of academic programs and the institution.

Stein and Weidman (1989) pinpoint that institutional culture is one of the factors influencing graduate students' academic acculturation processes. In this study, the three participants study in the same institution sharing the same institutional culture. This institution provided technological infrastructure, such as wireless on campus, a course management system (Carmen), and technological facilities in libraries, ESL service, graduate student teaching training service, and the recent establishment of a research service and support program. Moreover, this institution also proclaimed to offer "unique international expertise information and access to premier opportunities in a global setting" (document collection and field notes). Its graduate school declared that their mission was to provide "strategic leadership for graduate education...[foster] quality in graduate education...by providing essential services that support the work of graduate students, faculty, and staff... commitment to effective recruitment, retention, and support systems for all students...[and] the belief that diversity is a critical part of excellence in graduate education...promotes cultural diversity in the community" (document collection and field notes).

Interestingly, according to the interview data, the three participants did not report institutional support in academic learning other than ESL service, the institutional course

management system (Carmen), and libraries. Even though they made use of these institutional services and support, data disclose their dissatisfaction or limited use of them. The three participants, for example, took required ESL writing and spoken courses which were supposed to enhance their English academic writing and speaking competence. Nonetheless, data reveal that these courses were to prepare them as international graduate students to meet the institutional requirements (e.g., no plagiarism and being eligible to teach courses in English) rather than improving their actual English academic competence. Regarding the libraries, they mainly reported utilizing its search engine to download PDF of academic articles that they could not obtain from other academic search engines (e.g., Google Scholar) but no other uses. Concerning the course management system (Carmen), Cheng-Rui and Tian-You were able to gain the benefit of using it because their instructors possessed the competence in integrating this technology into their instruction and were willing to do so. Contrarily, Zhi-Kai was unable to obtain this benefit due to his instructors' preference for the traditional teaching method. Furthermore, data show that Zhi-Kai and Tian-You confronted difficulty in discussing course assignments and research with local and international peers other than Chinese-speaking students. Prior studies have also confirmed that international students face the challenge of connecting with local students (Cheng & Fox, 2008; Gilah & Forgasz, 2004; Grayson, 2008; Rajapaksa & Dundes, 2002; Rosenthal, Russell, & Thomson, 2007; Scheyvens, Wild, & Overton, 2003; Zhai, 2002).

In this study, these institutional service and support the three participants received seem not to correspond with the statements of the institution and its graduate school. Although field notes display that the institution attempted to boost multiculturalism through

holding regular cultural events on campus, these events stress to introduce food and general culture of different countries rather than facilitating cross-cultural communication in terms of learning. Such superficial multicultural events would not help both international and local students to learn from each other but continue to marginalize international students in the Western learning environment. Former research has also verified that degrees of academic support proffered by institutions could influence international students' satisfaction with their academic acculturation processes (Grayson, 2008; Mehdizadeh & Scott, 2005; McLachlan & Justice, 2009; Prescott & Hellsten, 2005; Zhai, 2002). Without appropriate and needed academic support given by the institution, the three participants would continue to experience academic difficulties and being dissatisfied with their academic acculturation processes.

Besides the institutional culture, academic programs are also an important factor impacting on graduate students' academic acculturation (Le & Gardner, 2010; Stein & Weidman, 1989). In this study, the three participants studied in different academic programs which of each had its unique culture. Therefore, they were influenced by their departmental culture in different aspects. Cheng-Rui's academic program, MSE, featured in high-tech teaching, learning, and research environments. Cheng-Rui reported that each classroom in the program was equipped with a big screen, a computer, and a video and audio recording device. Most of his instructors also video-recorded their teaching and uploaded the recordings to the course management system for students to review. Consequently, this unique culture enabled Cheng-Rui to review teaching content via the instructional videos created by his instructors. Moreover, MSE regularly invited local and international scholars to give talks. Cheng-Rui stated that he would attend the talks as

long as no conflict with his schedule. He also mentioned that he utilized this opportunity to establish a social network in MSE communities.

Zhi-Kai's academic program, Statistics Department, was characterized by involving their students and faculty in interdisciplinary research. Owing to this departmental culture, Zhi-Kai and his advisors collaboratively conducted research with professors from different academic disciplines and with private institutions. This research experience enriched Zhi-Kai's discipline-specific knowledge and research skills as well as enabled him to put the knowledge and skills into practice. Nonetheless, data disclose that the Statistics Department did not offer sufficient support in statistics software and training. Accordingly, Zhi-Kai oftentimes relied on his previous learning and experience of using statistical software (e.g., R and CAP) in Taiwan and on online resources to help him learn how to operate MATLAB to analyze his statistical data.

Tian-You's academic program, Computer Science and Engineering (CSE), featured in involving students in working with important academic partners within and outside of the institution and industrial partners. On account of this departmental culture, most research projects that Tian-You engaged in were to collaborate with industries or the U.S. governmental bureaus. This research experience, hence, prepared him to be able to work in not only CSE industries but also CSE academia in the future.

Taken together, the three participants' departmental culture showed the impact on the development of their discipline-specific knowledge and research skills. This finding extends the line of the literature on international graduate students' academic acculturation by indicating the influence of departmental culture on this group of students' academic acculturation. More importantly, both of their departments and

institution seem to overlook the international doctoral students' constant need to accommodate to the new language environment and Western academic culture.

8.2.2.6 Adjustment to English and the Western academic culture.

While the three participants socialized into their doctoral programs and discipline-specific communities, they also acculturated to the English environment and Western academic culture. Vygotsky's (1978) sociocultural theory and Lave and Wenger's (1991, 1999) communities of practice do not center on newcomers' backgrounds. Academic acculturation that Casanave and Li (2008) and other scholars, such as Simpson and Matsuda (2008) and Prior and Min (2008), discussed also focuses on students' socialization into graduate school and professional communities. Nevertheless, they did not investigate how the target language (English) and the Western academic culture might impact on international graduate students' academic acculturation (Casanave & Li, 2008). Casanave and Li (2008) indicate that graduate academic culture is dynamic and sophisticated, and both domestic and international students experience the difficult transition to graduate school and their discipline-specific academic communities. In order to become members of their communities, both domestic and international students need to acquire significant knowledge, participate in particular academic practice, negotiate their identities, and take an academically recognizable role in those communities (Casanave & Li, 2008; Heneda, 2009). Nonetheless, viewing both groups of students experience the identical challenges of academic acculturation, in fact, ignores international graduate students' learning needs. International graduate students require surmounting the challenges of adjusting to not only their particular discipline-specific

culture but also the target language (English) and the Western academic culture. Research has disclosed that similarities and differences between L1 and L2 educational culture could affect international students to acculturate to the L2 academic culture (Mehdizadeh & Scott, 2005; McLachlan & Justice, 2009; Yan & Berliner, 2009). Furthermore, studies have also verified that academic English (Johnson, 2008; Kim S., 2006; Lee, Farruggia, & Brown, 2013; Liu, 2012; Wan, Chapman, & Biggs, 1992) and Western academic culture (Dong, 1998; Huang & Klinger, 2006; Kim, Y., 2007; Lee, Farruggia, & Brown, 2013; Liu, 2012) are difficult for international graduate students to acclimatize.

In this study, the three participants all confronted difficulties in academic English listening, speaking, reading, and/or writing and in accommodating to the Western academic culture throughout their doctoral study. These difficulties further influenced them to learn discipline-specific knowledge and research skills, express their research ideas, socially interact with scholars in their discipline-specific communities, and write significant academic documents (e.g., a candidacy exam, a dissertation, conference proposals, and publications). Even though three of them were required to take English academic writing and/or spoken courses in their first doctoral year, multiple data reveal that these courses did not meet their learning needs but instructed them in fulfilling the institutional and departmental requirements of English academic speaking and writing, such as following citation rules and not plagiarizing someone's works. Additionally, there were no workshops or courses training them in English academic reading and listening or that attempted to enhance their overall English academic competence. Furthermore, there were no workshops or courses teaching them the Western academic culture. These tasks seem to be taken for granted by their instructors, professors,

academic programs, and institution that these international graduate students whose native language is not English and who get used to their native academic culture should know or have the competence to deal with these difficulties.

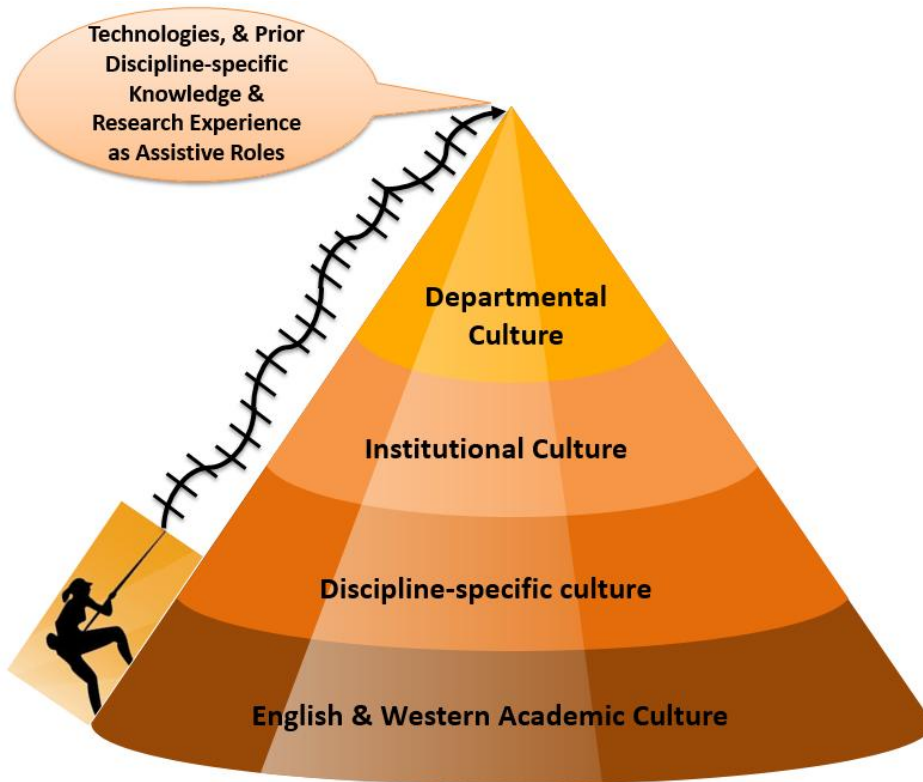


Figure 8. 2 Chinese-Speaking International Doctoral Students' Academic Acculturation

Figure 8.2 represents the academic acculturation processes where Chinese-speaking international doctoral students, like the three participants in this study, adjust to their departmental culture, institutional culture, discipline-specific culture, the target language (English), and the Western academic culture. During the processes, their prior discipline-specific knowledge and research experience, and technologies play assistive roles to help them acculturate to multiple cultures, including departmental, institutional, discipline-specific, and the Western academic cultures. The winding and fragment line rather than a

straight line symbolizes the problematic use of some technologies by the three participants which might negatively influence their academic acculturation in some degree.

8.2.2.7 Participation in multiple discipline-specific communities.

In addition to the above findings, another notable finding is that all of the three participants are members in multiple discipline-specific communities at the same time. The communities include their doctoral programs and discipline-specific communities in the U.S., Taiwan, and the international level. Figure 8.3 presents that the three participants, like other international doctoral students, simultaneously partook in these communities during their academic acculturation processes. Wenger (1999) pinpoints that newcomers “participate in multiple communities of practice at once” (p. 105). While learning important discipline-specific knowledge and research skills in their doctoral programs, they engaged in wider discipline-specific communities of practice through presenting at conferences in the U.S. and Taiwan and collaboratively conducting research with other scholars in different disciplines and in different countries and with private institutions or companies (in the case of Zhi-Kai and Tian-You). They also took part in the wider communities of practice through online. For instance, Cheng-Rui participated in corrosion-related groups on LinkedIn to build a social network with workers in MSE industries. Zhi-Kai partook in R and Hwa-Fan groups on Facebook and the statistical discussion board in PTT to solve some online users’ statistical questions and ask statistical advice from his previous peers in Taiwan. Tian-You read predominant CSE scholars’ research works on LinkedIn and involved in collaborative research projects

with his prior master's professors in Taiwan through email and Skype. On account of the feature of online social interactional software which is cross-border communication, they were able to participate in the wider communities of practice and establish and maintain relationships with scholars in their fields. Their participation in multiple discipline-specific communities also shows that they acculturated to not only their current doctoral programs but also wider discipline-specific communities. Prior studies (de Valero, 2001; Ellis, 2002; Li & Collins, 2014; Gardner, 2007, 2010a & 2010b; Morita, 2009; Nettles, 1990) mainly investigated that students socialize into their present doctoral programs. These studies did not explore socialization into the students' wider discipline-specific communities. This present study, hence, extends this line of the literature by pointing out that international doctoral students socialized into not only their doctoral programs but also multiple discipline-specific communities during their academic acculturation processes.

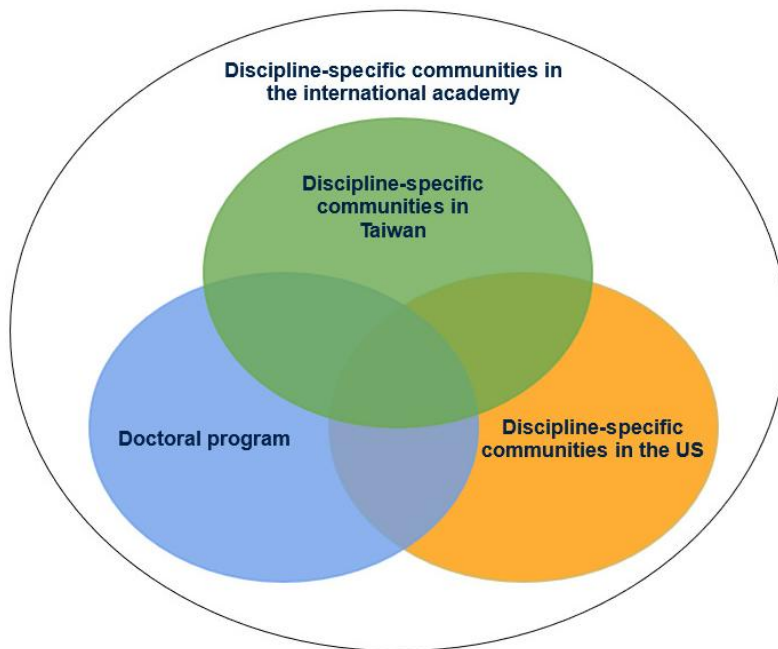


Figure 8. 3 Multiple Discipline-Specific Communities

8.2.2.8 Linear or interactive socialization.

O'Toole (1996) proposed the linear socialization of graduate students in higher education depicting a process where students are admitted into academic graduate programs, socialize into the programs, and graduate from the programs (see Figure 8.4). In other words, academic programs influence students through teaching programs' necessary knowledge and skills.

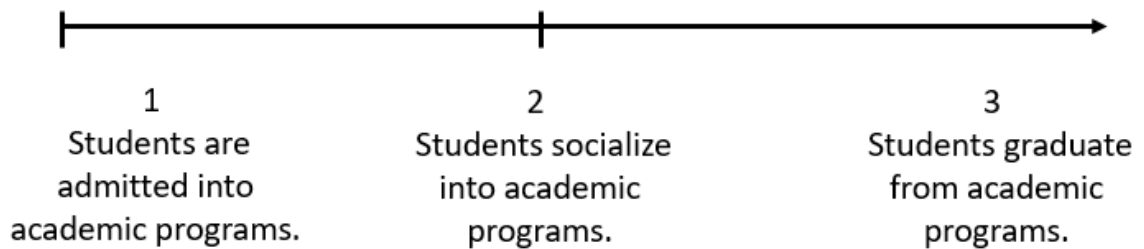


Figure 8. 4 The Linear Graduate Students' Socialization (O'Toole, 1996; Weidman et al., 2001)

On the contrary, Weidman, Twale, and Stein (2001) indicate that the graduate students' socialization is a non-linear and interactive process where graduate students are influenced by their academic programs and institutions. Meanwhile, they influence their institutions and professional communities by reflecting and evaluating own practice and culture. Figure 8.5 presents Weidman et al.'s (2001) interactive model of graduate students' socialization.

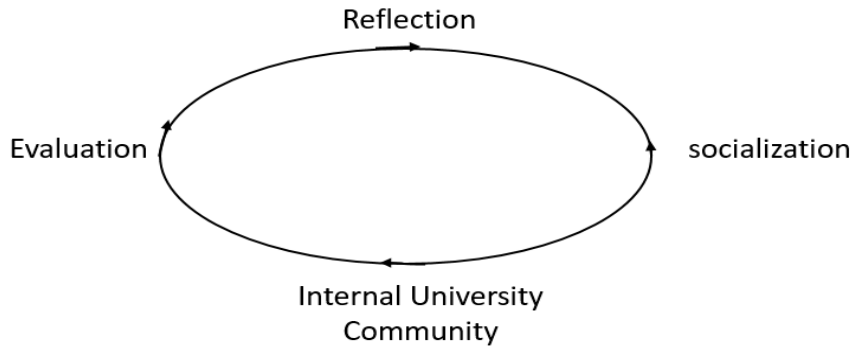


Figure 8.5 Interactive Model of Graduate Students' Socialization (Weidman et al., 2001)

This present study shows that the three Chinese-speaking international doctoral students' socialization were inclined to be linear. That is, the three participants were admitted to their doctoral programs, and they were influenced by their departmental, institutional, and professional culture as well as the Western academic culture. Particularly, the processes of evaluation and reflection by their academic programs and institution were likely missing, especially for providing needed and constant support for international doctoral students to adjust to the Western academic culture. The graduate school in the three participants' institution proclaimed to promote "cultural diversity in the community" (document collection and field notes). However, such a multicultural community stays in admitting students from diverse cultures and introducing their general culture (e.g., food culture) for the local students. Moreover, the three participants' academic acculturation processes disclose that they were limited to accept what their academic programs and institution provided and were marginalized by the dominant members of the community. This phenomenon shows the lack of open and interactive communication among international doctoral students, academic programs, and the institution. The absence of needed support for accommodating to the Western academic

culture and of open and interactive communication, therefore, exacerbated the three participants' academic acculturation processes.

The following chapter discusses the conclusion, implications, and limitations of this study and recommendations for future research.

Chapter 9: Conclusion, Implications, Limitations, and Recommendations for Future Research

This chapter reviews the major research findings emerged from the individual and cross-case analysis and indicates contributions this present study made. Next, suggestions on academic acculturation are given to international doctoral students, academic departments, and institutions. The last section discusses the limitations of this study and recommendations for future studies.

9.1 Conclusion

The number of Asian international students who pursue higher education in the U.S. increases yearly (Institution of International Education, 2012, 2013). This line of the literature has shown that this group of graduate students confronts various academic difficulties (Scheyvens, Wild, & Overton, 2003; Yeh & Inose, 2003). Studies have also discovered that the use of technology could assist them in enhancing their English competence (Bradleya, Lindstroma, & Rystedta, 2010; Kessler, Bikowski, & Boggs, 2012; Varley, 2009), reducing stress due to acculturation (Cemalcilar, Falbo, & Stapleton, 2005; Fan, 2008; Kline & Liu, 2005), and making connections with people from the identical ethnic groups and the target-cultural groups (Fan, 2008; Kim, 2010; Kim, Yun, & Yoon, 2009). This current study, hence, investigated Chinese-speaking international doctoral students' academic acculturation and the role of technology during their academic acculturation processes. Results display that technology plays a vital and

assistive role during their academic acculturation processes. They employed assorted technologies for varied academic purposes. The technologies they employed include academic search engines, online lexical resources, online interactional software, citation software, reading and presentation software, online videos, and discipline-specific technologies (e.g., statistical software). The academic tasks that they utilized technologies to accomplish include completing required academic tasks (e.g., assignments), acquiring discipline-specific knowledge, conducting research, discussing course assignments and research with peers, professors, experienced researchers, and advisor(s), establishing and maintaining relationships with scholars, and resolving academic difficulties they encountered. Most studies on international students' use of technologies for academic purposes center on using technologies to improve their English competence (Bradley et al., 2010; Kessler, Bikowski, & Boggs, 2012; Varley, 2009). This present study, thus, contributes this line of the literature by reporting their use of technologies for not only increasing their English competence but also undertaking other academic tasks (e.g., learning discipline-specific knowledge, conducting research, solving their academic questions, and establishing and maintaining relationships with peers, professors, and scholars). Another research finding is that the participants' former discipline-specific learning and research experiences positively influenced them to socialize into their doctoral programs and discipline-specific communities. Former research (e.g., Li & Collins, 2014; Gardner, 2007, 2010a & 2010b; Morita, 2009) mainly examined students' socialization into their doctoral programs. The finding of this present study, therefore, extends this line of the literature by pinpointing that international students acculturate to not only their doctoral programs but also multiple discipline-specific communities.

In addition to the above positive influence on international doctoral students' academic acculturation, there were some academic learning, tasks, and difficulties that the three participants confronted could not be coped with through exclusively utilizing technologies and their prior learning and research experiences. It requires them to learn from more experienced members and/or experts in their discipline-specific communities. For instance, tasks, such as how to conduct good research and write conference proposals and publications that meet disciplinary expectations, could not be accomplished by exclusively using technologies and their prior learning and research experiences. To accomplish these tasks necessitate guidance from more experienced members and/or experts in discipline-specific communities. As Vygotsky (1978, 1986) and Lave and Wenger (1991, 1999) assert, through guidance given by instructors, more experienced peers, and/or experts, learners enable to acquire knowledge and skills beyond their actual developmental level. Prior studies on doctoral students also acknowledge that healthy relationships with advisor(s) and peers and their academic support are beneficial for doctoral students' academic acculturation processes (Austin, 2002; Gardner, 2007, 2010a; Hung & Hyun, 2010; Le & Gardner, 2010; Li & Collins, 2014; Sato & Hodge, 2009). Besides adjusting to their doctoral programs and discipline-specific communities, the three participants, as international students, also needed to accommodate to academic English and the Western academic culture. Former studies have demonstrated that international students confront difficulties in adjusting to not only English but also the Western academic culture (e.g., Lee et al., 2013; Liu, 2012). Achieving academic English proficiency and understanding the Western academic culture, especially for cultural aspects opposite to international students' native academic culture, could not be acquired

through solely employing technologies. Instead, it necessitates constant support given by the members of the Western academic culture. Although both local and international doctoral students need to adjust to graduate school culture, international doctoral students encounter more hurdles during their academic acculturation processes. These hurdles could even marginalize them in their doctoral programs and discipline-specific communities when limited support given by their professors, academic program, and institutions. Overlooking the hurdles international doctoral students confront would lead to inappropriately and insufficiently provide support to them during their academic acculturation processes. Weidman et al. (2001) point out that graduate students' socialization is an interactive process where graduate students, academic programs, institutions, and professional communities are mutually influenced and changed during the students' socialization. However, this study shows the linear process where the participants, not their academic programs and institution, were influenced and changed in order to adjust to the Western academic culture and their discipline-specific communities.

9.2 Implications

This present study examines Chinese-speaking doctoral students' academic acculturation and the role of technology during their acculturation processes. The results show that they experienced academic difficulties in adjusting to the English environment, the Western academic culture, and interacting with peers who were non-Chinese-native speakers. Moreover, data reveal that their use of some technologies is limited or erroneous. Therefore, in this section, I provide advice on how international doctoral students, academic departments, and institutions could tackle the issues of technology

use, academic English, the Western academic culture, and the interaction with local and international students other than Chinese speakers.

9.2.1 Technology use.

With regard to technology use, international doctoral students could utilize different types of technologies to deal with academic challenges they confront and to extend their academic learning beyond the classroom. Citation software, for instance, could be used to deal with different citation styles required by different academic conferences and journals. In addition, it could be employed to help doctoral students systematically organize extensive academic texts they read. Another example is online social interactional software which could be utilized to establish and maintain relationships with scholars in the fields. It could also be used to have cross-border discussions about research with scholars in the fields. For some of the technologies (e.g., academic search engines), international students could consider adopting the same type but multiple technologies (e.g., Google Scholar, a school library search engine, and discipline-based academic search engines) to compensate for individual technologies' shortcomings. Moreover, international students could contemplate looking for resources written in English as well as resources which are multimodal and/or written in their native language to help them enhance their understanding of discipline-specific knowledge or texts in English. Tian-You, for example, searched for and watched scholars' presentation videos to assist him in comprehending sophisticated scholars' academic texts in English. Furthermore, while looking for online resources for academic purposes, international doctoral students should be mindful of the validity of online resources they obtain.

Academic departments could proffer both doctoral students and the faculty discipline-specific technologies for teaching and research. The data in this study disclose that some academic departments provided either limited discipline-specific technologies (e.g., in the case of Zhi-Kai) or technology sources for only the faculty rather than doctoral students. If a department expects their doctoral students to be outstanding in research and/or teaching in the academic field, it is crucial to support them necessary discipline-specific technologies in order cultivate students' research and/or teaching competence. In addition to offering discipline-specific technologies, departments could also think about giving workshops or training in how to correctly use these technologies for research and/or teaching. Moreover, departments could think about proffering valid online lexical resources and software (e.g., Corpora, software for checking English grammar, punctuation, and styles, and online multilingual dictionaries) that could aid international students in overcoming difficulties in academic English and in enhancing their academic English competence.

For institutions, the institution in this present study had the splendid technological infrastructure (e.g., wireless on campus and in student dormitories, a course management system – Carmen, technology and research centers, the library search engine, and online academic databases). Nonetheless, the participants and some of their instructors (in the case of Zhi-Kai) in this study did not take advantage of employing the institutional technological resources. Hence, an institution could make efforts to advertise and encourage students and the faculty to utilize institutional technological resources for research and teaching. Meanwhile, an institution could also provide workshops or training for students and the faculty to employ the institutional technological resources.

9.2.2 Academic English

The three Chinese-speaking international doctoral students in this study confronted numerous challenges of academic English. In addition to utilizing bilingual and monolingual dictionaries and online resources related to English grammar, they could consider using some software (e.g., the rehearsal function in PowerPoint and software for checking English grammar, punctuation, and styles) to help them solve pressing academic English needs. International students could also think about making use of institutional writing service (e.g., a writing center) to continuously develop their English academic writing competence. Moreover, international students could employ scholarly texts in the field as models to aid them in learning English usage, scholarly writing styles, the use of discipline-specific terminology, concepts, and theories, and how to structure their academic papers. Most importantly, achieving a high level of proficiency in academic English requires a long time for English learners, especially learners from countries where English is a foreign language. Besides this understanding, international students also need to continuously learn and practice academic English in order to reach a high level of proficiency in academic English.

Academic departments could also provide international doctoral students support for learning discipline-specific academic English through offering formal instruction or workshops. Departments or professors could also form a discipline-specific writing group which faculty members and local and international doctoral students involve in to offer international students a space to get feedback on their academic writing.

In addition to academic departments, institutions could also proffer support to enhance international doctoral students' academic English ability. In this current study, the

institution did provide ESL service. The three participants were also required to take some English writing and/or speaking courses in their first doctoral year. However, they reported dissatisfaction with the teaching because it stressed to fulfil the departmental and institutional requirements (e.g., no plagiarism and to legitimate to be teaching assistants). They stated that the teaching did not meet their English learning needs. More specifically, what they need is to enhance their academic English in order to surmount English difficulties they encountered during acculturation processes. Thus, institutions could provide academic English courses for not only fulfilling departmental and institutional requirements but also meeting international students' English learning needs. In order to satisfy the students' learning needs, an institutional ESL program could find out the students' English needs first and then base on this information to design courses.

Moreover, some of the participants in this study also pointed out that institutional ESL courses were required to take in their first doctoral year, but there was no need for them to write long papers in early doctoral years. An institutional ESL program could consider postponing the requirement of ESL courses for international students who will need this service later. Furthermore, this study discloses that the institutional ESL program merely provided English speaking and writing courses. Nonetheless, Chinese-speaking international students, like the three participants in this study, may also have challenges of academic English listening and reading. An institutional ESL program, hence, could take these learning needs into account and design courses to help international students improve their academic English listening and reading abilities. Besides these, data in this current study also display that the participants confronted academic English speaking, listening, reading and/or writing throughout their doctoral years. Merely proffering one-

year English support is deficient. An institutional ESL program could contemplate providing continuous support or service of academic English listening, speaking, reading, and writing to international students.

9.2.3 Western academic culture

In addition to the support of the development of English academic competence, the three Chinese-speaking international doctoral students in this study also encountered challenges of adjusting to the Western academic culture, especially for those cultural aspects opposite to the international students' native academic culture. For instance, Cheng-Rui and Zhi-Kai stated their unskillful in socially interacting with scholars in informal occasions. This unskillfulness might result from their native culture where people rarely talk to or even say hi to strangers. Another example is that Tian-You hardly expressed his opinions or asked questions during classes. Instead, he would discuss the teaching content quietly with peers during classes or ask instructors questions after class. This behavior, in fact, stems from the classroom culture in Taiwan where instruction tends to be teacher-centered and where a few student-to-student and student-to-instructor interactions happen during classes. The data also show that Zhi-Kai did not understand the Western academic culture more emphasizes learning processes rather than learning outcomes. This is because Taiwan academic culture is inclined to be examination-centered which focuses on learning outcomes. These differences of academic culture between Taiwan and U.S. are required members of the Western academic culture to explicitly inform international students. It also needs time for them to practice and adjust to these Western academic cultural aspects. Institutions and academic departments could

proffer workshops to address Western academic cultural aspects that international students may not know or have difficulty in accommodating to. Moreover, professors of international students could be aware of this issue and provide needed support for their international students.

9.2.4 The relationships with local and international students

The Chinese-speaking international doctoral students, especially for Zhi-Kai and Tian-You, in this study also confronted the difficulty in establishing and maintaining relationships with local and international students from other than Chinese-speaking countries. Academic departments, instructors, and professors could form a learning community where regular formal and informal meetings are held for local and international doctoral students to mutually share academic information, discuss research, and create opportunities to conduct collaborative research. In some meetings, departments, instructors, or professors could invite speakers to give talks which address both local and international doctoral students' academic concerns. In addition, such a learning community would be more effective when instructors or professors sometimes participate in so that they could understand what academic learning needs the students have.

9.3 Limitations of the Study and Recommendations for Future Research

This present study merely recruited three Chinese-speaking Taiwanese international doctoral students from three different academic disciplines. The research findings, thus, could not be generalized to all Chinese-speaking and Asian international doctoral

students in varied academic disciplines. Further research could recruit more international doctoral students from different Asian countries and academic programs. In addition, in this current study, the participants were all males. Future studies could also recruit female international doctoral students who are single and who have family to examine whether there are similarities and differences of academic socialization patterns between male and female international doctoral students and between . Moreover, intended research could recruit international doctoral students who study in different years to explore whether students in different doctoral years would confront distinct academic challenges and how they tackle these difficulties they encounter. Furthermore, this current study solely investigated international doctoral students' perspectives but not their professors' and advisor(s)'. Prospective studies could include faculty members' perceptions of their international doctoral students' academic acculturation in order to provide a more holistic picture of this research issue. Additionally, future research could investigate how professors' nationality and gender might influence international doctoral students' academic socialization.

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Appendix A: Refer to Supplemental File