A Formative Evaluation of a Collaborative Problem Solving Instructional Method for a
Client-Based Globally-Focused Undergraduate Program

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This dissertation titled

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Abstract

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A Formative Evaluation of a Collaborative Problem Solving Instructional Method for a Client-Based Globally-Focused Undergraduate Program

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American undergraduates completing their degrees and entering the job market are expected to have twenty-first Century skills to be able to solve problems, work collaboratively, think globally, and to use new technology in support of these skills. Nationwide polling suggests that most graduates are entering the workforce lacking the skills that employers desire. Problem-based learning arose from medical education but has been adapted to fit in other disciplines where its outcome is the development of the twenty-first Century skills. Nelson’s (1999) Collaborative Problem Solving instructional model was implemented in a client-based internationally-focused undergraduate problem solving program at a large, Midwestern university. The model was implemented once during the Fall Semester and a second time, with a revised version, during the Spring Semester of the 2013-2014 academic year. Data were collected throughout both semesters to evaluate the model’s effectiveness, efficiency, and appeal through observations, interviewing, an evaluation questionnaire, and document analysis in the form of question prompted student journaling. Findings reveal changes for this context that include methods to help a facilitator model collaborative and problem-solving behavior and to give the students greater experience with collaboration. Specific
recommendations for improvements are offered for instructional activities and participant roles. A separate focus is dedicated to the use and implementation of technology to support the CPS model and the development of twenty-first Century skills. Recommendations for the use of technology include discussions of potential uses for discussion boards, a learning management system, an online scheduling client, and a mobile group chat application. A practitioner may use the resulting recommendations for changes to the model in conjunction with the original publication when employing a collaborative problem-solving model in a higher education classroom.
Dedication

This dissertation is dedicated to my family who have helped support me both emotionally and financially through this process. Thank you for everything.
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I want to first and foremost thank my parents for their support throughout the past year. Thanks for letting me stay at your house and eat all of your food. Thank you for all your help and understanding. There is no way I would have been able to get this far without the two of you doing all of the things I didn’t have time for.

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Chapter 1: Background

In the United States, receiving an education at an institution of higher learning can lead to increased economic opportunities for a graduate, who, on average, will earn nearly $30,000 more annually than an individual with only high school diploma (Crellin, Kelly & Prince, 2012). Education is not beneficial to the individual, having an educated populace can positively impact society overall (Castells, 1993; Baum, Ma, & Payea, 2013). Castells (1993) identifies higher education as having four primary impacts on economic growth: 1) creating a highly skilled work force, 2) providing networking opportunities that help deserving individuals excel in their careers and make changes, 3) offering a space to disseminate common ideology among educated citizens, and 4) serving as research incubators. Researchers have shown that higher education leads to healthier individuals who tend to be more involved parents and citizens (Baum, et al., 2013).

President Barack Obama made increased access to higher education a primary goal for American citizens and has made strides to provide more funding for students (Crellin, et al., 2012). With the growth of tuition costs in the United States having nearly doubled the growth of the median household income since 1978, President Obama has placed greater emphasis on return on investment (ROI), not just cost (Schumpeter, 2010; Crellin, et al., 2012). In 2013, the President introduced a method to reward universities that provide students with the most return on investment (Chapter 3: Postsecondary education, 2012; Fact sheet on, 2013). The goal of this new ranking metric is that, in
response to rising tuition, it will become increasingly important for universities to provide evidence that the price of their education will be worth the cost of matriculation.

With the increased competition among universities that these reforms look to create, post-graduate earnings will factor into universities’ ROI ranking. This may mean that universities will have to examine and critically evaluate their instructional strategies. A May 28, 2013, Gallup poll revealed the poor perception university graduates have toward their higher education and the quality of skills they developed in their classrooms. The skills that the poll focuses on are termed “21st century skills” (Gallup poll, 2013, p. 1) and the majority of interviewees report having not learned the skills they need for post-graduation employment. The 21st Century skills include critical thinking, interpersonal skills, self-directed learning, and creative problem solving through authentic learning experiences. These skills are considered significant in their impact on job performance and post-college success for graduates. These same skills are identified by the same name in problem-based learning (PBL) literature (Hmelo-Silver, 2004; Nelson, 1999; Norman & Schmidt, 1992). PBL has gained popularity in education because of its ability to teach learners the 21st Century skills they will use beyond the classroom. The philosophy behind the use and effectiveness of problem-based learning is that instruction generally has longer-lasting results when it occurs in context and when learners actively apply their knowledge to create unique problem solutions (Norman & Schmidt, 1992). Bloom’s revised taxonomy of educational objectives lists creation as the pinnacle of student performance (Bloom, Anderson, & Krathwohl, 2001). At the moment, however, problem based learning and instructional methods like PBL are not dominating education, as
evidenced by the Gallup poll results. This suggests that universities can continue to make strides in providing students the tools to excel in post-graduation employment.

As President Obama strives to make universities more affordable and compete with one another to earn the business of students, graduates are starting to compete with people from around the world for the same jobs. Globalization is no longer strictly an economic term; it “encompasses not only economic, political, and technological forces, but also social-cultural and environmental aspects” (Martens, Akin, Mohsin, 2010, p. 1). Students who graduate from American universities are now expected to compete for jobs with an increasingly global focus (National Science Foundation, 2010). Global education has become a greater focus in American universities throughout the nation as a way to make their graduates more globally competitive (Miller, 2014). With globalization, technology has made it easier for education to become more international, connecting people across distances, allowing them to access global databases, and share resources more easily than ever before (Collins & Halverson, 2009; Olusola & Alaba, 2011). As higher education continues to adapt to consumers’ needs and the changing environment surrounding it, better education and higher ROI may become greater considerations for universities in the future.

**Statement of the Problem**

Too many American university graduates fail to acquire the 21st century skills that employers rank most highly in terms of importance to individual and company success (Gallup poll, 2013; *Critical skills survey*, 2010). Among non-academic publications, the list of 21st century skills varies but most often includes critical thinking, creativity,
collaboration, communication, problem solving skills, proficiency in technology use, global awareness, and self-directed learning (Gallup poll, 2013; The NCTE definition, 2013). These skills have become more of a focus in American higher education institutions because of their applicability in the workforce. But the Gallup poll shows that results have been minimal – with younger graduates reporting more experience with technology; yet, still lacking skills in problem solving and technology-based collaboration. Furthermore, with the world’s increasing interconnectedness and globalization changing the way graduates compete in the world, future American graduates will require a more globalized education (National Science Foundation, 2010; Miller, 2014; Duderstadt, 2012). As tuition rates continue to climb and prospective students become more conscious about the ROI from a university education, these institutions will have to become increasingly competitive with one another, offering more value for the money.

Finally, all instructional models need to be adapted to fit their context (Reigeluth & Frick, 1999). The Collaborative Problem Solving (CPS) model is a PBL approach. But it is a 14-year-old model that does not seek to address the technological proficiency and global awareness goals of 21st century skills. Research suggests that while the CPS model has influenced other instructional models, none of those published has been adapted to include both skills in technology and a global focus (Moallem, 2003; Jermann, 2004; Snyder, 2009). Such a model that seeks to specifically address all of the 21st century skills would need to be subjected to evaluation to be best adapted to this context.
Purpose of Study

The purpose of this study was to conduct a formative evaluation of Nelson’s (1999) Collaborative Problem Solving (CPS) Model in the context of two semester-long courses at a large Midwestern university offered within a client-based internationally focused program. The program is a problem-based certificate-granting elective for undergraduate students who conduct research for and present problem solutions to real companies or organizations with a global focus. Through two instances of the instructional method (the first with Nelson’s (1999) CPS model and the second one evaluating a redesigned model), the outcome of this study is a series of research-supported recommendations for implementing a revised context-specific version of this model. Additional research-supported recommendations are given for the use of technology to support the effectiveness of the revised model. To better tailor this instructional method to meet all 21st century skills, specific recommendations for the inclusion of technology and technology tools are outcomes of this study. The primary methodology used to evaluate the model, revise it, and make final recommendations is known as formative research. Formative research in instructional design is a research methodology undertaken to evaluate and improve an existing instructional design theory or method and redesign or adapt it to a new context it based on learner feedback, observations, and evaluations (Reigeluth & Frick, 1999).

The two primary questions to address through formative research are what the strengths and weaknesses of the model are and how it can be improved (Reigeluth & Frick, 1999). However, an important consideration of formative research can be
examining the use and adaptation of a particular model for a specific context. In the context of a large Midwestern university’s internationally-focused problem solving program and with an interest in adapting the CPS model to meet the 21st century skills standards, a specific research questions was needed to guide the recommendations made for the role of technology. Based on these recommendations and circumstances, the following research questions were used to guide the design of this study and the collection and analysis of data:

1. In the context of a client-based internationally focused undergraduate problem solving program’s classes at a large Midwestern university containing a global leadership program, what are the strengths and weaknesses of the Collaborative Problem Solving Model?

2. What changes should be made to the model to make it better fit this context and do these improvements impact the integrity of the model?

3. What role does technology play in the design of the CPS model in this context?

Formative research allows a researcher to capture the experience of the participants and adapt an instructional theory to meet their needs and desires. Formative research is similar to phenomenological and grounded theory designs in their data collection and analysis methods in addition to their eventual outcomes (Patton, 2002; LeCompte & Schensul, 1999). The primary difference being that while a researcher enters the field and documents participants’ experiences, the purpose of data collection and end results in formative research are much more specific. Whereas, in grounded theory, a researcher enters the field and documents what he or she sees happening to form
a theory, in formative research, the data are used to influence the redesign of an instructional method. In phenomenology a researcher attempts to document and understand the lived experiences of participants, yet in formative research, the researcher uses these documented experiences to influence the development of the instructional method. Although the second part of this research design proposes to evaluate and change an existing theory, a similar process of evaluation exists for developing a new instructional theory. That process is predominately, but not entirely, qualitative. Dick, Carey and Carey (2005) note that the design of formative research consists of a wide variety of data types a researcher will collect. These may include pretests, posttests, learner feedback on instruments and materials, attitude questionnaires, observations, and interviews. The research design and methodology are explored further in the third chapter of this dissertation.

**Significance**

Because the world constantly changes, the education that learners’ access and the manner in which they do so remains in a state of flux. This requires constant evaluation of learners’ needs through a concerted improvement and refinement of instruction (Merrill, Barclay, & van Schaak, 2008). Specifically, when discussing American higher education, which has seen tuition rise at five times the rate of inflation over the past 40 years, improved instructional strategies and a higher return on investment for students will need to become a higher priority (“Higher education: Not,” 2012). This need is emphasized by current President Barack Obama’s reformed ranking system for higher
education institutions examining how much return on investment universities offer graduates.

The benefits of problem-based instruction for 21st Century skills development are well documented (Mitchell, Canavan, & Smith, 2010; Lyon & Teutschbein, 2001; Inel & Balin, 2010; Martenson, Eriksson, & Ingelman-Sundberg, 1985). Although, some researchers have argued against the benefits of PBL and other minimal guidance instructional methods (Kirschner, Sweller, & Clark, 2006) As such, an adapted instructional model that strives to impart all of the aforementioned skills can have a much better chance of teaching all the skills that employers look for.

Not only is it necessary to evaluate instruction in this context, adapting and improving an existing instructional model for a specific context through usability and field tests is one of the primary aims of instructional design (Reigeluth & Frick, 1999). “But none of the . . . theories . . . has yet been developed to a state of perfection; at the very least, they can all benefit from more detailed guidance for applying their methods to diverse situations” (p. 633). This study is significant because it represents a proposal that seeks to adapt an instructional methodology for a specific site, which is facing the need to adapt to compete for student attainment post-graduation. Furthermore, because research indicates that Nelson’s Collaborative Problem Solving methodology has been subjected to formative research for its applicability with computer-based instruction and not necessarily face-to-face instruction by other researchers, this study represents a unique undertaking on evaluating a model that can be generalizable to any learning situation,
regardless of what technology learners have access to (Bernard & de Rubalcava, 2000; Moallem, 2003; Snyder, 2009; Guan & Mikolaj, 2002).

Universities may have to begin to compete for student enrollees by offering competitive post-graduation prospects and a better ROI as part of the new university ranking system. Related specifically to the business-like environment in which the students participated in this study, Eisenberg (2013), et al. argue that “For business schools’ career prospects, the implication is that a company recruiter would realize that including a well-designed and taught CCM [cross-cultural management] course in the curriculum could increase the ability of graduates to cope better . . .” (p. 168). A resulting model specific to this context would apply problem-based methodology in a globalized academic environment and address more of the 21st Century skills because of it. A problem-based instructional model adapted to fit to its context that attempts to give students the particular skills and experiences that research indicates they need for success pointedly addresses the problems higher education faces that have been laid out in this first chapter.

Definitions of Key Terms

Collaborative learning. Collaborative learning has been used in so many different situations with so many different basic definitions that it can be difficult to adequately define the term (Dillenbourg, 1999). In general, collaborative learning refers to learning that occurs when a group of individuals (2 or more) work together. The philosophical underpinnings of collaborative learning come from a social constructive perspective meaning that learners together shape their knowledge.
**Collaborative Problem Solving methodology (CPS).** Designed by Laurie Miller Nelson (1999), the CPS method is a nine-step, iterative instructional model that is designed to allow learners to collaboratively solve problems. In addition to instructional steps (or activities), the model lists a set of roles (methods) that learners and instructors must use both individually and collaboratively.

**Constructivism.** Constructivism is a learning theory, which states that individuals learn by building on their own knowledge through the construction of new knowledge, and the creation of meaning based on their experiences (von Glasersfeld, 1995). Von Glasersfeld states two defining principles of constructivism: Knowledge is an active process and “the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality” (1989, p. 114).

**Facilitator.** Used interchangeably with instructor throughout this dissertation to refer to the course instructor, as he or she is named in Nelson’s (1999) CPS model. In PBL methodology, the instructor is labeled a facilitator because of his or her shifted role away from a dispenser of information (Hmelo-Silver, 2004).

**Faculty.** The Higher Education Research Institute (2009) defines a faculty member as “any full-time employee of an accredited four-year college or university who spends at least part of his or her time teaching undergraduates” (p. 1).

**Formative research.** Formative research is “a kind of developmental research or action research that is intended to improve design theory for designing instructional practices of processes” (Reigeluth & Frick, 1999, p. 633). An instructional designer uses
formative research to evaluate instruction or an instructional model and to make it both more effective and efficient (Dick, et al., 2005).

**Higher education.** Higher education, separate from tertiary education, refers to formal learning at a college or a university following the completion of secondary schooling. It does not refer to vocational schooling or training following the completion of secondary education.

**Instruction.** Smith and Ragan (1999) define instruction as “the intentional facilitation of learning toward identified learning goals” (p. 332). Dick, Carey, and Carey (2005) define instruction as “a set of events or activities presented in a structured or planned way, through one or more media, with the goal of having learners achieve prespecified behaviors” (p. 365).

**Instructional design.** Instructional design (ID) is a discipline that involves the creation or refinement of instructional theories and models that best fit a particular context and scenario. Instructional design is the set of instructional methods that serve as the connection between learning theories and instructional practice (Tennyson, 2010).

**Metacognition.** The deliberate act of thinking about how one learns, acknowledging existing knowledge and gaps in knowledge, and learning to plan, control, and observe learning gains (Siegel, 2011).

**Phenomenology.** Phenomenology is a research methodology, which allows the researcher to describe participants’ lived experiences of a given phenomenon (Creswell, 2013). Through qualitative data collection, the researcher attempts to describe the essence of the experience.
**Problem-based learning.** Problem-based learning (PBL) is a pedagogical approach that was developed in the 1950s in medical education but was fully elaborated on and explored at The McMaster University Faculty of Health Sciences 1970s (Hung, Jonassen, & Liu, 2007). As an instructional methodology, it “is focused, experiential learning organized around the investigation, explanation, and resolution of meaningful problems” (Hmelo-Silver, 2004, p. 236).

**Project-based learning.** Project-based learning is similar to problem-based learning in that it presents learners with a real-world problem they have to research and find a solution to. Unlike problem-based learning, project-based learning has defined outcomes and tasks for learners to undertake (English & Kitsantas, 2013)

**Tertiary education.** Tertiary education, separate from but inclusive of higher education, refers to any formal learning that occurs following the completion of secondary schooling. It may refer to vocational schooling, training, or college and university education following secondary education.

**Traditional instruction.** Traditional instruction refers to teaching that is predominately lecture based. In lecture-based classroom environments; there are seldom collaborative activities. Traditional education emphasizes memorization and often focuses more on an instructor imparting knowledge rather than students discovering new information (Boud & Feletti, 1997).
Chapter 2: Literature Review

Instructional Technology

While technology has long had a place in education, research in the field has not had as extensive a history. It began life as audiovisual communications and in the 1960s started to shift to what it is now known as educational technology (Robinson, Molenda, & Rezabek, 2008). It is a term converted from B.F. Skinner’s original term, “technology of teaching” (p. 21). It was at this time that researchers in the field began exploring the use of teaching machines and programmed instruction. Both of these ideas that are attributed to Skinner resemble modern educational technology practices, namely computer-based learning/instruction and its design. The definition of the field has changed many times yet today it remains familiar due to its similarity to the original description. The definition of the field is now as follows: “Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources” (Januszewski & Molenda, 2008, p. 1).

As the field grew, instructors started to realize that too much emphasis is being placed on the technology (Davis, 2011). Yet, they continue to view technology as a tool to better engage students and provide enhanced access with multiple methods of instruction for students with disabilities. “Some pointed out that if anything the new technology drew attention to ineffective teaching and that it might inspire weaker teachers to improve their practice” (Davis, 2011, p. 2). Yet, so-called conventional instruction (lecture-based instruction, minimal interaction, the accompaniment of, perhaps, a PowerPoint presentation or an overhead projection) still thrives in higher
education. Some argue that this type of instruction has been successful for years and if it still works then it does not need to change (Davis, 2011). But educators and learning theorists have started to reevaluate their approaches to instruction. Meanwhile, instructional theories have moved from evaluation being the highest level of achievement to a student’s ability to create using his or her existing knowledge as the pinnacle of learning (Bloom, Anderson, & Krathwohl, 2001). Bloom’s Revised Taxonomy transformed the ideal of quality education. That ideal is no longer evaluating and synthesizing; the ideal has become the application of knowledge for creation. Using technology in a classroom does not necessarily guarantee that students will begin learning to apply their knowledge but, when used in a well-thought-out manner, the technology can enhance a student’s ability to apply knowledge and create a product. While students tend to prefer more technology in a classroom they, like their instructors, understand that technology should not be the focus of the instruction (D'Angelo & Wooley, 2007).

Technology is constantly changing the ways in which education is delivered and how classrooms are structured. The changes are driven by the ever-evolving technologies. “Now we are going through another revolution on the same scale as the Industrial Revolution. . . . [It] is fueled by personal computers, videogames, the Internet, and cell phones” (Collins & Halverson, 2009, p. 4). New ways of experiencing the world such as internet-driven just-in-time learning, pushed out information, online interactions and communications, and even role-playing games are changing the way people think, which should be affecting the presentation of education. More than ever before, emphasis is now being placed on students being able to apply their knowledge, solve problems,
locate facts rather than memorize them, and understand concepts (Collins & Halverson, 2009; Devaney, 2008; Bloom, Anderson, & Krathwohl, 2001). Students and learners need to be able to think critically to accomplish these tasks as critical thinking skills translate into high order workplace skills while students learn to solve problems (Hung, Jonassen, & Liu, 2007).

The technology in the classroom has made learners more interconnected than ever before (Robinson, Molenda, & Rezabek, 2008). Because of the technology, students can now access education in new and different ways, allowing instruction to work for any type of learner. It can now provide audiovisual, visual, auditory, interactive, kinesthetic, and multimedia education that improves constantly and was never possible with such ease and access previously. Concepts have evolved from their humble beginnings to designs more capable of delivery. Although there are problems inherent in an added reliance on technology such as unequal access, cost, and learning to manage the tools, the benefits far outweigh the issues (Collins & Halverson, 2009). A newer endeavor, mobile learning, continues to expand and grow. As more research is carried out, more is learned about what mobile tools offer a learning environment, and how an instructor can harness these to stimulate learning.

The role of instructional technology. PBL is an inherently ill-structured instructional process that requires learners to actively apply their knowledge base in creative ways to identify nebulous solutions to problems that have a basis in the real world (Barrows, 1986; Boud & Feletti, 1997). The participants in PBL are expected to direct their own learning by defining individual learning needs and existing and missing
knowledge with guidance and facilitation from instructor, not direct instruction (Savery & Duffy, 1995; Boud & Feletti, 1997). Finally, as instructional methods, CPS and PBL are collaborative in nature (Nelson, 1999). Instructional technology can support PBL by creating environments where learners have the tools they need to carry out complex problem solutions, find resources, access just-in-time instruction and communicate and collaborate with people from the devices in their hands. “ICT contributes in a major way to support PBL model by connecting to communities, network and resources of students’ own interest” (Zhou, Purushothaman, & Rongbutsri, p. 53). Research shows that learners enjoy the use of technology in a classroom and may be inherently more motivated initially by the novelty of doing something different and more attuned to their interests (Chen, 2003). Of course, a novelty wears off after only a short while and the implementation of technology into a classroom must be useful enough to not only catch but maintain the learners’ attention. More important is that the technology must not be needlessly integrated for the sake of using technology. It can be inappropriate to integrate technology if work can be done simpler and just as effectively without it. A facilitator can use technology to give learners the tools they need to collaborate and help others identify research and gaps in knowledge. When a facilitator implements it appropriately and effectively, technology can help the learners complete the types of cognitive and metacognitive challenges they face in this environment.

**Technology for online collaboration.** PBL requires learners to collaborate on all fronts, including brainstorming, project design, learning, and writing. It requires them to become active learners and seek out unfamiliar content in varying formats at any place
and time they may have to. Jones and Dirckinck-Holdfeld (2009) describe a list of the ways that technology can help learners with this disruption to the traditional instructor-led teaching models. The items in the authors’ lists demonstrate how the technology can apply to a nontraditional educational model like PBL. They list time, place, content, literacy, and public/private boundaries as ways technology can change instruction.

Regarding time and place, the authors argue that information can now be delivered asynchronously and anywhere, particularly as mobile devices become more prevalent among learners. Technology allows for changes in content because facilitators and learners can now use blogs, wikis, discussion boards, and SMS to deliver content to and collaborate with one another. Technology has allowed this content to shift from written text to images and instructional videos, creating new expectations for learner literacy.

Finally, with teamwork and collaboration occurring through an LMS or similar environment, these interactions can be preserved for a facilitator to use as content for assessment.

For online collaborative writing, researchers have used wikis to promote the development of autonomous learners and teach collaborative writing skills – in language learners in these examples (Kessler, 2009; Kessler & Bikowski, 2010). A wiki is an open website which gives all member users the ability and permissions to write on it and edit its content. Using a wiki for collaborative writing can provide significant benefits for learners and the non-native English speakers who join the certificate program projects. Collaborative writing can allow users to collectively create a piece of writing that is of higher quality because all users have the opportunity to read, discuss the content, and edit
it (Kessler, 2009). Specifically, collaboration “contributes to an increased complexity in writing and willingness to utilize peer feedback” (p. 80). In this sense, the use of a wiki or another tool where all users can edit, can not only allow them the opportunity to create higher quality writing but provide them the space for metacognition and reflection on their own writing. By sharing knowledge and providing feedback to one another, participating students can learn from all aspects of writing on a wiki or online collaborative document.

In addition to allowing learners the space to create writing of a higher quality, an online collaborative document like a wiki provides a safer space where students may be more willing to write and collaborate without fear that the instructor is standing over their shoulders. Kessler (2009) demonstrates that participants are willing to edit and correct one another without the instructor’s intervention. However, Kessler and Bikowski (2010) point out that without any sort of instructor intervention, learners may do their work but they may be “inclined to engage in tasks that require less critical thinking. Students tended to engage primarily in the language acts of adding new information, deleting information and clarification/elaboration of information” (p. 52). In a similarly collaborative online environment Buss (2012) found that the integration of social tools for collaboration in a PBL approach to instruction requires the facilitator to be involved in leading discussions or posing questions to the learners to move their dialog forward. Zhou, et al. (2013) identified similar findings with the need to support learners’ independent collaboration with facilitator guidance.
However, while some learners can get distracted in an online collaborative environment, Kessler and Bikowski (2010) note that students have been shown to use the space to build working relationships with one another and they valued this experience in addition to having the opportunity to take ownership of their learning. Similarly, in Nelson’s (1999) Collaborative Problem Solving model, forming relationships, learning to collaborate, and taking ownership of learning takes precedence over the quality of the final product. Other online collaborative writing tools are available that function like wikis and, as previously mentioned, the technology should not get in the way of student learning and the tool they use should be best fit to the environment, the learners’ needs and comfort levels.

Users can participate in a social network for collaboration that is more familiar and accessible to the learners. Using a social environment, an instructor can create a group and write open ended questions that the learners can respond to and start a dialogue (Yunus, Salehi, & Chenzi, 2012). The authors recommend using Facebook™ for group brainstorming sessions because it provides a space that promotes reading and writing in addition to giving them the opportunity to link to or embed video, files, and photos. The main advantage to using it is that it is a familiar environment for most learners—a similarly familiar environment could offer the same benefit. Creating a social networking space for education can help spur creativity because learners can immediately see what their classmates post and have access to news feeds and videos all on the same web page. Moving part of the education to a social network can help build motivation and confidence within the learners in addition to providing a single space with all of the
information and instructions the learners will need (Yunus, et al., 2012). However, a social network can be distracting and the typically social, non-academic environment promotes the use of non-academic writing, shorthand, and jargon. An instructor should be aware of the fact that the Internet is full of incorrect and contested information to which a learner can easily link and disseminate among his or her peers much more quickly than they might otherwise. Applied in the CPS model, using suspect information posted online may provide a good exercise to show learners how to evaluate sources for credibility, which is an important critical processing skill that the model seeks to instill in students.

*Mobile tools in the higher education environment.* Mobile learning is generally defined for the tools or technologies involved or based on the effects they have on learners – i.e. increasing mobility and learning access (Traxler, 2007). In defining mobile learning, Traxler (2007) extracts terms from literature used to define it in comparison to that of more traditional educational technology education. For mobile learning “we find words such as ‘personal,’ ‘spontaneous,’ ‘opportunistic,’ ‘informal,’ ‘pervasive,’ ‘situated,’ ‘private,’ ‘context-aware,’ ‘bite-sized,’ and ‘portable.’ This is contrasted with words form the literature of conventional ‘tethered’ e-Learning such as ‘structured,’ ‘media-rich,’ ‘broadband,’ ‘interactive,’ ‘intelligent,’ and ‘usable’” (p. 4). Mobile tools are being used in collaborative environments, medical education, teacher training, on-site work, distance education, and corporate training (Traxler, 2007). Quite simply, mobile learning is “learning that happens anywhere, anytime” (Franklin, 2011, p. 261). It is the use of mobile tools to learn at a time and place suitable for the individual learner. The
tools used for mobile learning can be e-readers, mobile phones, smart phones (including iPhones, Android-operated phones, and Windows phones), laptops, tablets, etc.

Mobile learning is being approached as a legitimate educational strategy for a number of reasons, not the least of which is that increasingly sophisticated devices are becoming nearly ubiquitous. “Mobile learning [is] uniquely placed to support learning that is personalised, authentic, and situated” (Traxler, 2007, p. 7). One carries his or her mobile device at all times, allowing instruction to occur at any time (Franklin, 2011). The mobile phone offers the possibility to deliver personalized information and education directly to students wherever they are, whenever they want it (Traxler, 2007). An instructor can deliver a vocabulary word of the day, a Microsoft Word or PowerPoint file, a syllabus, an announcement, a question prompt, an audio or video file, or other learning materials directly to a student’s device, which they can then carry around with them anywhere in the world. With messaging, personalized, short responses can be delivered to a specific learner with little effort or time on the part of the sender (Franklin, 2011). This makes learning more individualized, giving the learner direct, one-on-one interaction and/or instruction from the instructor while allowing them more freedom to choose “who, when, where and why to communicate” (Franklin, 2011, p. 262.). Mobile learning can be context-based, providing education when learners are at a given location at a specific time, enhancing that experience and creating a memorable learning situation. In this way, mobile learning supports independent and self-direct learning. With the structure of the devices the way it is, messages are stored on them, are easy to navigate to, and can be
accessed at any time, making it easier for a learner to communicate whenever he or she
wants to (Franklin, 2011).

Mobile tools can allow learners to connect to an LMS at any time to access
information or to connect with their teammates. PBL requires the facilitators and learners
to communicate and collaborate with one another in an unscheduled time frame.
Arreymbi and Draganova (2010) found that learners support the use of mobile devices to
communicate directly with their teammates, and receive communications from their
instructors.

The convenience of using a mobile device or smart phone for communication and
collaboration can make it an ideal feature in a collaborative environment. And learners
find it enjoyable (Echeverria, et al., 2011). Other research indicates that mobile
communication directly supports collaboration among users. “The level of collaboration
was enhanced by the use of the tablet among the project members and others within the
class . . . teaching and collaboration could easily be noted as roles that were the outcome
of having tablets in the classroom” (Franklin, Sun, Yinger, Anderson, & Geist, 2013, pp.
252-253).

Mendoza and Alejandro (2014) found that learners used their mobile phones and
the communication application (app) LINE more frequently than they did LMS
communication. The learners in this case used the app to communicate more with the
facilitator than those who were communicating via the LMS. Furthermore, the group
using the LINE app created a final research report that was considered to be a better
synthesis of all team members’ ideas than the reports created by groups communicating via the LMS.

**Learning management systems.** A learning management system (LMS) is an online piece of software that schools or instructors use as a hub for administrating or delivering education. Sometimes referred to as a course management system (CMS), this software may be used in addition to in-class instruction or it may be used in online education as the main page where learners go to submit work, interact with classmates, and find access to all materials and information. An LMS may be used for all of these purposes in any classroom, not just an online course. Popular examples are Blackboard, Moodle, and Desire2Learn. The LMS is important for the learning context of the proposed research study because it can house announcements and documents, be accessible through a mobile device, link to or embed most of the technologies mentioned in the above sections. The research discussed herein details how an LMS can be used in PBL courses and how it can affect learner autonomy.

In a problem-based environment, a facilitator can take advantage of the many features built into the LMS to promote collaboration and help guide learners. It can assist a facilitator with his or her learner assessments. In an instructor-led PBL course, “the use of a LMS system to . . . serve as a repository of learning need report uploads, would allow a designated case manager to monitor the multiple student groups and the assigned tutors for a specific case. . .” (Clark, Mulligan, Kataoka, & Baba, 2011, pp. 226-227). The built-in wiki feature of most learning management systems and how it and other collaborative online systems with word-processing-like features can help create a
collaborative environment has been covered in a separate sub-section. In a PBL classroom, Tosun and Taskesenligil (2011) found that learners were less shy about asking questions on a discussion board in the LMS than they were in face-to-face discussions. As part of their study, the researchers used the LMS to create and house an open question forum. The students were encouraged to submit questions to the forum and actively respond to one another. They were told that they could use the environment to ask questions about any topic – not strictly academic or related to the course. After the completion of the course, the open forum became a frequently asked questions forum and the facilitators used it in successive years with PBL courses.

Yu, Sun, and Chang (2010) conducted an evaluation of instructor and student use and views toward a course management system. Most participants in this study found that an LMS is best used for social activities, albeit in an academic manner. Discussion boards, communication, group work, and commenting all ranked highly in terms of usage volume next to items like viewing grades and uploading assignments for usage. Instructional technology and an LMS require adequate instructor interaction, guidance, and scaffolding (Buus, 2012; Zhou, et al., 2013). Proper instructor prompting and scaffolding can allow the facilitator to use an LMS for discussion and collaboration, as the examples and research describe. As the following section details, an LMS can be used for reflection and discussion, which are integral parts of PBL and the CPS model (Yeo, 2008; Nelson, 1999).

LMS for reflection and discussion. In a 2012 study by Krishnaiyer, Mushahar, and Ahmad, blogs were used for students to reflect on their learning processes. The
facilitator prompted the learners with questions to respond to that were directed toward specific learning processes within the class. Student reaction to the reflective blogging process was positive with most learners stating that they enjoyed it and felt comfortable using the medium for reflection. The majority of participants (90%) reported that participating in reflections through the blog “made the course more interesting” (p. 945). For self-expression and reflection, the learners in this study reported that the activity helped them express their feelings, and even share ideas that they may have been unable or unwilling to say during the in-class sessions. The blogging allowed the participants to reflect on what they learn through metacognition (80% agree or strongly agree) and by reading friends/classmates blog entries (70%). The study concludes by noting how the quality of learners’ blog entries became more robust and indicative of reflective techniques with more time and practice.

In a case-based problem solving class for students studying to be instructional designers consultants, participant learners responded to question prompts that would guide them through the instructional process. “. . . they also served to prompt [the students] to elaborate their thinking, articulate their thoughts, make justifications for their decisions and solutions, and monitor and evaluate their reasoning and problem solving process” (Du, Yu, & Alinzock, 2011, p. 33). Evaluated on their decision-making and progression through the ID process, the learners who were given discussion and question prompts performed better than those students who were not. In a study examining question prompts and their abilities to elicit responses in correspondence with Bloom’s revised taxonomy, Ertmer, Sadaf, and Ertmer (2011) found that divergent question
prompts led to responses exhibiting higher levels of thinking. Divergent questions are ones that can have a variability of unique answers. In an online environment, the researchers point out that the learners may be able to avoid confusion that may come along with processing higher-level responses in a face-to-face environment with little time to collect and arrange their thoughts in order to present them in a cogent and comprehensive manner.

The research presented in this sub-sections indicates that prompting and facilitator guidance in an online environment like the LMS are key components for learners to get the most collaboration, reflection, and use from the software. Ge, Chen, and Davis (2005) used a problem solving approach for teaching instructional design and found that question prompts in a web-based environment helped guide the learners through the instruction process. The prompts that required the learners to write a response or think about their response helped the students in “elaborating their thinking, and monitoring and evaluating the solution process. One of the examples was that the question prompts helped the participants identify relevant factors and consider alternatives for problem representation” (p. 239). For the participants who had more experience with problem solving, the guidance and prompts served as ways to simply keep the learners on task. By elaborating on their problem solutions and ideas through prompts, the students were pushed to consider alternatives and critique their hypothesized problem solutions. The research from the study indicated that the students who had relevant background knowledge and those who were less skilled in facing complex problems to solve were groups that benefitted the most from the question prompts.
Instructional Design

Instructional design (ID) is a discipline that is often synonymous with instructional/educational technology and involves the creation or refinement of instructional theories and models that best fit a particular context and scenario. The Association for Educational Communications and Technology (AECT) defines instructional design as:

A purposeful activity that results in a combination of strategies, activities and/or resources to facilitate learning. Also, creating blueprints for effective, efficient, and engaging instruction Also, the systematic process of analyzing, designing, developing, implementing, and evaluating instruction; also known as instructional systems design. (Spector, Merrill, van Merrienboer, & Driscoll, 2008, p. 822)

Instructional design is the set of instructional methods that serve as the connection between learning theories and instructional practice (Tennyson, 2010). The world in which students learn constantly changes. This change is not always reflected in the instruction they receive. Students often lack the knowledge to understand how they learn. Quality instruction is important not simply because it helps students learn more effectively; it is necessary to help them learn more efficiently. As the costs of higher education continue to rise and instructors continue to take on multiple responsibilities such as researching, publishing, and advising students, instructional design matters to all parties involved in educational funding. In addition, instructional design is not only applied in academia or education. Instructional designers and the researchers who create instructional models often work in businesses creating learning modules for any situation.
from training new employees, retraining employees, and technological training for new tools being introduced into the workplace.

Although John Dewey initially proposed something like instructional design as a science to link research and practical instruction, the ID field is considered to have started in response to ballooning enrollment from baby boomers in the 1950s and perceived American educational inferiority to the Soviets who launched the Sputnik satellite in 1957 (Morrison, Ross, Kalman, & Kemp, 2011; Tennyson, 2010). At this moment, the U.S. government began investing much more heavily in educational research and curriculum reform. From its academic and government-supported beginnings, the field of instructional design has grown significantly and has branched out from just academics into the business world where design strategies are varied and large teams of designers collaborate to take on problems (Roytek, 2010). In its infancy, “the instructional design field was seen as an attempt to develop a single, ideal instructional theory based in systems theory that would specify teacher characteristics, classification and evaluation procedures, and means to modify the design systems being tested” (Tennyson, 2010, p. 2).

The field has since gone through several changes and there are now countless different methods and models that designers can choose from to employ in a given situation (Hamdani, Garbaghi, & Sharifuddin, 2011). The most used and popular method is an instructional system design (ISD), of which there are over a hundred. Most of these are based on what is commonly known as the ADDIE model. A systems approach to instructional design generally “incorporates the major components common to all models
including analysis, design, development, implementation, and evaluation” (Dick, Carey, & Carey, 2005, p. 3). These major components make up the name of the ADDIE instructional model, which is a linear process in which the designer progresses through each of the five steps one at a time. Despite its popularity, the ADDIE model has been criticized for its inability to adapt to the benefits offered by technology (Hamdani, et al., 2011; Chevalier, 2011). Although it is often referenced and commonly known as a well-accepted instructional model, Morrison, et al. (2011) note that the name ADDIE is simply a term that was given to a general interpretation of ISD based on its five steps. An actual ADDIE model, they state, has never existed. This may be part of the reason there are so many models that adhere to the five steps that comprise ADDIE. Another widely used instructional model is Jerold Kemp’s model, which is cyclical in design because each part of the design process must work together with the other parts and a designer should not think of them as individual steps (Morrison, et al., 2011). A third widely used model is the Systems Approach Model, which focuses on specific outcomes of learning and highlights the importance of the interconnectedness of all parts of the instruction to the desired outcomes (Dick, et al., 2005). The model includes a specific step wherein a designer would revise and retest the designed instruction for appropriateness. This evaluation has spawned a research methodology specifically designed for evaluating and redesigning instructional models known as formative research. Finally, a newer approach to instructional systems design that developed as a reaction to the flaws in current models is the Successive Approximation Model, or SAM (Allen, 2012). The SAM model is a three level, iterative design process. Its design is based on four established criteria for
ideal model selection: A model should support iterative, collaborative, manageable, and efficient and effective processes.

**Formative Research in Instructional Design**

Formative research is the assessment of instructional methods that occur during implementation in order to design or revise them in a final form that most fits the given situation (Scriven, 1967, p. 51). An instructional designer uses formative research to assess instruction or an instructional model in order to make them more effective, efficient, and appealing (Dick, Carey, & Carey, 2005). The evaluation is formative in the sense that it occurs during instruction, or during a trial instruction, in order to better prepare the design for its final form (Scriven, 1967). Cronbach (1963) demonstrates the rationale behind formative research in instructional design: “Evaluation used to improve the course while it is still fluid, contributes more to improvement of education than evaluation used to appraise a product already placed on the market” (p. 236). The general assumption driving the use of formative research is that most, if not all, instructional methods are not perfect and that through testing and re-testing, not only can they be improved but also changes for their implementation for specific contexts can be determined. Scriven (1967) argues that most, if not all, practitioners actively engage in formative research when instructing by constantly seeking to improve instruction, whether or not they recognize it. This methodology is used to design new instructional methods that meet the arising needs of learners, such as the use of new technological tools. Its primary goal in evaluating existing methodologies is to assess them for effectiveness, efficiency, and appeal.
Formative research. Formative research, as it is normally thought of outside of the instructional design field, is developmental and can be strikingly similar to action research (Patton, 2002). Formative research within the instructional design field is foundationally based on not only action research but also on case study methodology (Reigeluth & Frick, 1999). In case study methodology, a case can be anything from a specific occurrence or program or, in this circumstance, an instance of the instructional methodology. Case studies have, in the past, played significant roles in formative research as it occurs outside of instructional design (Patton, 2002; Eisenhardt, 1989). Philosophically, because it shares much of its practical roots with case study methodology, formative research can be viewed through a heuristic lens. It is similar to Design Research, which is “a particular kind of formative research” (Collins, Joseph, & Bielaczyc, p. 16). Design research seeks to evaluate and constantly refine both the instructional practice and the theory that researchers use as a foundation to base their modifications of the instruction on.

Merriam (1998) states that a case study can be particularistic, descriptive, and heuristic. In formative research, the outcome is undetermined, designed through trial and error, and the redesigned methodology is created through an inductive process, very much a heuristic process. Unlike Patton’s (2002) definition of traditional formative research, the resulting methodology in Reigeluth and Frick’s (1999) formative research for instructional design is intended to be generalizable and may be more fitting with Patton’s definition of summative evaluation wherein “what works one place under specified conditions should work elsewhere” (p. 224).
Dick et al. (2005) separately define summative evaluation in instructional design as other researchers collecting data on instruction using a model that has already been subjected to formative research. Viewing it through a heuristic lens would allow one to conclude that only by studying the phenomenon in question (the instance of instructional design, in this case) could a researcher discover its best use and most appropriate implementation.

**What formative research lacks.** Both Reigeluth and Frick (1999) and Dick, et al. (2005) provide researchers a linear, step-by-step outline of conducting formative research. Noting that case study methodology (to which they compare formative research) has been criticized for its imprecision, Reigeluth and Frick (1999) describe three issues in data collection of which researchers are to be made aware: “(a) construct validity, (b) sound data collection and analysis procedures, and (c) attention to generalizability to the theory” (p. 647). Reigeluth and Frick (1999) offer details and suggestions on all three of these issues. However, they generally do not address specific steps a researcher must take when collecting and analyzing data. There are considerations specific to this methodology that are explained and detailed, such as giving learners advanced preparation to critique the design model. Though, predominately, it is simply noted that the data collection phase is qualitative and a researcher should be familiar with most of these methods before endeavoring to apply this methodology.

Similarly, Dick, et al. (2005) provide details, questions to ask participants, and desired outcomes for each of the three steps they list as part of the research process. Because their prescriptions are absent of specific analysis procedures, there is much that
can, and, in fact, should be gleaned from other existing theories on data collection and analysis in order to effectively design a research methodology with formative research.

**Problem-Based Learning**

Pedagogies and methods of delivering instruction continue to adapt to changing technologies and evolving student needs. New instructional strategies can be driven by many variables: Changing needs, learning theories, or, in the case of problem-based learning, dissatisfaction with current practices. Problem-based learning (PBL) is a pedagogical approach that was developed in the 1950s in medical education but was fully elaborated on and explored at The McMaster University Faculty of Health Sciences 1970s (Hung, Jonassen, & Liu, 2007).

As an instructional methodology, it “is focused, experiential learning organized around the investigation, explanation, and resolution of meaningful problems” (Hmelo-Silver, 2004, p. 236). Problem based learning was first designed as a reaction and solution to the clinical performances of the medical students who failed when asked to apply their memorized knowledge in practical situations. Within a short while, the methodology caught on and spread throughout medical schools in the 1980s and 1990s and is now the primary methodology in medical education in many nations around the world. Having been adopted in many places throughout the United States as part of the massive medical education reforms in the 1980s, it has since been called “perhaps the most innovative pedagogical method ever implemented in education” (Hung, et al., 2007, p. 486).
Following the success in the medical field, educators brought this instructional methodology to higher education and K-12 throughout the world in the 1990s in disciplines ranging from business administration to social work to chemistry and science. Interest continues to expand around the globe and researchers expect its use and implementation to grow (Hung, et al., 2007). Hmelo-Silver (2004) notes that PBL is timely and cutting-edge because of the renewed interest being placed on flexibility in thinking and lifelong learning. Furthermore, because problem based learning stresses the importance of transferable learning and applicable skills acquisition, it has become a hot commodity in education. In the post-graduation job environment, employers recognize that they get better results from employees who can easily adapt and work independently when necessary than to be able to have knowledge of memorized factual information (Boud & Feletti, 1997). Too often, traditional education overemphasizes memorization and ignores teaching learners the skills they can apply in the real world.

Problem based learning may not be considered a traditional teaching method but, as Barrows and Tamblyn (1980) point out, solving problems is a part of the human experience. Learners have a need to know and understand the process of solving problems. As an instructional strategy, PBL relies on constructivist theories of learning and asks students to solve problems that are complex and authentic. In order to solve the problems, students will need to use and develop problem-solving skills by implementing their existing base of knowledge (Barrows, 1986). Learners in a PBL environment are not asked to perform rote memorization tasks. They are asked to apply relevant facts and information in an effort to find solutions to authentic problems.
Many researchers who write about problem-based learning identify different goals/considerations/instructional principles of the methodology (Barrows, 1986, Hmelo-Silver, 2004; Hung, et al., 2007; Savery & Duffy, 1995; Boud & Feletti, 1997). Despite the variations, these goals remain rather consistent among PBL researchers. Generally, the goals are as follows:

1. The problem and problem-solving process should be authentic and simulate a real situation (Boud & Feletti, 1997). Solving a problem in the real world requires a multi-disciplinary approach (Hmelo-Silver, 2004). As such, any problem designed for learners should not be simple and should not have a single, correct solution. Inasmuch as the problem should not have a simple solution, it should be ill structured with many variables for which learners must account (Hung, et al., 2007). Authenticity helps learners recall the information when they may need to access it later. “It is suggested that learning new knowledge in the context of problems may foster its retrievability and use when needed for the solution of similar problems” (Norman & Schmidt, 1992, p. 558).

2. Problem based learning seeks to develop analytic, problem-solving skills within the learners. This is implicit in the methodology’s name and was previously mentioned as a desired skill in reaction to the medical students’ poor performances in clinical evaluations. Many methodologists state that learners acquire these skills through collaborative practice, intelligent problem design, instructor questioning, and by the instructor modeling appropriate

3. Problem based learning should support self-directed, student centered, lifelong learning. Self-directed learning comprises lifelong learning, which PBL methodology seeks to develop in learners. When learners are aware of what they know, what they do not know, and what they need to learn to solve a problem they will be able to set and achieve realistic goals (Hmelo-Silver, 2004). Identifying personal learning needs is a key concern here (Boud & Feletti, 1997). The instructor facilitates this by pushing students to delve deeper and constantly seek out new and better knowledge (Hung, et al., 2007). Part of creating self-directed learners stems from the PBL instructor giving control to the learners to find their own solutions to the problems (Savery, & Duffy, 1995). This means that in PBL an instructor becomes more of a facilitator than a dispenser of knowledge (Boud & Feletti, 1997).

4. Problem based learning is often collaborative and should develop collaborative problem solving skills within the learners. Collaboration in PBL is a result of its inherent constructive theoretical underpinnings wherein learning and knowledge are often socially constructed (Savery & Duffy, 1995). Additionally, the collaborative aspect of PBL has been emphasized for the role it plays in the authenticity of the instruction. “Group problem solving is one of the most common and natural situations in which we accomplish he work of society” (Nelson, 1999, p. 244).
5. Finally, most problem based learning research discusses motivation as a main goal. Motivation is important because it leads learners to seek deeper learning and it helps them become more self-directed, which can then lead them to become lifelong learners (Barrows, 1986; Hmelo-Silver, 2004). Instructors can help motivate students to learn by making the problems relevant and personal to the students, and by providing a space where they can explore their learning. “Classroom contexts that reward students for deep understanding, independent thought, and action are also more motivating than may traditional classroom structures that reward comparative performance” (Hmelo-Silver, 2004, p. 241).

**The structure of problem based learning instruction.** Although variation exists within instructional strategies and methodologies of problem based instruction, the general outline is consistent among most researchers. Learners start with the problem, often presented to them by the instructor (Savery & Duffy, 1995; Hung, et al., 2007). The problem may be decided upon by the learners in order to give them greater control over their learning (Nelson, 1999). However, great concern is often needed to ensure that the problem is ill structured, authentic, and complex enough to ensure it meets all of the goals and considerations of PBL (Barrows, 1986). After they receive the problem, learners work in groups to create a common definition of the problem and to determine what they already know and what they can identify about the given situation. Relevant facts that they can point to are elaborated on. By doing this, learners gain the experience of metacognition and learn to identify gaps in their own knowledge. This may be the
beginning of acquiring the self-directed learning skills for many of the learners. Once they do this, learners use their collective knowledge and identified knowledge gaps to generate a preliminary hypothesis – an initial solution to the problem. Once they have created a hypothesized solution, learners identify what more they need to learn to either prove or disprove their hypothesis. Learning goals are distributed among group members and each member sets out to learn his or her part. Eventually the group reconvenes, knowledge is shared and applied, and the members collectively revisit their hypothesis for re-evaluation. Hmelo-Silver (2004) notes how learners progress through the early stages of PBL instruction by showing how they might take notes on a white board under four separate columns: (1) Facts, or what they know or can identify from the problem; (2) Ideas, or their hypotheses; (3) Learning issues, or what they still need to study and learn; (4) Action plan, or how they will solve the problem or how they will obtain information.

**Role of the instructor.** In problem based learning the instructor has a specific role to play in facilitating the learners’ analytical skills, their acquisition of problem solving skills, and guiding learning. The instructor, or facilitator or coach, is not present to dispense knowledge, tell students all the right answers, and answer all their questions (Stinson & Milter, 2006). Instead, the PBL facilitator asks guiding questions not to lead students to a single correct answer (which should not exist anyway) but to ensure that learners are exploring all sides of an issue. An instructor may act as a model in order to demonstrate to learners how to correctly analyze and think critically (Hmelo-Silver, 2004).
Or, in Jonassen’s (1997) ill-structured problem solving model, the instructor models analytical argumentation so that learners will be able to sufficiently defend their proposed solution. This is a strategy, which, he says, is necessary given that learners will often face situations when they will have to offer solutions that are popular among some and unpopular among others and will therefore have to argue for it. Stinson and Milter (2006) argue that the role of the facilitator is to provide the students with access to experts in the field to review their work. Nelson (1999) states that the instructor only directly instructs when he or she perceives a general skill the learners lack and only helps the students access information if they have found it but are somehow blocked from accessing it.

For instance, a PBL facilitator may help arrange a meeting for students with a content expert who might otherwise be inaccessible to them. Jonassen (1997) argues that the facilitator’s role is to provide learners with the authentic resources (primarily documents and interview transcripts from experts) that they will need to find the best solution to the problem. However, most researchers generally agree that part of the learning process is identifying and seeking out needed resources.

**Educational benefits of problem-based learning.** Problem based learning teaches learners the skills that transfer to other disciplines and life experiences (Barrows & Tamblyn, 1980). Students and faculty often enjoy it and it can lead to more deep and critical thinking (Albanese & Mitchell, 1993; Vernon & Blake, 1993; Martenson, Eriksson, & Ingelman-Sundberg, 1985). Problem based learning is widely accepted in medical education as a useful and respected instructional methodology and is gaining
popularity in other disciplines. However, it is not without its critics. Chief among the criticism levied at PBL is that it fails to teach learners the lower level skills, such as the kind of knowledge that students would be required to know for standardized tests. This is problematic because, if it were true, learners who participate in PBL would not pass standardized tests. If this criticism were accurate, then one would expect learners to not succeed in problem solving because it requires them to employ their base of knowledge in order to succeed in higher order thinking – solving complex and ill-structured problems. This, of course, is not the case. Krischner, Sweller, and Clarn (2006) make the argument that PBL and other instructional methods with minimal instructor guidance are insufficient because the learners do not have enough existing knowledge to be able to guide themselves. More researchers are publishing studies highlighting the effectiveness of PBL annually. However, “compared to PBL research conducted within the medical field, empirical studies conducted in non-medical disciplines and K-12 settings are relatively scarce” (Hung, et al., 2007, p. 489). Presented here are four research studies that demonstrate the effectiveness of problem based learning in teaching not simply problem solving skills but in giving learners the tools they need to compete with other learners on standardized evaluation.

A study examining the implementation of a pilot PBL curriculum for electronic engineering majors at an unspecified university in the U.K. compared student attitudes and achievement in a PBL learning environment to a lecture environment (Mitchell, Canavan, & Smith, 2010). In end-of-the-year assessments (exams in the lecture environment), students had higher (though not statistically significantly higher) averages
in the PBL curriculum. Both students and faculty found the PBL classrooms to be enjoyable and generally preferred it to the traditional lecture classes. This study demonstrates how PBL can allow faculty to pay closer attention to curriculum and the development of life-long learners. Finally, as opposed to the final exam in the traditional environment in this study, the final assessment given during the PBL pilot project created zero failing students. This demonstrates that students can excel when asked to complete projects and solve problems that allow them to demonstrate their knowledge in ways that exams would and could not. This study demonstrates that PBL gives students the opportunity for personal evaluation based on their skillset rather than how well they perform in a standardized environment. This not only provides a fair assessment of all learners, it gives each student the space to learn and grow that a test or exam would not.

In a hydrology master’s program at Stockholm University, students experienced a problem-based approach as part of a research study (Lyon & Teutschbein, 2001). There were two groups of students, with each reporting a significantly higher attainment of course learning outcomes following the PBL implementation than they did following traditional instruction. On average, 67% of students believed they met the learning outcomes prior to PBL installation and roughly 93% said that they met the outcomes after the PBL approach. Student performance improved from written exams to the PBL assessment procedures. On average, the researchers state that learners improved in their achievement of learning outcomes by 17% in PBL (Lyon & Teutschbein, 2001).

In a study that compared academic achievement in a traditional lecture course to a PBL course, Inel and Balim (2010) found a significant difference in post-test scores in
favor of students participating in a PBL class. The participants were a group of 41 seventh-graders in Turkey, 20 of whom were assigned to the experiment group for a four-week problem-based learning class on science and technology. In the pre-test, no significant difference in academic aptitude was found between the control and experiment groups. The post-test results demonstrated that students in the experiment group had significantly higher scores than those in the control group. They were, on average, almost nine points higher; in the pre-test, the control group scored roughly one point higher on average. The study and post-test reveal that students participating in the PBL class were able to better construct complex concepts in the field of science and technology.

At the Karolinska Institute in Stockholm, problem based methodology was implemented in two different chemistry classes asking students to collaboratively approach problems, collect information from primary sources, think deeper and more critically, and take ownership of their own learning (Martenson, et al., 1985). The instructional strategy was split among courses and three groups of learners from a control group using traditional teaching methods and three from the experiment group were used to collect data. Following each course, student participants were given a short answer and long essay format written test. Not only did students perform better on the essay portion of the test after participating in PBL, they also showed increased retention of knowledge over those who did not experience this instructional strategy. On average, those participating in the problem-based instruction retained approximately 60% more
information than those who did not from between two to four and half years after taking
the course (Martenson, et al., 1985).

**Problem-based learning in a business environment.** The focus of the
informative research study is the refinement and adaptation of Nelson’s 1999)
Collaborative Problem Solving (CPS) model in a global business/consulting environment.
Specifically it was the use of a client-based project (CBP) model with the CPS model
because of the real-world implications and learning gains this model provides (Lopez &
Lee, 2005). The primary difference between a CBP model and PBL model is that the
problems learners’ work on come from clients, which can be companies, organizations,
or corporations. Both the deliverables and the problems learners face are real so there
may be less negotiation in terms of what the problem is and what a final product should
be. The beneficial outcomes of using the CBP model are similar to those of PBL: An
authentic learning experience; gaining skills in collaboration, critical thinking, and
problem solving; and increasing learner motivation by providing an authentic and
relevant experience. The researchers provide a list of five principles for the creation and
use of client-based projects. These are (a) carefully select the client; (b) vary the length
and scope of projects; (c) plan and prepare ahead of time for problems; (d) set high
expectations; (e) provide formative research throughout the process.

The client-based project model was effectively combined with problem based
learning by Liu and Olson (2011) at their home university. The researchers designed an
instructional model around the combination of the two models and its subsequent
implementation. The learners acted as consultants for a local massage clinic and health
and wellness product manufacturer. The students were tasked with creating a marketing plan for the company’s products. Although this appears well structured, the decisions that students needed to make along the way were varied and, like traditional PBL methodologies, there was no single correct solution. This was emphasized by the fact that there were multiple groups competing to design the best or most agreeable solution to the problem presented. The problems, decision-making, and learning process remained ill structured because of the volume of variables involved with making the choices that learners were asked to make while deciding the best course of action to take. Essentially, this learning model asked learners to make decisions as though they were the company CEO, which came along with accounting for all the choices for which a person in that position has to account. Although this example demonstrates most of the principles and goals of problem based instruction, the constraints of the defined student outcomes appear to be much more rigid than what typically exists in PBL. For instance, students are required to design a marketing strategy, yet as consultants they may realize that the marketing of the product is not the real issue. As Jonassen (1997) reminds readers, the first task in solving a real problem is to decide if the apparent problem actually exists. However, by placing the emphasis on the cooperative part of the learning model, Liu and Olson (2011) saw marked improvement in student motivation and interest in addition to the higher quality results expected of collaborative efforts.

Not only is PBL being implemented in education to prepare learners to enter the business workforce, Yeo (2008) has designed a model that implements the use of problem based learning for workplace training. Specifically, the researcher mentions its
use in three separate areas of human resource development: (a) employee socializations; (b) on-the-job training; (c) cross-cultural training (Yeo, 2008). By introducing problem-solving themes with employees, personnel are given a different context in which to interact, thus creating a more familial work environment and more motivated workers. By training new employees through PBL, employers not only better prepare them to contend with the situations they will face as full-time employees, they allow them to become immediately familiarized with the company’s interworking and clientele. With regard to promoting cross-cultural training, PBL provides learners with the opportunities and situations to experience a multicultural environment, better preparing them to work in any complicated multi-variable problem-solving situation. Of course, when PBL is introduced in instruction, the learners acquire the latter two of the three areas of focus here. This research article demonstrates not only the usefulness and applicability of problem based learning in instruction but its potential need to better prepare learners and even current employees to face challenges in a working environment.

Nelson’s Collaborative Problem Solving Model

Nelson’s (1999) model was designed to address the limitations of cooperative learning and problem-based learning, neither of which inherently includes aspects of the other. Collaboration is a necessary skill that learners need to acquire because it is “one of the most common and natural situations in which we accomplish the work of society. As a result, education and business have come to recognize the significant learning gains and increased creativity which develop from learning and working collaboratively” (p. 244). This methodology is designed to teach learners the skills that they will need to succeed in
their careers and learn to become not only standout employees, but agents of change. Hung, Jonassen, and Liu specifically list retention of content, problem solving skills, higher order thinking, self-directed learning, and confidence as stated outcomes of problem based instructional methods (pp. 491-492). Nelson presents lists of values, guidelines, conditions, and specific steps required for the accurate implementation of this model. The eight primary values for the CPS model are as follows:

1. The learning context must be authentic, learner-centered, collaborative.
2. The instruction must be relevant to the learners and they must take ownership of their own learning, the content, and they specific ways in which they learn.
3. Students are active participants and learn by doing.
4. The development of critical thinking and problem-solving skills is key.
5. Learners must explore and analyze information from several perspectives.
6. The instruction must place a great deal of importance of social contexts
7. The instructor and instruction must help foster supportive relationships among learners and between learners and instructors.
8. The instruction must attempt to cultivate and emphasize lifelong learning and the skills to support this goal. (Nelson, 1999, pp. 245-246)

Nelson (1999) elaborates on these eight guidelines by describing the conditions in which this model may be applied. Rather than being applied for algorithmic, process instruction, CPS is better suited for heuristic learning tasks that do not require specific procedures and may have multiple answers or murky solutions. The learning environment is a necessary consideration and Nelson states that, in the context of implementing this
instructional model, collaboration, critical thinking, and experimentation should be encouraged. The environment must support these goals, both conceptually and physically. The layout of a classroom needs to sustain the collaborative nature of the model and an instructor needs to be carefully aware of this fact. Generally, Nelson states that learners must be willing to take responsibility for their own learning and they need to accept the fact that the instructor will not be completely in charge of the direction of the class. The instructor, meanwhile, has to be willing to give up a degree of control and be able to teach learners that they need to take charge. It is necessary for the instructor to remain flexible with what exactly students will learn in the process of problem solving. For example, the actual learning gains may not directly match those that the instructor would have set prior to the start of any instruction and the instructor needs to be accommodating (Nelson, 1999). The instructor’s role in the CPS model is congruent with other problem-based designs, which cite the shifting responsibilities of facilitators as being a potential barrier to implementation (Hung, et al., Hmelo-Silver, 2004).

**Comprehensive guidelines in the CPS model.** The second set of Nelson’s guidelines is more comprehensive and provides specific details about the roles instructors and learners play both separately and together. Like the first set of guidelines, these are ongoing, iterative, and not simply steps in the process of implementation. “At any given time during the process, any number of the guidelines can and should be used” (p. 50). Nelson (1999) separates the comprehensive guidelines into four categories, (a) Instructor-Implemented Methods; (b) Learner Implemented Methods; (c) Instructor- and Learner-Implemented Methods; (d) Interactive Methods (p. 251). The following four sub-sections
describe Nelson’s (1999) methods. The descriptions provided within each sub-section are taken from Nelson’s (1999) publication and should be considered referenced paraphrasing of her model’s design.

**Instructor-implemented methods.** Nelson (1999) lists four methods for an instructor to follow that are in line with the initial values presented. The primary method is that the instructor is no longer a teacher and becomes more of a facilitator who provides feedback, skills development, and assistance rather than knowledge distribution. The instructor must provide a space and context in which students can work and collaborate. The key to this method is that the instructor must provide changing environments for learners to experience multiple instances of problem solving. In order to succeed at this, the instructor needs to know when and how significantly to change the environments based on student experience. Third, the instructor becomes a questioner who can direct students to learn the important parts of the given content of which they might otherwise be unaware. Often, in this method, the instructor pushes the learners to evaluate their suppositions and think more critically. Nelson’s final instructor-implemented method is to be aware of when learners require just-in-time instruction in order to gain the skills and knowledge to complete a task. The instructor may often be able to anticipate these learning needs but not necessarily.

**Learner-implemented methods.** Nelson (1999) presents two specific methods that learners must employ in order to solve problems and gain the desired knowledge. An instructor must charge his or her students to direct themselves in these methods. First, learners must determine how to contextualize and implement the information and
research they gather to help solve the problem. Not only do they have to implement the information they find, this method implies that learners must critically evaluate their findings in order to determine degrees of relevance in solving the problem. Second, learners must start to become self-directed by determining time allotment, even individual group-member contributions, and accountability. Although the responsibility belongs to the learners, the instructor needs to ensure that students consistently check in and report on their work so that he or she may resolve problems as they occur, before they lead to larger issues.

**Instructor- and learner-implemented methods.** There are five methods that instructors and learners work together to achieve. Together, they carry out a series of methods and tasks in order to accomplish the main goal of solving a given problem or set of problems. There is a great deal of variation within the amount of autonomy given to the learners, which is determined by the instructor and depends on the students’ experience with self-directed learning as well as the instructor’s level of comfort working and facilitating in this context. At the start of the process, the learners and instructor decide the learning goals and objectives. Again, although the level of participation of both the instructor and the learners varies, Nelson points out that a greater degree of control for the learners augments their ownership of their learning – a foundational value of the CPS model. Together, the learners and instructor must meet to discuss the progress of each group and to allow the instructor to provide personalized feedback. The third method Nelson (1999) mentions states that the learners and the instructor should collaborate to help find appropriate and needed resources. Learners and groups should
share resources and ideas for finding resources together. “Collaboration should be taking place both within groups and among groups” (p. 253). Additionally, the learning should be constantly evaluative with formative assessments occurring throughout in multiple ways. Throughout the learning process, learners are assessed by the instructor and by one another. Together, the instructor and learners are expected to assess and evaluate the quality of the product throughout the time they spend working toward a solution. They need to constantly ensure that they are working toward the originally stated goals and objectives. Finally, the last method involves self-assessment and summative evaluation. This method should be completed as a collaborative effort between learners and the instructor.

**Interactive methods.** The interactive methods in the CPS model guide an instructional designer on the processes that occur during interaction. These methods not only help learners collaborate more effectively, they help an instructor assist learners and provide him or her with the methods to deal with any issues that arise. The instructor must teach and/or give learners the means to become leaders, build trust, communicate effectively, manage conflicts, and make difficult decisions. New groups should engage in team-building activities at the instructor’s discretion. An instructor must provide a context and support “investigation, interaction, interpretation, and intrinsic motivation” (p. 254). Nelson provides more specific details that an instructor may use in supporting these ideas and beliefs among learners. The interactive methods require that each member of the group be given an equally important (and equally challenging) task in working toward the final solution. It is necessary that the instructor monitor groups and that
groups monitor themselves to ensure consistent and equal participation among all members. Nelson states that the instructor needs to remind learners that the success of the individual is contingent upon the success of the group and that there needs to be a sentiment of “positive interdependence” (p. 255) within the groups. In support of this interdependence, group members must value one another’s independence and should be encouraging of their group members. However, despite the interdependence, it remains necessary to hold each group member individually accountable to ensure fairness and an equal contribution among all members.

Process activities. The final part of Nelson’s model describes a linear process that takes place over an extended period of time. It details more specific activities that are involved in the Collaborative Problem Solving model. There are nine separate activities that make up the process activities in the CPS model. Despite its linearity, there may be times when an instructor and learners repeat certain activities. For example, a group may need to re-assign roles when presented with a new task that falls within or makes up a part of the original task of solving the main problem. Groups may return to the first step if it is determined that a team of learners is unprepared for collaborative work. Additionally, some steps in the process are intentionally and premeditatedly repeated. For instance, a group of learners will work together over an extensive period of time creating solutions and refining them, each time repeating a single step in the series of process activities. The following nine sub-sections describe Nelson’s (1999) methods. Much like the descriptions of the model’s methods, the descriptions of processes provided within
each sub-section are taken from Nelson’s (1999) publication and should be considered referenced paraphrasing of the CPS model’s design.

_Instructor and learners establish and build their readiness to engage in collaborative group work._ The first step requires the instructor to review the values and guidelines with the learners as this type of instruction will be new to most, if not all, of them. It is at this point that the instructor is expected to discuss any concerns he or she sees with any anticipated difficulty the learners may face. The evaluation process is then discussed in this process activity. As a class, during this activity, students may ask questions and discuss concerns with the instructor who can help assuage their concerns, offer them tips and suggestions, or simply recognize the difficulties.

Following a general introduction and addressing student concerns, the instructor presents the authentic problem to be solved. Depending on the context and their readiness, learners may help the instructor in this process. The instructor needs to consider everything about his or her learners and the context (ability, interests, knowledge, time constraints, culture, etc.) in designing an appropriate problem. The last part of developing readiness is for the instructor to help create a good working environment by having students engage in interpersonal skills development, leadership training, interdependence competency, and consensus building. Students should be allowed to practice and hone these new skills with a temporary group before joining the groups with which they will work to solve the problems.

_Either the instructor or the learners form small heterogeneous work groups, and then the groups engage in norming processes._ Nelson recommends heterogeneous
groups with three to six members each. Heterogeneity within each group is necessary to give learners the experience working with individuals of varying race/ethnicity, gender, experience, etc. who still share a common interest in the topic. An instructor may provide criteria for forming a heterogeneous group to the learners and ask them to meet these requirements in forming their own groups. It is important that once groups are formed, they begin a norming process by setting ground rules for conduct, division of labor, and consensus reaching. The instructor needs to be present for this process and can help to ensure that groups are evaluating all aspects and asking critical questions about forming their rules of conduct.

**Groups engage in a preliminary process to define the problem they will work on.** In this step groups come together and formulate a mutual understanding of the project. They then work to formulate a wide number of possible solutions or project plans. Because of their relative inexperience with the collaborative problem solving process (and likely with the problem they face), groups need to draft a wide range of possible solutions and project plans. From among the possibilities, they choose one to help them progress and endeavor to create an initial design or action plan for further investigating the solution. With the assistance of the instructor, groups are tasked with identifying what information and research they will need to solve the problem (or validate their solution), who they might need to talk to, and where they can find the information. Once a group decides what resources it needs, the members set out, find the information and resources, share them with their group members and determine what, if any, information the instructor might need to help them acquire. Following this step,
learners synthesize the information to make a determination on the quality of the initial design plan.

*Each group defines what roles are necessary to accomplish the design plan and then assigns them.* Each group is asked to assign roles to every group member in order to think through all the work that needs to be accomplished in order to meet the group’s goal of finding an adequate solution to the problem. Roles should be designed, given responsibilities and assigned to group members with the instructor’s facilitation if necessary. Though, primarily, assigning roles and tasks is the group’s job and learning to do so adequately is part of the CPS process. Role filling is an important consideration because, while one person may be better suited to fill a role than another, a student may benefit more from learning to fulfill a role in an area in which he or she lacks experience. Therefore, Nelson’s model stresses the importance of learning the skills a student needs to achieve quality results in difficult roles more than it emphasizes ensuring a successful end product and problem solution. An instructor needs to carefully balance learners who want to take on familiar roles with those who want to take on roles to learn a new position. Roles may shift and gain or lose certain responsibilities throughout the process and this activity may be one that learners will need to revisit. Nelson does not define specific roles and groups may create distinct student responsibilities depending on specific needs and prior experiences.

*The group engages in the primary, iterative CPS process.* This step in the process is the most time-consuming and contains the most details. Much like the series of nine process activities, this single activity contains many sub-parts, the navigation of
which is both linear and iterative. This process consists of nine tasks which are (a) refine and evolve the design plan; (b) identify and assign tasks; (c) acquire needed information, resources, and expertise; (d) collaborate with the instructor to acquire additional resources and skills needed; (e) disseminate acquired information, resources, and expertise to the other group members; (f) engage in solution- or project-development work; (g) report regularly on individual contributions and group activities; (h) participate in intergroup collaborations and evaluations; (i) conduct formative research of the solution or project. Since each of the components that make up this step in the process have been elaborated on in some capacity through the description of this model, there are no details that need to be described here. It is important to remember that this is an iterative process and learners may progress through these steps multiple times before moving onto the next process activity. The learners will have to work with the facilitator and other student groups to make sure they are exploring all possible realms and recommending a feasible, appropriate solution.

Groups begin to finalize their solutions or projects. Learners will likely not reach this step in the process until they have repeated the previous activity multiple times. Once here, though, groups of learners formulate a draft of the final project/solution and proceed to complete a final usability test of the end product. Nelson’s model requires the learners to conduct the test in an authentic setting, or one as authentic as possible. The usability test influences the revision of the final product, which is then submitted to the instructor for evaluation.
The instructor and learners engage in activities to help them reflect and synthesize their experiences. Nelson’s model recommends the instructor arrange an activity or series of activities for debriefing and to encourage reflection. Learners should reflect on what they learn with regard to “(a) content knowledge and skills, (b) group-process skills, and c) metacognitive strategies” (p. 265). This process activity is necessary for learners to understand what happened, contextualize it in a way they are familiar with in education, and to share their feelings regarding the entire collaborative learning experience.

The instructor, and, when appropriate, the learners assess their products and processes. The initial part of bringing finality to the learning process involves assessing the learning gains the students self-identified in the previous process activity. Once this is done, the solutions that students developed are evaluated based on their quality and authentic applicability. The last part of this process involves an evaluation of group processes for each working group. Nelson gives no prescriptive instructions for evaluating group work. Learners may collaborate with the instructor to design the evaluation criteria or learners may write up their own self-evaluations, which the instructor can choose to consider along with his or her personal evaluation.

The instructor and learners develop an activity to bring closure to the learning event. “Closure is an important but often-neglected aspect of any social activity, including group-based learning” (p. 266). Creating an activity to bring closure to the experience is intended to honor the learning of the students and help them celebrate what they have accomplished. It is necessary for an instructional methodology that places so
much of its emphasis on collaboration and building a sense of community to see to the
development and nurturing of these values through to the end of the work.

**Current research on the Collaborative Problem Solving model.** Instructional
designs are often evaluated and redesigned through formative research. Although
evidence suggests that Nelson’s CPS model has not been subject to any formative
research, there have been situations where some of its prescriptions have been applied,
tested, and evaluated, particularly in online instruction. Collectively there may be few
researchers who have fully implemented her instructional model; many of its
recommendations and process activities have served to influence multiple scholars.
Moallem (2003) cites this instructional model for its applicable recommendations for the
development of tasks or problems to be solved with stimulating student collaboration. In
designing adult education learning communities, Snyder’s (2009) instructional model
uses Nelson’s (1999) CPS model as a basis for the inclusion of learner reflection and self-
evaluation. In a doctoral dissertation on collaborative problem solving and the role of
computer support, Jermann (2004) is influenced by the CPS model’s inclusion of student
and peer feedback or evaluation when designing a collaborative problem-solving model.

David Merrill (2002) includes Nelson’s (1999) CPS model in his examination of
the first principles of instruction in new and evolving instructional design models.
Although Merrill (2002) does not include collaboration as one of his first principles of
instruction, (static principles that that are indicative of quality instruction) he does state
“learning is promoted when learners are engaged in solving real-world problems” (p. 43).
Merrill (2002) lists four other first principles that define high quality instructional design models:

(b) Learning is promoted when existing knowledge is activated as a foundation for new knowledge. (c) Learning is promoted when new knowledge is demonstrated to the learner. (d) Learning is promoted when new knowledge is applied by the learner. (e) Learning is promoted when new knowledge is integrated into the learner’s world. (p. 43)

Merrill (2002) states that while collaboration is important for a learner to be able to implement and activate knowledge, he does not consider it a first principle. However, the CPS model, as a problem based learning and collaborative instructional model, contains all five of Merrill’s principles. Although Merrill (2002) does not include collaboration as one of his five principles of instruction, other researchers have demonstrated the learning gains students experience with collaboration (Vygotsky, 2012; Driscoll, 2005; Yew & Schmidt, 2012; Bruffee, 1999). As the research from these individuals suggests, some may consider collaboration to be a more integral part of learning and instruction than David Merrill argues.

**Similarities and differences between PBL and CPS.** At its heart, Nelson’s (1999) Collaborative Problem Solving model is problem based and takes much of its foundational principles from PBL. Both designs place collaborative learning at their centers. They both focus on defining the problems learners face as authentic and relevant. They both stress student ownership of their learning. The instruction is learner-centered; the instructor plays the role of facilitator rather than a distributor of knowledge; and one
of the outcomes is the development of self-directed, lifelong learners. Problems are typically multi-disciplinary, often messy, and never have one correct solution. The primary differences between the two are that Nelson (1999) places more emphasis on readying the learners for the process of instruction, asks them to identify their roles in the learning process, requires them to authentically test their problem solutions, and gives them control and ownership over their learning. The Collaborative Problem Solving (CPS) model recognizes that “students typically resist working in groups, be it in laboratories or class projects, because of prior experiences” (Mohd-Yusof, et al., 2011, p. 13). Unlike traditional PBL models, the first step in the CPS model actively addresses this concern by having the instructor review the whole process, including a discussion on the benefits and drawbacks of working in groups. The CPS model even requires that learners be allowed to voice their concerns and ask questions of the instructor regarding any hesitation they have toward group work or the problem-solving process in general.

 Typically, at the beginning of the problem solving process in either design, the instructor assigns the learners a problem they will work on throughout their time spent working in the class. In the CPS model, the instructor chooses the model or opts to use his or her discretion to collaboratively design one with the learners based on a set of outcomes that have been designed through collaboration. Then, learners form groups. Nelson (1999) makes special note of the makeup of groups. She states that a group should be heterogeneous given a set of parameters (gender, cultural background, etc.) and learners may form their own groups so long as they meet a facilitator’s standards. Once learners form groups, they engage in a norming process. In the CPS model, this step
includes the requirement that learners create ground rules for participation, interaction, reaching a consensus, and a division of labor. The difference is that in Nelson’s CPS model, after groups of learners identify a common understanding of the problem, they identify the different roles that the group will need to have in order to find a solution to the problem. The groups then assign different members to fill each of the roles. This process may be repeated multiple times throughout the process as learners face different problems and sub-problems.

Near the end of the instruction process, the collaborative problem-solving model requires that learners conduct a usability test for the solution to their problem. “For example, each group will want to test its proposed solution or product with subjects from the target audience in a setting and under conditions as close to the real-world as possible” (Nelson, 1999, p. 265). The usability test informs the revision of the solution. Other PBL methodologies typically have learners present their solution to their instructors or to a group of experts for critique and feedback (Stinson & Milter, 1996; Jonassen, 1997). Once learners complete their revisions and finalize their solution, in the collaborative problem solving model, they are given more ownership of their learning and, at the instructor’s discretion, may self-assess the final products they create. The last step in the CPS model actually involves no learning and is instead a fun activity designed to create a greater sense of community within the group while serving to close the learning event in celebration of the learners’ hard work.
Collaboration

Collaborative learning does not have a strict definition and has, as Dillenbourg (1999) notes, been used in so many different situations with so many different basic definitions that it can be difficult to adequately define the term. In general, collaborative learning refers to learning that occurs when a group of individuals (two or more) work together. However, as previously mentioned, this definition can be similar to that of cooperative learning, yet the two should neither be confused nor used interchangeably (Oxford, 1997). Bruffee (1999) recognizes many models and variations of collaborative learning including collaborative project work and peer tutoring. Bruffee further describes collaborative learning as being a type of gateway to a culture or community that learners form as they construct their knowledge together. This builds on Vygotsky’s (1978) philosophical notion that ideas are socially constructed and one’s understanding of the world should not be thought of as separate from his or her social interactions. The definition of collaborative learning is further complicated when considering what it means to learn together and the vast differences that exist between small groups of collaborative learners (two to five) and large groups (two to 30 or more) (Dillenbourg, 1999). Dillenbourg (1999) is quick to point out that what research says about one group of collaborative learners can in no way be used to define or describe another group. These variations of the definitions of collaborative learning highlight important distinctions. There may be a unique definition that each study or instructor uses to define collaboration. However, Bruffee (1999) provides an encompassing definition that is grounded in theory. He states that a collaborative classroom can be defined as follows:
“negotiated relationships among students gathered into small ad hoc knowledge communities and a negotiated relationship between those student communities and the teacher” (p. 89).

Regarding its instructional implementations, “Collaborative learning began with a concern that the hierarchical authority structure of traditional classrooms can impede learning” (Bruffee, 1999, p. 89). Bruffee (1999) asserts that collaborative learning is important to student development because it teaches much more than simple facts. When participating in collaborative learning students acquire the skills that teach them how to work with others and work autonomously – without instruction from a teacher. Because collaborative learning forces learners to construct their knowledge through negotiation and constant inquiry, it may teach learners the skills to become lifelong learners. Vygotsky’s (2012) zone of proximal development further elaborates on collaborative learning theory, stating that not only do learners achieve more when working together, an individual working in a group learns to imitate a higher-achieving teammate in order to eventually develop a greater cognitive capacity. Because of the variety of definitions for collaboration and its misuse and miscategorization as a synonym for cooperative learning, perhaps looking at empirical studies is insufficient and researchers may be better served to examine its theoretical underpinnings, social construction. Social construction as a learning theory is examined later in this chapter.

**Collaborative and cooperative learning.** Similar to collaboration is cooperative learning which entails five distinct principles: (a) positive interdependence; (b) individual accountability; (c) face to face interaction; (d) appropriate interpersonal skills; (e) regular
group function assessment (Mohd-Yuson, et al., 2011, p. 14). In a study combining these principles with problem based learning in engineering instruction, Mohd-Yuson, et al. (2011) found that the model motivates students and helps them achieve greater results. By focusing on the cooperation aspect of PBL through accountability and group assessment, it allows the learners to develop the interpersonal skills that highly functional teams require. Cooperative learning places a direct emphasis on developing the transferable interpersonal skills that are to be the result of problem-based instruction.

The two terms (collaboration and cooperation) are often used interchangeably. While they are rather similar, they are not synonyms and their differences are important to note. Cooperative learning is generally well structured with a large instructor role and greater teacher intervention (Oxford, 1997). Collaborative learning, conversely, is more ill structured. The philosophical underpinnings of collaborative learning come from a social constructive perspective meaning that learners together shape their knowledge. In this sense, learners are more responsible for their own learning in a collaborative environment. Thus, collaborative learning, not cooperative learning, is a core component of Nelson’s Collaborative Problem Solving model wherein there is no single solution to the given, ill-structured problem and the instructor must allow learners to direct their own learning and be comfortable with shifts in learning outcomes.

**Collaboration and problem solving.** A critical element in problem based learning and constructivist pedagogy is collaboration. Collaborative and social skills are becoming increasingly important because they translate well to the workplace environment. According to Brown, Collins, and Duguid (1989), collaboration is more
than just group meetings and discussions. Collaboration “give[s] rise synergistically to insights and solutions that would not come about without [it]” (p. 40). Ideal collaboration allows people to do and create in groups with multiple minds thinking and bodies working what they would not otherwise be capable of alone (Driscoll, 2005). Dialogue in a collaborative learning environment is key to preparing students to work in the real world because it opens them to new ways of thinking and contradictory points of view (Yew & Schmidt, 2012). Simply listening and not actively participating in a dialogue will likely influence one’s point of view and/or force him or her to make critical evaluations.

Collaboration is the underlying element present in the pedagogical approaches and theoretical underpinnings of constructivism and PBL. In fact, Yeo (2008) has suggested that learning in problem-based learning is completely reliant upon collaborating to create a common understanding of the problem and to identify group and individual learning objectives. “Consequently, learning is intensified when participants engage in personal reflection and collaborative investigation to illuminate problem solutions” (p. 321). An examination of the role collaboration plays in PBL in student activities and learning gains is thus a crucial addition to this literature review.

In a Project-based e-learning environment, Papanikolaou and Boubouka (2010) found that collaboration is preferred by students and serves a number of purposes in both the development of the project and student learning. Collaboration in this instance “promoted the exchange of many different ideas and opinions . . . , supported the establishment of common goals . . . , and enhanced peer learning as they helped each other overcome difficulties” (p. 150). While seeing educational gains and developing
collaborative skills, student participants listed improvement in ICT skills as an important factor of collaboration online.

Communication among collaborating group members when involved with problem-based learning is only one key to finding success and developing self-directed learning skills. A 2012 study by Yew and Schmidt conducted a set of studies looking at the relationship between collaboration in PBL and self-directed learning gains. The first was a one-day problem based instruction with first-year students in a Singaporean university who already had extensive experience with the methodology. Despite its abbreviated time frame, the instruction proceeded through all of the steps that a PBL environment typically would and occurred over an eight-hour period of time. The second study conducted involved 35 first year students who were familiar with the PBL model. The second study was the same as the first but gave more freedom to the learners to self-direct their problem solutions rather than requiring meetings with instructors and their teammates. The results indicated that the more learners participated in active collaboration the greater their ability to direct their own learning became. As learners sought to work with their groups to analyze the problem and activate their prior knowledge to shape their understanding of it, the greater their likelihood of being able to identify learning needs and set out and achieve them. Additionally, the more learners communicated and collaborated to make sense of the knowledge and information gained during self-directed learning, the greater their individual and team achievements. This study demonstrates that not only is collaboration a necessary element in problem based
learning but that those individuals who seek to collaborate and communicate more frequently tend to generate more useful results for their teams.

A critical part of collaboration, particularly through ICT and online is the role that relationships and social presence play. Students appreciate community in online learning environments and it aids in their learning (Papanikolaou & Boubouka, 2010). Bikowski (2007) demonstrates a positive relationship between community atmosphere in an online problem-based learning environment and learning outcomes. In studying online cross-cultural collaboration, Zhu (2012) found that while some students perform very well when collaborating online, those who are unfamiliar with the self-direction that successful learners possess tend to struggle. This study was part of a course that asked Flemish students to collaborate online with Chinese students.

**Social Construction as a Conceptual Lens**

Collaborative learning and Constructivism as both pedagogy and learning theory are paramount to the framing of this research inquiry. “Social construction understands knowledge and the authority of knowledge as community-generated, community-maintaining symbolic artifacts” (Bruffee, 1986, p. 777). In a basic sense, social construction theory states that reality and knowledge are products of social interaction and that truth can vary from society to society (Berger & Luckman, 2011).

In Bruffee’s description of social construction, truth and reality vary from group to group and, in some ways, the knowledge that is socially generated helps define these groups or cultures. Learning does not come strictly from the natural world; it comes from the active engagement and negotiation of knowledge among participants in a given
relationship (Gergen, 2003). The theory asserts that knowledge is not something that just happens to people. Only through interaction with the world and other people can one construct his or her knowledge (Bruffee, 1986). To this point, Bruffee (1986) makes a distinction between being in contact with something and interacting with it or “dealing with” (p. 777) it. Knowledge, he says, is only created by not simply dealing with the situation, but instead by rationalizing and validating one’s beliefs socially.

The philosophical beliefs that shape social construction are derived from Vygotskian (1986) theory wherein one’s cognitive functions are the products of social interactions. Vygostky (2012) posits that individuals work together to construct knowledge. When working collaboratively, one learner will imitate the performance of another student of greater cognitive ability and eventually reach that level of capability, so long as the other learner is within the first individual’s zone of proximal development.

The zone of proximal development has been disseminated among and used by a multitude of philosophers and researchers to describe the way learners socially construct and build their knowledge (Vygotsky, 2012). Separating beliefs and knowledge from their social context is impossible. Because this is where people collectively form knowledge, an individual and his or her knowledge are profoundly positioned together in a social context.

The purpose of the theory is to analyze the way in which social learning and construction occur. It is not an analysis on what constitutes truth and knowledge and whether what is constructed is so-called Truth. That is a philosophical argument and Berger and Luckman (2011) remind readers that social construction is a sociological
theory. One main tenet is that of “relativist ontology” (Guba & Lincoln, 1989, p. 86) meaning that there are multiple realities. This pluralism of beliefs states that each reality is truth to the holder of the belief. Individuals have to experience the world to form their knowledge and make meaning of it in addition to interacting with others to form a conception of their surroundings. As a theory and conceptual lens, social construction is pervasive throughout this study and will drive much of the research design, the inquiry, and the results.

Constructivism. Constructivism is a learning theory, which states that individuals learn by building on their own knowledge through the construction of new knowledge, and the creation of meaning based on their experiences (von Glasersfeld, 1995). Knowledge, therefore, is subjective and is based on the learner’s worldviews and his or her experiences, both present and past. It has multiple interpretations and researchers maintain disparate views of it (Phillips, 1995).

Constructivism can trace its roots to Jean Piaget (Phillips, 1995; Robinson, Molenda, & Rezabek, 2008). However, Ernst von Glasersfeld is recognized as having introduced the term constructivism as a theory of knowledge (1984; Phillips, 1995; Robinson, et al., 2008). Vygotsky (2012) wrote about constructivism by stating that “. . . a concept is more than the sum of certain associative bonds formed by memory, more than a mere mental habit; it is a complex and genuine act of thought that cannot be taught by drilling . . .” (p. 158). Proponents for constructivism argue for its necessity as a reaction to instruction. “Since reality . . . is in principle inaccessible to human beings, there can be no absolute knowledge and no absolute truths. Human knowledge must
always be regarded as only a currently adequate, currently useful result of socially-shared construction processes” (Terhart, 2003, p. 32). Von Glasersfeld states two defining principles of constructivism: Knowledge is an active process and “the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality” (1989).

Efforts to define different constructivism and its pedagogical applications have been separated into categories and/or placed along a continuum. Researchers have dichotomized constructivism into two main categories: Moderate and radical (Terhart, 2003; Robinson, et al., 2008). According to Terhart (2003), others have placed radical constructivism at one end of a continuum and varying degrees of moderateness along the rest of it (Terhart, 2003). Radical constructivism “is a theory of active knowing, not a conventional epistemology that treats knowledge as an embodiment of Truth that reflects the world ‘in itself’, independent of the knower” (von Glasersfeld, 1996, p. 2). Terhart (2003) argues that extremely radical constructivism is counter-productive and would not produce learning in certain disciplines.

As a learning theory, constructivism is not singularly defined. While there are basic principles that define all constructivist theory, there are certain characteristics they all share pedagogically. In their most basic forms, the characteristics of constructivist instruction are collaboration, interaction, and authentic learning environments (Huang, 2002). Students in a constructivist environment will become the center of focus and control and become less the receivers of education and more the constructors of it as they interact with the education to learn (Molenda, 2008). Additionally, Driscoll (2005)
defines a list of five conditions for creating a constructivist-learning environment. First, learning needs to be realistic and complex. Second, it needs to allow for discussion, negotiation, and collaborative learning. Third, constructive pedagogy needs to deliver learning in multiple methods with compounding perspectives. Fourth, it should encourage learners to be self-directed and autonomously think through the learning process. Finally, it should make students self-aware of their own roles in the constructive process and provide opportunities for reflection and self-analysis. These five conditions are designed to address the core design of constructivism, learning through the construction of reality.

In problem based learning models, constructivist philosophy forms the basis of instruction. Constructivism has continued to expand and dominate theory in education. This is part of the reason that the popularity of PBL has continued to grow in American education (Camp, 1996). For Problem based instruction, Savery and Duffy (1995) list the three primary positions of constructivism influencing this methodology: (a) understanding is in our interactions with the environment; (b) cognitive conflict or puzzlement is the stimulus for learning and determines the organization and nature of what is learned; (c) knowledge evolves through social negotiation and through the evaluation of the viability of individual understandings (pp. 1-2). In essence, problem based learning actively supports the tenets of the instructional applications of constructivist learning theory “Regardless of the specific teaching methods adopted in higher education, students’ creation of high levels of understanding and competence are promoted when arousal is optimised, self-efficacy is maximised, and anxiety is minimised” (Hendry, Frommer, & Walker, 1999, p. 369). Problem based learning
actively attempts to meet all of these goals of constructivism. Similarly, constructivism is not simply a learner’s interactions and negotiations with the world. According to Baden and Major (2004), understanding comes from social interactions, self-reflection, and “cognitive conflict” (p. 29).
Chapter 3: Methodology

This formative study can be viewed in two separate parts. The first part was a 15-week, semester-long implementation of an existing instructional method, Nelson’s (1999) CPS model. This first instance occurred in the Fall Semester of the 2013-2014 school year. For this instance, the 23 participating learners were faced with finding a recommended problem solution for a local Indian-inspired community to increase tourism and earn more money. Following data collection that included student feedback, observations and an assessment of learning gains seen throughout the first semester, the model was revised for the context. In this second part of data collection, the revised CPS model was implemented throughout the 15-week spring semester of the 2013-2014 school year in the same context with a group of 22 participating learners. For this revised instance, the learners were faced with finding a solution to problems faced by four entities either based in or with operations in Vietnam. The clients consisted of a luxury hotel in Vietnam, a multinational manufacturer of small technology part with operations in Vietnam, and a well-known motor vehicle company with a new dealership in the country, and a biotechnology institution seeking to establish partnerships in the country. Following data collection in this second instance, recommendations for a final revision to the CPS model for this context is added to the end of this dissertation.

A study’s research questions dictate the methodological approach to a research study and those chosen are formative in nature. Formative research seeks to evaluate instructional methodologies based on three criteria: (1) effectiveness; (2) efficiency; (3) appeal (Reigeluth & Frick, 1999). The researcher sought to document, understand, and
describe the experiences of the participants in this study in relation to how well the chosen instructional model, Nelson’s (1999) Collaborative Problem Solving Model, meets these three criteria.

Data collection was primarily qualitative in nature and was completed through observations, interviews and document analyses. In evaluating the model’s effectiveness the researcher used two unique instruments. The first is a collaboration and problem solving evaluation rubric developed by Pazos, Micari, and Light (2010). This rubric guided observations and participant journaling. The second instrument is an attitude assessment designed to measure learner perceptions of gains in the skills that PBL methods impart (Yuan, Williams, Yin, Liu, Fang, & Pang, 2011). Each of these instruments is described in greater detail within the data collection methods section of this chapter. This varied strategy for data collection was chosen to give the researcher a triangulated approach to uncover additional complexities and be able to further amend the model for effectiveness, efficiency, and appeal.

Formative research, as a methodology, because of its limited scope with regard to its application primarily for instructional design (though in other forms it is also used in curriculum development, counseling, administration, etc. in education), is not well researched. However, as it relates to instructional design, it has been used to evaluate computer simulation models (Hsu, 2009), videogame-based instruction (Watson, 2007), and program evaluation (Schankman, 2006). The methodologies through which researchers collect data in formative research incorporate proven techniques from a wealth of qualitative researchers. These methods, along with considerations for site
selection, sampling, data analysis limitations, and myself as the researcher, are considered and described within the following sections.

**Research Design**

Dick, et al., (2005) list three steps in the formative research process. The first step in the process is to evaluate all learning materials in a one-on-one setting with a learner. In conducting the evaluation, materials were first evaluated for clarity, impact, and feasibility. In Nelson’s CPS model, the facilitator does not directly instruct learners unless, in context, a need is perceived for direct instruction. The only materials, therefore, were the instructions for navigating the LMS, responding to questions on the Blackboard page’s discussion board, and course information on the syllabus. Ideally, an instructor chooses three learners representative of the target population with below average, average, and above average ability to help evaluate the course materials. Other characteristics that can affect performance are experience with the instructional model or attitude. In each semester, the researcher chose three of the students from the class who had never worked together on a team and were determined to have varying skill levels based on their performance in the program in the past. Their skill levels were determined based on their performances on individual assignments in previous semesters. In the first semester, Male #1 was chosen because his performance in prior classes was deemed outstanding based on prior assessment rubrics and evaluations. Female #1 was chosen because her performances in prior classes were deemed good but not exceptional. Female #7 was chosen because her performances in prior classes were deemed good but not up to the level of her classmates’ performance. In the second semester, Female #13 was chosen
as the outstanding performer, Male #8 was chosen as the good but not exceptional performer, and Female #19 was chosen as the below average performer. The participants in this step helped the researcher clarify the wording of materials presented to the classes in order to assure that expectations and course rules and regulations were clearly presented.

The second step in formative research per Dick, et al. (2005) is to conduct small-group evaluations, the purposes of which are to examine the revisions made from the first step and to help determine the effectiveness of the instruction. Because there were so few materials to be reviewed, the researcher deemed this part of the second step to be unnecessary. The second part of this step refers to the evaluating the effectiveness of a new instructional model. Since the CPS model has already been developed and presumably been subjected to these procedures and since it was to be evaluated for effectiveness in step three, the researcher skipped step two altogether.

The third step in formative research is the field trial or implementation of the instructional model (Dick, et al., 2005; Reigeluth & Frick, 1999). Following implementation, the researcher administered a learning assessment, which measures participant perception of their gains in the skills that problem based learning methods impart (Yuan, Williams, Yin, Liu, Fang, & Pang, 2011). The process of evaluating an instructional methodology in formative research consists of the following six linear steps:

1. Select the design theory. Nelson’s (1999) collaborative problem solving model was chosen for this formative evaluation.
2. Design an instance of the theory. For the first instance of the methodology, the designer must create a pure representation (instance) of the original designer’s intentions, thus avoiding error and to maintain researcher credibility (Patton, 2002). The outline of the CPS model is present in chapter 2. The site selection is described in further detail later in this chapter.

3. Collect and analyze formative data on the instance. Predominately qualitative in nature, data were collected through observations, interviews, document analyses, a questionnaire, and an observation rubric. These were all intended to help inform the identification of strengths and weaknesses of the model in addition to helping the researcher explore potential improvements through addition or subtraction. The researcher always seeks input from the participants on improving weaknesses and to gauge their reaction to a designer’s ideas for improvement. Specific details on data collection are described later in this chapter.

4. Revise the instance. Based on the data collected, the instance of instruction was amended.

5. Repeat the data collection and revision cycle. It is recommended that a researcher revise and repeat the process as many times as possible in order to discover not simply the best fit but also alternative fits given specific contexts. The process was repeated one time for a total of two complete instances.


Following the first instance of implementation of the CPS model, the researcher revised the model to fit this particular context. This revised model was implemented and
subjected to the same six-step process of evaluation in order to provide better data to support final recommendations for revisions to the CPS model.

**Site selection.** The site that matches the research questions is the globally focus leadership program at a large, Midwestern university. This two-year certificate program seeks to “prepare students to become lifelong learners in order to serve as internationally-minded, skilled, attuned, professional, and experienced leaders in all walks of life” *(Description and requirements, 2014, para #2).* This university was the state’s first public university and has a main campus undergraduate enrollment of over 17,000. This site was chosen for its established problem-based learning methodology and dedication to providing learners a global learning experience. The researcher had an established relationship with the certificate program, having worked as a teaching assistant there for the previous six academic years.

**Sampling.** Students enrolled in the certificate program were given the choice to participate in the study. The first semester consisted of 23 undergraduate participants who would be partaking in their third semester in the program. The second semester consisted of 22 undergraduate participants who would be partaking in their second semester in the program. Eisenhardt (1989) states that random selection of sampling in a case study grounded theory design is neither a necessary nor desirable solution. The learners from both instances consisted of undergraduates from a variety of disciplines, genders, ethnic backgrounds, and first languages.

As part of data collection, the researcher conducted focus groups and one-on-one interviews with each group of student participants. Focus groups occurred with
consenting students. One-on-one interviews occurred with three of the four participating students in the first semester and two of the 15 participating students in the second semester. Additional interviews were unnecessary once the researcher reached data saturation (Charmaz, 2006). Patton (2002) states “sampling to the point of redundancy is an ideal” (p. 246). Data collection was considered to have reached saturation when participants reveal no new information and findings become repetitive.

**Data collection methods.** In formative research, Reigeluth and Frick (1999) separate the collection of data into two general categories: Thoroughness and researcher credibility. Thoroughness entails pre-preparing the participants to critique the design, an emergent design, gradual decrease in researcher obtrusiveness throughout data collection, iteration until saturation, and a focus on both what the participants like and dislike about the instructional method. In documenting observations, Creswell (2013) presents a series of guidelines, which he says are steps in the process. After identifying the site, a researcher has to identify who/what to observe and for how long. He mentions that a researcher can, at this point, decide on his or her level of participation. But this level of participation may change over time.

After defining the object and goal, upon beginning the observation, the researcher needs to have a specific method for collecting and organizing data through the use of a protocol. The protocol will help the researcher guide the observation, allowing for space to include particular details and descriptions. Observations in this research study focused on the primary research questions. In creating a rich, thick description as an observer, the researcher tried to focus his attention on participant interaction, collaboration, and
problem solving abilities, as defined by the measurement tool designed by Pazos, Micari, and Light (2010). This rubric was used to assess student collaboration and problem solving. It was used to guide the researcher’s observations and the online question prompts learners responded to, which are discussed later in this chapter. The parts of the rubric that evaluate facilitator interaction and instruction during group work were not used because the researcher doubled as the course facilitator. The observations influenced the post-instruction interviews the researcher conducted, giving him specific discussion points for certain participants. This observation rubric is described in further detail in the Instruments Used sub-section of Chapter 3.

In this research study, audio-recorded interviews and focus groups were used following each of the two instructional instances. Each instance lasted one academic semester. The interviews were influenced by two distinct interviewing protocols, intensive and responsive interviewing. Intensive interviewing is a semi-structured interview protocol, which provides the participant with the space to communicate and gives the researcher the probes and tools to dig deeper (Charmaz, 2006). Responsive interviewing is a semi-structured interview protocol that allows the researcher to communicate to the interviewee in response to new or unexpected results or developments (Rubin & Rubin, 2012). Similar to constructivism and phenomenology, “this model assumes that what people have experienced is true for them and that by sharing these experiences, the researcher can enter the interviewee’s world” (p. 7).

As formative research requires the researcher to get a breadth and depth of interview data and assumes that what individuals experience is their phenomenological
truth, this methodology employed both the intensive interviewing and responsive interviewing techniques. Interviewing, observations and document analysis were chosen as data collection techniques in order to give this study a triangulated approach to add credibility to the data collected and help ensure that the research questions were addressed fully (Creswell, 2013). Reigeluth and Frick (1999) mention that triangulation in formative research may include the fact that there are interviews with multiple participants and multiple iterations of the instance. Part of triangulation involves providing rich, thick descriptions in the observations and interviews. Charmaz (2006) includes a list of seven questions that the researcher used to evaluate the sufficiency of collected data:

- Have I collected enough background data about persons, processes, and settings to have ready recall and to understand and portray the full range of contexts of the study?
- Have I gained detailed descriptions of a range of participants’ views and actions?
- Do the data reveal what lies beneath the surface?
- Are the data sufficient to reveal changes over time?
- Have I gained multiple views of the participants’ range of actions?
- Have I gathered data that enable me to develop analytic categories?
- What kinds of comparisons can I make between data? How do these comparisons generate and inform my ideas? (pp. 18-19)
Asking these questions throughout the data collection period can help increase the likelihood that the research findings will be more transferrable and can help the researcher point to a stronger link between the data and the final analysis (Charmaz, 2006). Interviewing is seen as an effective way to study a problem-based learning environment because the learning atmosphere combines so many varied aspects of pedagogy and media (van Gog, et al., 2008).

Focus groups can be effective because participants will have had similar experiences and the subject matter of the questions will not be of a sensitive manner. “This method assumes that an individual’s attitudes and beliefs are socially constructed: They do not form in a vacuum. People often listen to others’ opinions and understandings in forming their own” (Marshall & Rossman, 2011, p. 149). As such, focus group interviews are a natural extension of the constructivist collaborative problem solving methodology, which centers on this collaborative notion.

Another part of data collection for formative research was document analysis in the form of participant journaling through online discussion boards, responding to question prompts. A discussion board can be beneficial to creating a breadth and depth of data in document analysis because it creates “a supportive and collaborative environment, and encourages them [learners] to reflect on how they accomplish tasks” (Bikowski & Kessler, 2002, p. 28). These allowed the researcher to not only gain a broader understanding of the participants’ experiences of the phenomenon but created pathways that helped guide interview questions and further areas of explanation (Patton, 2002). Student participants were asked to respond to question prompts designed to elicit their
experiences with the instructional methodology. Clear prompts can lead to clear feedback by supporting the development of metacognition in learners (Kauffman, Ge, Xie, & Chen, 2008). Furthermore, using online or ICT (information communications technology) can create a less stressful environment and more productive way for the participants to complete classwork. In reflective analysis, online reflective writing can help learners think about instructor effectiveness and overall experiences (Krishnaiyer, Mushahar, & Ahmad, 2012). It is important to remember that an instructor can further facilitate the quality of student reflective feedback through sufficient modeling of reflection and feedback.

The final data collection method was an attitude scale that measured student perceptions of and attitudes toward the effectiveness of the CPS model (Yuan, et al., 2011). This scale was used to help define the perceived effectiveness of the CPS model and its revision. This attitude scale specifically measures student perception of how well the instruction imparts the identified skills that problem based learning is supposed to teach. The researchers identify these skills as critical thinking, problem solving skills, self-directed learning, motivation, and interpersonal skills, in addition to content domain knowledge (p. 578). They are intended outcomes that can be found throughout PBL research and are discussed in depth in Chapter 2 in the Problem-Based Learning section. The instrument used is a 20-item self-reporting 5-point Likert scale that measures perceptions of effectiveness toward the skills outcomes. For the purposes of this study, it was changed to a 6-point scale, as described later in this chapter. This instrument was used to help evaluate the model’s effectiveness.
**Data analysis.** The sub-sections under this section describe the methods the researcher employed to analyze data under each data collection method. Because Reigeluth and Frick (1999) do not offer prescriptions for data analysis, these sub-sections consists of guidelines from qualitative researchers conducting similar approaches that require interviewing and analysis through coding, bracketing, and memo-writing.

**Data analysis in interviewing.** Based on interview protocol by Rubin and Rubin (2012), the researcher followed their plan for interviewing data analysis. Prior to conducting an interview, the researcher bracketed his own experiences in order to come into the interview without preconceptions (Marshall & Rossman, 2011). Upon completion of each interview, the researcher summarized and took notes of any immediate thoughts, reactions, and plans for subsequent interviews. Prior to proceeding to additional interviews or observations, the researcher used these notes and reactions to formulate questions for subsequent participants. After conducting the interviews, the audio recording was used to transcribe and summarize them again. To analyze the transcriptions, the researcher followed grounded theory methodology. Grounded theory is a natural fit with formative research because they both rely on the same philosophical assumptions. Namely, that reality is described through empirical evidence, participants create their own meaning through interpretation, and theories develop (or are redesigned in the case of this formative research project) through inductive means (Charmaz, 2006). Grounded theory is a flexible methodology and was designed with the knowledge that it would be applied as researchers saw fit. In this methodology, “coding generates the bones of your analysis . . . Thus coding is more than a beginning; it shapes an analytic
frame from which you build the analysis” (p. 45). Rubin and Rubin (2012) recommend a grounded theory approach to coding, using line-by-line coding analysis, only when the transcript is not the researcher’s. Line-by-line coding was therefore not used. For each interview the transcripts were coded paying attention to themes and trying to answer the guiding research questions. After going through the first interview with close line by line coding, the researcher moved to focused coding and then theme development and eventually theory development as a theory began to emerge from the data. For interview analysis, Atlas.ti © and QDA Miner © were used to code and develop themes.

Observation analysis. In-class student-to-student interactions, during group interactions, and group-to-group interactions were made the focal points of the observations. Observation is necessary to influence interview questions and follow-ups as well as a way to reveal actions and behaviors that may otherwise remain undocumented (Guba & Lincoln, 1989). As Creswell (2013) suggests, the researcher used observational protocol to aid in the collection of thick, rich description as well as to bracket his thoughts and reflections from descriptions. Analysis of collected observational data started immediately following each observation. The researcher wrote a narrative description of the events, excerpts from which can be found in the following two chapters. At the same time, the researcher evaluated any effects the observations had on interview questions or pathways for further exploration in seeking to make improvements to the CPS model for this context. The researcher used the collaboration and problem-solving rubric to guide participant observations (Pazos, et al., 2010). The designers of this rubric provide an average score that demonstrates how well participants perform on
different indicators of collaboration and problem solving. The researcher analyzed the results from the observation rubric in the same manner.

**Document analysis.** Student participants were asked to respond to discussion board question prompts that asked for their analysis and feelings on the instructional strategies being used throughout the learning process in addition to questions designed to help them elaborate on their problem solving process (Du, Yu, Alinzock, 2011). These discussion board entries were analyzed as documents. Document analysis “provides a variety of cues for questions that can be asked during an interview” (Guba & Lincoln, 1989 p. 209). The documents functioned similarly to an interview as participants responded to researcher-generated questions. The researcher analyzed the documents by reading through each journal and creating a summary. The documents were subjected to content analysis, which, rather than focusing on the words and the meanings between them, was used to describe and interpret the learners’ responses (Marshall & Rossman, 2011). The documents were coded in much the same way they were in interviewing, looking for themes and approaching the research question.

**Attitude scale analysis.** In evaluating the instructional model for perceived effectiveness, this study used a Likert scale that allowed participants to self-report their skills development as a result of instruction (Yuan, et al., 2011). The skills the instrument evaluates include critical thinking, problem solving skills, self-directed learning, motivation, and interpersonal skills (p. 578). The instrument was used with permission from the authors of this 2011 study. The researchers take the average of the participants’ responses on the scale items to examine the mean scores of perception toward the
development of the aforementioned skills to assess the effectiveness of the instructional model. The researcher used the median score of the responses to gain a more accurate picture of learner attitudes. By examining the median scores of participant perceptions, the researcher was able to more carefully evaluate the instructional model’s effectiveness. GNU PSPP © was used for statistical analysis of the attitude scale to measure the standard deviation, alpha score and descriptive statistics. The results from this instrument were used to evaluate the formative revision of the model in order to best adapt the CPS model to this particular context and ensure the model remains effective.

**Instruments.** The two scale instruments used match the instructional methods and research methodologies that guide this research inquiry. The first was a ten-item scale that is designed to be used by an observer to rank participants on collaboration, interaction, critical thinking, and facilitator instruction (Pazos, et al., 2010). The second instrument was a 20-item self-report scale that asks learners to evaluate the effectiveness of a given instructional model’s ability to teach the stated skills that result from problem based instruction (Yuan, et al., 2011). Each one is described in greater detail within this section and was used with permission from the test creators.

**Assessing problem-solving approach and group interaction.** This instrument is designed to evaluate the effectiveness of the model in teaching problem solving and group interaction skills (Pazos, et al., 2010). It can be used to evaluate the instructor’s (or the facilitator’s in problem based methods) approach in leading groups. The instrument was designed to evaluate peer-led learning groups, meaning that within each group a peer leader emerges. Although this is not a part of the CPS model’s process activities or
comprehensive guidelines, that model does include a step where team members create individual roles on the team. The majority of the items in this instrument have been designed to assess collaboration and problem solving skills, not intra-team leadership skills. Specific items in the instrument ask an observer to evaluate student collaboration and interpersonal skills, critical thinking skills, and student and facilitator participation.

Based on significant research, the researchers identified the constructs of quality of interaction and problem solving approaches as being two of the three main factors that define peer-led group learning environments – the third being facilitation style (Pazos, Micari, & Light, 2010). It can be argued that these two main constructs serve to define the essence of collaborative, problem-based work:

First, although the students learn in a group, the ‘groupness’ of the experience can be more or less salient. Secondly, the ways in which the group approaches the problems can lead it to simpler or more profound engagement with the questions and concepts of the course. (p. 202)

Qualitative observations of group interactions were conducted throughout a school year by the three researchers who then compared findings using a thematic analysis technique. They initially identified five defining aspects of group learning environments upon which they based an initial observation rubric. This was scrutinized and amended by additional researchers and led the researchers to create the two distinct dimensions of collaborative groups, group interaction and problem solving approach. These were then shown to experts and undergraduate learners who were trained in group facilitation.
Each dimension was broken down further and put into a 2X2 model (consisting of four unique group classifications) to reflect dichotomous sub-descriptions of each aspect of group learning. The researchers chose these constructs because of the research that demonstrates their link to effective group work and desired learning outcomes. In order to further support these constructs, because assessing performance based on received grades can be problematic, the researchers use a confidence scale to demonstrate a correlation between confidence in performance and the two previously mentioned constructs (interaction and problem solving skills). The validity of the test items in evaluating these constructs is defined through confirmatory factor analysis. The instrument items are deemed reliable using Cronbach’s alpha.

This measurement tool was chosen because it provides a non-disciplinary-specific evaluation method to assess knowledge and implementation of problem solving skills. The specific skills assessed by the instrument (group interaction and problem solving skills) make up much of the CPS model’s process activities and guidelines. Because of the difficulty in creating a measurement for these skills, particularly across disciplines, the observational rubric is ideal because it does not rely on context-specific outcomes. The sub-topics that encompass the test items (interaction, communication, guidance, and management) are common among various problem-solving methodologies. The 10-item instrument can be found in Appendix A.

**Student views on the effectiveness of PBL.** This instrument, the PBL Evaluation Questionnaire, is designed to evaluate student perceptions of the effectiveness of the instruction in teaching the skills the researchers have identified as being taught by PBL
(Yuan, et al., 2011). They identify these skills as the following: Professional knowledge (applying knowledge, critical thinking), problem solving skills (real-world problems, critical thinking), self-directed learning (identify gaps in knowledge, identify learning needs), motivation (interest in learning), and group collaboration (interpersonal skills) (p. 578). The PBL Evaluation Questionnaire is a five-point Likert scale. For the purposes of this research study, it was shifted to a six-point scale. In an odd-numbered scale, researchers argue that it is most often tied to respondent ambivalence and Kulas, Stachowski, and Haynes (2008) suggest using an evenly numbered scale to eliminate the ambiguity associated with these types of responses. Garland (1991) has cited social desirability and a need to be socially acceptable as a possible reason why respondents have tended to select a neutral choice on Likert scales. Within the proposed study, this instrument was used to evaluate the perceived effectiveness of the CPS model and its revision.

The PBL Evaluation Questionnaire was first developed as part of a dissertation study by the lead author (Yuan, et al., 2011). The scale’s items were written based on PBL literature that identifies them as outcomes of well-designed PBL models. Respondents are asked to rank their perception of how well the instruction taught them each particular skill on a 5-point Likert scale. The scale goes from low to high, with the higher scores indicating a greater perceived effectiveness of the instruction. The study from which the researcher identified the scale implements it with two groups of undergraduate nursing students in Macao and Shanghai. All students had only completed this one-semester PBL course before taking the assessment. There were 28 fourth-year
students in Macao and 23 second-year students in Shanghai. The researchers calculated a content validity index of one. They identified internal reliability with a Cronbach’s alpha of 0.80 and a test-retest reliability measurement of 0.89 (p. 578).

The PBL Evaluation Questionnaire was chosen because it evaluates student perception of the effectiveness of an instructional model. It has an acceptable reliability measurement and it attempts to evaluate an instructional model on its ability to teach all the skills that the researcher identified as prominent outcomes of PBL in chapter 2. This instrument allows this dissertation to make a more definitive statement regarding the effectiveness of the revised CPS model in the context of the client-based internationally-focused problem solving program for undergraduate learners at a large Midwestern university. The questions for this instrument can be found in Appendix B. The authors have given permission for its use.

**Self as Researcher**

Throughout the past six years the researcher has worked at the global problem solving program that was the focus of this study as a teaching assistant. Within the past three years, the researcher started instructing classes and leading learners to complete problem-based projects. Having worked with undergraduate learners in this context for so many years, I understand how this type of instruction can impact their future careers beyond undergraduate study. I have had the opportunity to see the deep need for more learners to acquire the skills that these students get. My experience also allows me to see that the instruction is always changing to adapt to learner need and new technologies. It is
this dynamic environment matched with an equally dynamic instructional method that makes me believe that this research project will be both important and well received.

That viewpoint may have influenced my work on this project, since a novice researcher may have a tendency to want to find positive results. But, as Patton (2002) reminds readers, all data are results and a good researcher has to understand this, no matter his or her personal stake in the project. Having worked in PBL for years, there was a tendency to want to attempt to revert to old habits, but as I write about in researcher observations, I actively tried to face these concerns.

This study was carried out in classrooms being taught by the researcher. Measures were taken to limit the issues of bias presented by conducting backyard research. Data triangulation has already been mentioned as a method to improve data credibility and transferability (Creswell, 2013). Because of the emergent design and importance placed on collecting accurate data from participants, the researcher bracketed biases and preconceptions through *epoché*, as previously mentioned (Patton, 2002; Moustakas, 1994). Students were made explicitly aware that their participation in the study was completely voluntary and any feedback they provided regarding the critique of the instructional methodology would not affect their grades in any way (Bikowski, 2007). In fact, not all enrolled students participated in the research study. In conducting backyard research the researcher formed a close working relationship with the participants. Rubin and Rubin (2012) suggest reminding the participants that: (a) the interviews or data collection are in no way associated with their grade or class performance, and (b) that any interviews will be conducted as formally as necessary.
Finally, they were reminded that their critiques were always helpful and were directed toward the instructional model and not the facilitator, who was following the existing model. However, having the working relationship with the students may have made it easier to build better interviewee-interviewer relationships.

Summary

This Chapter described the data collection methods used in implementing and evaluating Nelson’s (1999) CPS model in order to recommend changes and improvements for this context. Formative research was chosen as the primary methodology as an evaluation of the instructional method’s effectiveness, efficiency, and appeal (Reigeluth & Frick, 1999). Throughout the two semester-long data collection phase, the researcher used interviews, focus groups, rubric-guided observations, a 20-item attitude assessment, and participant journaling to evaluate the instructional method. This chapter describes how the researcher used recommendations from literature to guide observation, interviewing, and focus group interviewing techniques. This chapter also describes how literature influenced data analysis techniques for all qualitative data collection methodologies. Grounded theory was used to influence the use of epoché, coding, and interview analysis. This chapter describes how the researcher used suggestions from literature to design the coding and analysis of documents and observations. The two instruments used in this study are described in detail; their use allowed the researcher to evaluate the model for its effectiveness and appeal.
Chapter 4: Findings and Analysis of the CPS Model’s First Instance

The findings described in this chapter served as the basis of the first revision of the CPS model. In this section, findings are presented in context of the guiding research questions and additional research, where appropriate. The research questions are as follows:

1. In the context of the client-based internationally-focused undergraduate problem solving program’s classes at a large Midwestern university, what are the strengths and weaknesses of the Collaborative Problem Solving Model?

2. What changes should be made to the model to make it better fit this context and do these improvements impact the integrity of the model?

3. What role does technology play in the design of the CPS model in this context?

This chapter outlines the findings from the data gathered from the 15 female and 8 male (23 total) participants and the researcher as participant observer from the first instance of the CPS model. This took place during the fall academic semester, school year 2013-2014. Data collected throughout this semester informed the model’s first revision, which was implemented during the spring semester of the same academic year. Data were collected through observations, document analysis in the form of journaling, focus groups, interviews, and a Problem Based Learning Evaluation Questionnaire. Findings from each data collection method are described within this chapter as they influence specific parts of the CPS model and as they provide answers to the guiding research questions. Findings are elaborated upon in sections describing the instructional method’s process activities (specific steps in the instructional process), participant
methods (instructor-implemented, learner-implemented, instructor- and learner-implemented, and interactive), and problem-based learning outcomes as described by Hung, Jonassen, and Liu (2007). Not all data collection methods reveal findings for all process activities, participant methods, and PBL outcomes. The chapter concludes with an analysis of findings and how they influenced the first revision of the instructional model. Participants were numbered based on the order in which they participated in interviews, focus groups, and participant journaling.

**Process Activities**

This section of findings details all relevant data referring to the CPS model’s process activities. The process activities are the steps through which learners and the instructor proceed throughout the course of instruction. They are sequential and meant to be followed in order. In each sub-section, a description of what occurred during the first iteration of the CPS model precedes the descriptions of the findings. Findings sections are organized as follows: (1) Focus groups and interview findings; (2) participant observations; (3) what were the strengths?; (4) what were the weaknesses?; (5) what improvements can be made?; and (6) what role does technology play?. Because the data did not reveal weaknesses and opportunities for improvement or the use of technology for all process activities, some of the following sections do not contain sub-sections related to those research questions.

**Build readiness.** During the first semester’s instance of the CPS model, the instruction began with an introduction to the instructional model. Learners were given space to voice any concerns or ask any questions of the researcher. They were prompted
on an online discussion board to state any concerns or ask any questions they would have before meeting in class. These concerns and questions were used by the researcher to prompt in-class discussions or to answer to outstanding questions. As the second part of the building readiness phase, learners are to “engag[e] in group- or team-building activities under the guidance of the instructor” (p. 259). These activities are designed to build the skills and experience learners need to participate in team-based work. To this end, learners were asked to learn about the culture with which they would be working in team-based and collaborative work by reading about the Indian-influenced community, discussing what they learn, and collaborate to teach one another specific cultural points. Nelson (1999) suggests doing so through “an instructor-led workshop or by distributing self-instructional materials to learners . . . unless their development of such skills is already fairly high” (p. 259).

Because the semester of data collection was the group’s third in a PBL environment, they were deemed to have already developed the types of skills Nelson says are essential (interpersonal interactions, group leadership, process management, interdependence, and consensus building). More focus was put on learners coming to a consensus on their understanding of this unique culture. The decision was made to emphasize the importance of learning about the culture of the location while building teamwork readiness in order to give all learners a common grounding, to elaborate on the point that any problem solution needs to be made specifically for this unique situation, and to entertain. The work students completed in this phase was determined by the facilitator based on the knowledge the learners would need to acquire. Students were
asked to collaborate on researching the community and writing about it with preliminary teams. They were then asked to read selections from a book detailing the international community in the modern world, which would form the basis of group and full-class discussions.

**Focus groups and interviews findings.** When asked about their feelings toward the initial discussion that outlined the instructional process and asked for their thoughts and concerns, student participants said that they thought it would not be too beneficial to discuss the process if they were trying to conceptualize it before having a real understanding of what the process would look like. But some participants found the candor and comprehensiveness of this part of the phase to be reassuring, beneficial, and rewarding:

Female #6: I think that doing that this semester was really helpful was because last semester was a rough one as far as instruction went because we did have a lot of difficulties and so it was really nice to be able to do that at the beginning of this semester so there’s not as many concerns as there were prior.

Researcher: You mean by laying out, this is exactly what’s going to happen?

Female #6: And just having more things that were under our control.

Learners appreciated being given a forum and the space to have their comments and concerns heard via the Blackboard discussion board prior to the in-class discussion.

Learners were asked to read about and then discuss certain aspects of the culture of the Indian culture in the United States. Students remarked that in past projects they learned a greater amount from learning about the cultures through reading news articles,
sharing videos, and talking to or asking questions of natives from that culture than otherwise. Learners expressed their enjoyment of this part of the phase but not all students saw the importance of cultural understanding:

Female #10: I guess it’s good to get to know the culture but I didn’t find how much we got to know the culture to make it really useful for the project. Because I never saw myself referencing that when I was doing research. Obviously it’s important to keep in mind the culture that they have and how they want to keep that alive but I don’t think I need to understand their culture for that.

Male #6: I don’t think it was necessarily as important for this project because we were still working inside the parameters so we understand how business is done and the targets market they’re going at are US people so we understand it. But if we tried to skip that introductory stuff or cultural stuff for [a different project] – like how they interact and all that stuff so we might be telling them how their idea would succeed but that would be in a US context. It wouldn’t be in the context of their culture for their customs.

However, more student participants saw the benefit of the cultural part of the building readiness phase of the CPS model than those who voiced their displeasure with it:

Male #2: I thought it was helpful too that really helped us understand that there was a thing with the different mentalities in the community. I don’t think we really would have understood the significance of that trend if we hadn’t done the book thing. So from that element it contributed to the project. It was also interesting to talk about it in this discussion like the actual culture itself. I’m just
trying to think if we hadn’t done that we would all wouldn’t have a similar understanding of what [they] believe so what their goals are and what’s important to it and certain things like that.

Male #7: I think it’s actually really necessary whether it applies to the business aspect. It does affect your understanding and interactions with the client as well as the approach you might take because for [them] they have so many tenets they have to follow and if you completely ignore those and recommend something that’s completely against them you’re treading against them and you come off as completely insensitive and you’ve practically done your research in vain because you didn’t consider what the client really wants socially and culturally for that environment.

Male #3: [It] gives us the understanding that there is a different factions inside their organization and it gave us a better understanding because it was related to our project even having [a wellness center] here some people might protest, you know. And it can be controversial for them. So, I think it opens our eyes a little more.

Despite more student participants being generally in favor of participating in culturally-related team-based activities than those who were not, there was the sense that this phase lasted a bit too long as the learners were eager to move onto the next part of the project.

One even described it as busy work:

Female #2: I feel like in the beginning we were kind of doing a bit of busy work just because we were . . . We didn’t really know what the client wanted. And
that’s when we all focused and decided what to really focus on. But I feel like if we could have done that a lot earlier it would have saved people a lot of time.

Researcher: OK so you’re giving me a couple different things here. So the first part, the cultural stuff. So you did or did not like that part?

Female #2: I just thought it was busy work sometimes. I don’t know if it was necessarily but I think I understand why I thought it was busy work.

Researcher: Now how would you feel about a different project skipping the introductory cultural stuff altogether?

Female #2: I feel like some of it’s needed but I didn’t feel like it wasn’t necessary every time.

**Participant observations.** This section is a recreation of the researcher’s participant observations and reflections. It appears as a synopsis and includes direct quotes from the written journaling and summaries. Regarding student reaction toward the in-class discussion on the instruction that would follow and the learners’ prior experiences with problem based learning, the researcher wrote that:

Student reaction was generally favorable. They like the idea of working on real problem solving skills and projects. One student remarked: ‘I find that I learn so much more with hands on learning and it’s more interesting that way, as well.’ They also like the community feeling that develops from working so closely with teammates in a problem-solving environment. One student said: ‘The collaborative aspect has been a very rewarding part of the instructional method because people in [this program] have very different, but valuable ideas so you
have to learn how to pull certain parts of ideas from different individuals apart to solve the problem or project charge.’ Many of the other comments students made regarding their good experiences with this type of instruction dealt with the program’s unique international component and the involvement of real companies for which students are solving problems.

When the class discussed the students’ experiences and concerns with the problem based methodology, the observer noted that students were largely concerned with the inherent lack of clarity and perceived disorganization in problem solving methodology. The observer noted that the learners worry about how being faced with the unknown makes it harder to plan ahead. Problems and design plans do shift frequently in any problem-solving model, including the CPS model, and the observer wrote that the ambiguity in this type of instructional methodology can be problematic for students.

They are given a problem to solve, which they have to determine is even the correct problem and if their classmates share a similar interpretation of it. Then they have to find and test an adequate solution to the problem. This model is difficult to work with for students who are new to it or are accustomed to being assigned tasks and assignments for the purposes of passing a paper-based test. It sounds strange to write this but students have a difficult time finding their own ways to an unclear and ambiguous final end-result with a purpose that I would call more tangible than passing a test for a grade, which may or may not have actual real-world implications somewhere down the line. This ambiguity carries over to their obsession with grades and assignments.
The CPS model allows students to set their own schedules and determine any assignments that keep them moving forward on their problem solutions and demands. One student said that “. . . sometimes things seem a bit unknown or ambiguous and we aren’t clear on what to do or how to do things.” This need for tolerance for the unknown seems to be inherent in the CPS model, which does not have one set predetermined outcome or problem solution. “Some of the projects are hard to start because they are so broad, but I think this is necessary for the nature of . . . class.”

The researcher discusses how the concerns students had were addressed as part of an in-class discussion the nature of facing ambiguous situations and shifting problem statements and solutions and how this would relate to their post-college work. Once the observer and students discussed this, student participants “were vocally more acceptable (not just tolerant) of ambiguity after the discussion.” The observer goes on to write:

I did note that since the students come from a variety of backgrounds and that they often enter a problem situation with little knowledge of the background and context involved these instructional situations become much more ambiguous than they might be when working after college. They agreed but also stated that facing these situations would better prepare them for any challenges they may face in a job and might even help them become much more versatile and valuable assets to a company.

Building readiness spanned multiple classes as the students were asked to not only familiarize themselves with the instructional method, which took less time because of
their familiarity. They discussed the problem statement as it was introduced and started brainstorming different approaches to the problem.

*What were the strengths?* When the Build Readiness process activity was implemented in this environment, student response was generally favorable. The in-class discussion allowed learners the space to voice their concerns and the online discussion board allowed them more space to do so prior to the in-class discussion. The discussion board responses provided talking points for the instructor to help lead the discussion. This discussion led participants to not only tolerate but accept some of the fears they had expressed on the discussion board. These fears included issues such as ambiguity in the learning process and less guidance from the instructor as they would have liked. Female #6 said the following: “it was really nice to be able to do that at the beginning of this semester so there’s not as many concerns as there were prior.”

Students provided feedback stating that they have enjoyed taking time to learn about the cultures of the international client for whom they solve problems. They found it enjoyable in previous projects and they see the need for it in future projects. Most students enjoyed reading news, discussing it, and learning about the culture. As was previously mentioned, one learner said that finding an adequate problem solution would have been impossible without knowledge of the client’s culture. Male #2 said, “I don’t think we really would have understood the significance of that trend if we hadn’t done the book thing.”

*What were the weaknesses?* Most student feedback and observations were positive regarding the first process activity. However, there was negative feedback
regarding the amount of time spent on the cultural activities as part of working on group
skills. One student, Female #2, found the cultural activities to be what she deemed “busy
work” and there were others who only appreciated some of the team-based work. But
when pressed on the issue, the students admitted that some of it was important and some
they felt was not relevant. Learners felt that they should be working with the problem
statements much earlier in the process rather than spending as much time in this phase.

What improvements can be made? Although sometimes the introduction of the
problem statements in an environment with real-world clients can be dictated by factors
out of the instructor’s control, the build readiness process activity was not well divided
among all three sections. The instructor should gauge the participants’ preparedness for
the collaborative instruction and move onto the problem statement as appropriate for the
class. Because this class was more experienced with collaboration and problem based
methods, they did not require as much team-based preparation. Furthermore, to prevent
the cultural work from feeling like busy work as the one participant stated, learners can
work with the instructor to create their own assignments and team-based tasks for group
process practice. Not only would this ensure the research is more relevant for the
learners, it promotes self-directed learning and gives them additional ownership and
control of the learning process (Boud & Feletti, 1997; Hmelo-Silver, 2004). An
amendment to the build readiness phase for this context should be that learners practice
group process skills with the aim of also learning about the culture of the target client.
Understanding the unique cultural differences of the client or the client’s place of
operation can be integral to the success of any business practice (Gao, 2013). When
possible, these cultural activities can be directly related to the client and problem statement because of the importance placed on being familiar with the target demographic and working environment of a particular culture (Morales, 2011). This process should be aided by the use of an online discussion board that allows for learners to voice any concerns, positive opinions, or questions regarding the likely unfamiliar methodology. As Bikowski and Kessler (2002) point out, using the discussion board encourages reflection while supporting collaboration. Using the discussion board can be beneficial for those learners who have previously participated in a problem-based course as it can help them reflect on overall experiences (Krishnaiyer, Mushahar, & Ahmad, 2012).

The final change that was made for this environment is that the authentic problem was presented to the learners instead of the instructor working in conjunction with them to define an authentic and appealing problem. Working in a PBL context with real clients, Lopez and Lee (2005) noted that the difference in that situation from a traditional PBL is primarily in the selection and delivery of the problem statement. The problem learners face is inherently authentic in this context and the intended outcomes are the same as those previously stated in Chapter 2. Based on this research, the improvement made to this process activity is to carefully select the client for learner appeal and relevance, and to present the problem statement to the learners rather than collaborate to write one.

**What role does technology play?** The use of the discussion board to precede the in-class discussion on problem-based instruction was essential. It provided a voice for every student – some of whom may have been reluctant to discuss his or her concerns in
class. And, as was previously mentioned it provided discussion points that led the learners to tolerate and accept the ambiguity and need for self-direction that are so important to PBL. The participants said that they enjoyed using it and it gave the instructor discussion points to talk about.

**Form and norm groups.** Nelson (1999) writes that the instructor can allow students to form their own groups within certain constraints when it is possible. Some criteria listed are “. . . that both sexes be represented, that at least one person be an international or ESL student (where applicable), and that each person on the team should work with at least one person who is not already known” (pp. 259-260). Since every member of this class knew all the others, they were asked to choose teammates based on different majors, representation of both sexes, somebody they have not worked with on a team previously, native speakers of English – that is one team should not contain any more than nonnative English speaker. Once students were in teams, they were asked to create a set of ground rules and operating guidelines and a team identity by way of a unique team name.

**Focus groups and interviews findings.** Even within the constraints the CPS model provided for finding teammates, participants did not want to have to choose one person over another and discriminate that way. They did not want to hurt anybody’s feelings. There were no mixed emotions. None enjoyed this approach:

Male #5: I think it’s a bad idea too. With groups that know each other very well I think it’s a bad idea because – I don’t know. It’s just like everyone knows by now, I think, like a little bit about each other’s strengths and weaknesses so I feel like it
can turn and increasingly it’ll turn into a more political thing than it should. You know what I mean?

Researcher: Yes.

Male #5: I’m not saying that happened this time but I didn’t think. I never thought that we were going to be able to choose our groups. It kind of just came out of nowhere. But I feel like if we were to choose them next semester with advance – I don’t know. I just feel like it becomes more of like a . . .

Female #10: Competition.

Male #5: I don’t really know how to say it. It’s like. I don’t know how to say it.

Female #8: It’s just uncomfortable.

Male #5: It makes people upset when you have to make a decision.

Male #2: It’s polarizing.

Female #8: It’s like we all respect each other so it’s like awkward. I don’t know. I wouldn’t care who I was in a group with. . .

The researcher offered justification for this practice by citing the CPS method’s stance that learners should be allowed to choose their own teams when possible. One student offered an alternative solution:

Male #4: I think if we had a week to do it then it would be OK.

All: No. I don’t like that.

Female #4: I’d just like it to be randomized. And sometimes you can see things from an outside perspective so you should just do it.
Male #3: I just think it’s better when you guys choose the groups. Somebody said down here that you guys have a different – the right perspective as somebody that is a teacher to look at all of us and decide where we go. We don’t think, at least I did not. I didn’t think about working great with one person. You know what I mean? It’s a little more academic based whereas when we do it, it’s more “who do I want to hang out with for a few weeks?”

Male #5: I feel like it’s like lunch tables in grade school. That’s what I was trying to say.

After forming groups, teams were asked to create a set of ground rules and create their sense of identity by creating a unique team name. During the focus group and interviews, participants stated that they found the ground rules unnecessary since they are a group of students who have already worked together for one year and have A) done this exercise before, and B) already established organically a set of rules and procedures for themselves:

Male #7: Ground rules are kind of a given. We did them the first semester. At this point everyone understands how things work so we kind of just make them up because we feel like we have to.

Female #3: I feel like our class as a whole already has our set ground rules that we already know that lead us to respect each other.

Researcher: Does anybody have any different reaction?

Female #6: I didn’t like them.

Researcher: What about the first semester? How was it then?
Many: I think it was fine. It was good. We were new.

Male #2: As an instructor it lets us know that this is what you want. It lets us know your expectations. We kind of looked at it that way. But now it seems like it’s unnecessary.

Despite the ground rules put in place, one team had an issue with a teammate who was not contributing equally and not arriving at meetings on time. Even though the team had created ground rules to cope with a situation like this, they still approached the instructor and asked for the issue to be resolved. When asked during a one-on-one interview, one member of that team stated that the ground rules in place were not followed to resolve the conflict internally:

Female #9: I feel like at the moment I wanted you just to fix it. I mean probably not [the ground rules were probably not followed]. I really don’t think that comes down on the responsibility of the instructor. I really don’t see how getting you more involved would have helped. I think it might have made it worse.

**Participant observations.** The researcher reports recognizing that this group of learners, with their prior experience in problem-based methodology, was advanced enough and had an existing baseline of understanding how to work together on problem solutions to need to participate in some of the early procedures. For example, on writing a set of ground rules, teams were able to complete the task rather quickly since they have prior experience working in a similar problem-based instructional methodology. The researcher wrote, “Nelson (1999) mentions that this part of the process can be particularly hairy, and I don’t disagree for those who have no experience doing so. But today it was
not difficult for any of the teams.” However, the researcher observed how the teams seemed to enjoy creating their sense of identity by giving their groups team names that were often silly.

The researcher observed how the students felt uncomfortable choosing their own groups, even when given parameters of working with people with whom they had never worked, did not know as well as some of their other classmate, and have dissimilar disciplines. “I got the impression that they didn’t want to appear to play favorites.” Once the students were in their teams, the researcher met with each team to gauge their starting points and next steps. On this experience the researcher writes about how it felt following the CPS model’s comprehensive guidelines:

It felt strange to be so hands-off with the instruction. Even with years of experience in problem-based instruction, I had to force myself to allow the students to explore any problem solution they found feasible. In time I know that the research they gather will either support their problem solution or not. However, I did find myself doing as Nelson (1999) suggests by facilitating student questioning (not telling them what to do) and making sure that they were asking as many questions as possible and approaching it from many angles.

What were the strengths? Student reaction to the activities in this phase was almost universally panned, except for the creation of a team identity in the form of a nickname, which the students enjoyed and enjoyed showing off. Despite the fact that students did not enjoy the way teams were formed, the teams were heterogeneously composed, which, as the intent of this process activity in the CPS model, gives learners
“a richer experience” (Nelson, 1999, p. 259). The sizes of the teams (four teams of four, one team of three) were adequate, save for the one team with a teammate who was not taking on as much work as the others. The teams that eventually formed were productive and remained mostly on task, as observations and document analysis reveal later in this chapter, indicating that the manner in which teams were formed was effective, in some respects.

**What were the weaknesses?** Asking the students to find their own teammates, even based on the criteria they were given, was problematic and was met with resistance by the students. It created a feeling of competition and antipathy among the participants who said they felt like they were choosing among their friends and did not want to be exclusionary. The students stated that they would prefer the instructor choose teams for them.

Asking learners to create a set of ground rules was also widely disliked by the students. They said that they only complied because they were asked to and likely did not take the exercise seriously. This was most evident when a problem arose later in the course and the team immediately sought help from the instructor rather than referencing the rules they had set out. This indicates that the weakness was not the exercise of creating ground rules or their necessity. Rather, the weakness may lie in communicating the importance of the ground rules and the students’ knowledge of effective conflict management.

**What improvements can be made?** Nelson (1999) offers many options to form teams in the CPS model. Because the learners in this context work together closely for
two years, the concern of excluding some classmates can be problematic. The learners in this first instance of the CPS model viewed the process as choosing among friends. They need to be made explicitly aware that they are forming teams to adhere only to the criteria the instructor lays out. The instructor needs to be aware that there can be problems when asking the students to choose among their friends and may need to avoid allowing it or set specific criteria.

The second change to the CPS model for the first revision regards the instructor’s communication of the importance of the establishment of ground rules and his or her expectations for their adherence. The fall semester’s experience demonstrated that when the instructor did not communicate that he expects student teams to follow the ground rules then the students may not take them seriously or follow them. The instructor needs to give the students time to research established rules and regulations for work and conflict management. He or she needs to communicate to the learners that these are important because they will be asked to adhere to the rules before seeking out instructor mediation because of the learning gains this experience can provide. He or she needs to communicate that this is part of their instructional process. The instructor will always be there but the educational process needs to be about students directing their own learning and practicing interpersonal skills. Emphasizing the importance of these ground rules can be important to the development of the students’ education. The CPS model and other problem based methods offer learners the opportunity to learn skills that drive success in business, and Sadri (2012) writes that “dysfunctional conflict . . . tends to divert energy from work, creates stress for people, wastes resources, creates a poor work climate,
negatively affects the cohesiveness of work groups and can lead to aggressive and hostile behaviors” (p. 22). Since researchers also indicate that problem based instructional methods can help develop conflict management skills in learners, the instructor should not deny the learners the opportunity to practice (Seren & Ustun, 2007; Yalcin, Karahan, Karadenizli, & Sahin, 2006).

**What role does technology play?** For the first revision of the CPS model, the instructor asks learners to research established rules and regulations for teamwork. This can be done in class and learners will undoubtedly need technology like a computer or smart phone to conduct the research. Furthermore, the class can use an online forum to collaborate on the creation of ground rules or to share resources during this process activity. Alternatively, the instructor can provide resources on effective teamwork rules and regulations via the class Blackboard page.

**Determine a preliminary problem definition.** During this process activity teams were asked to negotiate a common understanding of the problem they faced. The class discussed among teams what the problem was so that all students came to a whole-class understanding. Initially, some teams did not have a common understanding among team members, but they were able to quickly come to terms as individual groups. The activity continued as learners identified learning issues or information that they would need to know in order to create a design plan. They identify where they can find the information, set out to acquire it, bring it back to their team, and create a design plan. The design plan for each team focused on an initial brainstorming phase of potential problem solutions, of which learners selected one to guide their design plan. After this process, the CPS model
dictates that the design plan is to be re-evaluated and redesigned as new information dictates. All teams followed this procedure as they initially set out to find information to help refine their design plan and eventually they re-designed or completely changed their design plan. Once teams were set with their design plan they moved onto the next process activity.

**Focus groups and interviews findings.** When teams were asked to determine different potential problem solutions they were able to easily figure out where they needed to look for initial resources and facts. Some found it easy to start with potential problem solutions and, as the following interchange demonstrates, others found this restrictive and did not select one to evaluate over others:

Male #7: It gave us all kinds of different options to explore. We just kind of had time to think about the problem and assess what might be the best way to take it.
Researcher: So it got you thinking?
Male #7: Yeah. And I don’t think we necessarily chose one. I think we chose a couple to investigate in case we felt otherwise about certain aspects of one.

This part of the instructional process continued while teams reported findings to their team members and they continued to refine their design plan. Although some learners appreciated the approach of being able to outline their design plan from the start, others identified their distaste for this part of the phase:

Male #2: What I didn’t like was sometimes you get a little invested in something and it turns out, well, we were right in the first place but you’ve already done this
much work so you find a way to tweak it so that, you know what I mean, be as right as possible, within this work.

A dialog started with the students on this point. The researcher asked how they would approach it instead. The following exchange highlights these points:

Male #2: I don’t know. Maybe have objectives for research and we want to understand this by this point and as things come up, you can add those to that list but if you have an objective of go this route and you’re gonna research stuff not as intense as it should be.

Male #1: Expanding, I agree. Maybe pick two or three points to research and see how work diverges.

Researcher: So, rather than start with what you think could be a solution, collect a bunch of base research on stuff before?

Male #1: Right. Some ideas sound pretty before you actually look into them but after you look into them more you’re finally almost done with your project you find that one flaw and you’re done.

Researcher: So how many people thought it was difficult to start with identifying a solution?

[Majority of hands raise]

**Participant observations.** When the teams worked past step three of presenting the information gathered during their fact-finding missions to refine, redesign and alter their design plan, the researcher observed one team abandon their original design plan and problem solution in favor of another. The researcher wrote that watching this occur
was positive because “the process worked in this case and they had to abandon their original plans based on facts and good research.”

Other teams slightly shifted and started to focus their research plans a bit more – all after the initial fact-finding mission. The team that, on the previous class date, did not have a project design and felt more comfortable with a preliminary fact-finding mission was coming around and being led to a solution more fitting to the problem statement.

The researcher observed that, although he was trying to ask teams questions and elicit a response, “some teams are still not asking enough questions and analyzing the situations from enough angles. I think that having inter-group meetings and letting them see some of the questions that other teams are asking will help.”

**What were the strengths?** Asking learners to identify a common understanding of the problem statement worked well as a way to get all team members on the same page. The researcher observed this and wrote, “having seen what can happen when teams don’t have the same understanding of the problem, this is an ideal starting point for the teamwork.” No negative statements were made regarding this part of the process activity.

Similarly, having learners continue by identifying their learning issues by way of identifying their existing knowledge and gaps worked well and felt like a logical next step. Following that, having students brainstorm solutions, settling on one, fact-finding and refining their design plan all allowed students to move forward easily. One student remarked that he “liked that it drove us to find a solution in the first place we had to put a name to it. And it gave us a baseline start somewhere.”
What were the weaknesses? That same student who enjoyed having a baseline from which to start went on to note that starting with and working out from a problem solution prevented his team from reaching the best possible solution because they had so many resources invested into an initial design plan. The process of finding a solution, researching it and then re-evaluating and changing it if necessary worked for a short period. But once teams started moving along further with one problem solution they were certainly less apt to change it, as evidenced from the paraphrase from the focus group above. It forced students into defining a solution before they had any information on the problem and, in some cases, led to research that was selected to match their proposed solutions rather than the other way around. There may be a problem solution presented to learners that is based in the real world but the problems that the students see are often actually the result of a problem. In no way can the learners begin to design a solution when they have failed to see the true problem.

What improvements can be made? The participant observer wrote that identifying potential problem solutions at the start of the investigation felt like “putting the cart before the horse” because the learners did not appear to have enough knowledge to create a workable hypothesis. Designing an initial research plan can still be beneficial and students still need to identify gaps in their knowledge and locations of information to do so. The learners started to formulate potential problem solutions to the problem without enough information to justify their decisions. In the first revision of the model, rather than identify potential problem solutions, learners were asked to identify gaps in their knowledge that they will need to fill in order to eventually identify a problem
solution. Before brainstorming a list of possible solutions, learners conduct fact-finding
tasks and research. This is a normal PBL procedure, as the learners determine what they
do and do not know and has been identified as one of the primary goals of this
instructional method (Barrows, 1986; Yuan, Williams, Yin, Liu, Fang, & Pang, 2011).
Eventually, they will have enough research and information to identify potential problem
solutions. Although this is not a dramatic shift from the original model it does keep the
learners from being forced to identify problem solutions before they have enough
information to do so. The learners in this instance of the CPS model did not know enough
about the situation to even identify the gaps in their knowledge without first conducting
research. Additionally, learners are asked to create a preliminary action plan to set out to
find information on their client, problem statement, industry, etc. This, instead of creating
and revising a design plan, will help learners establish a baseline of information to share
with their teammates and lead to a long-term action plan. This designing of an action plan
phase took place in the subsequent process activity in the revised instance of the CPS
model.

This change is based not only on student feedback and participant observations.
The PBL tutorial process, as described by Hmelo-Silver (2004) has learners formulate a
hypothesis for the problem solution, but only after they understand the problem well
enough. With the complicated problem that learners faced in the first instance of the CPS
model, they did not fully understand the problem until after completing fact-finding
missions. Furthermore, it may have been the language used in Nelson’s (1999) model that
prevented learners from abandoning their potential problem solutions. It could also be the
need to develop an initial design plan from the one selected potential problem solution. Teams can explore various hypotheses (as Hmelo-Silver (2004) calls them) in pursuit of a workable problem solution. In fact, many teams set out to explore many ideas at once during the first instance of the CPS model. Ramsay and Sorrell (2007) lay out a PBL model specifically designed to prepare learners to be professionals. In their process, learners start by identifying their existing knowledge and relevant missing knowledge they will need to define a hypothesis. Only after setting out an investigating can learners identify a hypothesis.

**Define and assign roles.** During this phase of the CPS method, teams were asked to determine the team member roles they would need to have to find a solution to their problem definition and then assign those roles to individual members. Before assigning the roles, the teams were given some suggestions of roles and asked to conduct in-class research about common roles in team-based work. They were to use this research to determine the roles that would best suit their team and their specific needs. The instructor met and worked with teams during this process to ensure that they were exploring all their options and that they would have a suitable range of roles.

**Focus groups and interviews findings.** The general reaction is that student participants found these to be unnecessary and useless. If they were forced to do them, students would prefer a list from which to choose various roles, rather than being given some suggestions and asked to find and determine them autonomously. The following exchange demonstrates many of the participants’ opinions toward role assignment:

Male #2: We pretty much just picked roles because we had to.
Researcher: So you guys basically just did it because you were asked to?

Team: Yeah.

Researcher: How many people did that?

<many hands>

Researcher: How many found it really beneficial.

<no hands>

Others saw the benefit to having roles initially but pointed out that the roles become less well-defined or even observed as the project moved along:

Female #5: I also feel like the roles were helpful especially in establishing – they were kind of in a way of what we wanted to get done. There were things that we knew we needed to do but I don’t know if our group necessarily stuck to them throughout the semester as much as we probably should have or could have. So they were helpful but later on they were kind of not even thought about.

Female #10: They disappeared.

Female #10: I think people’s roles just start to naturally take place as it progresses.

Nelson’s (1999) CPS model allows for roles to shift as the project moves on and this comment highlights the teams’ willingness to change and adapt. Learners were able to adequately identify individual tasks and responsibilities throughout the entire process and were not constrained by their initial roles. The students took on different responsibilities and tried different things throughout the whole semester:
Male #7: The roles we defined for each other – everyone ended up just doing the same roles. Doing what was necessary. Someone could do this or do that and I felt that was better than everyone having to go to one person to do one specific thing. Everyone just kind of did it in a team-basis.

Researcher: OK. What about roles that were. Like you’re in charge of, let’s say, submitting the team’s stuff or you’re in charge of communicating with this person or something like that. Would that be helpful at all?

Male #7: Those roles are kind of assigned as the project progresses depending on what phase you have. Like it was contacting . . . then it was my job. If it was . . . then it was [teammate’s name] job and so forth.

Female #9: Theoretically, for us, it worked at the beginning and then it disintegrated. It was just maddening. I just agree that it comes naturally. You’ll fill in with what you need based on your strengths.

Participant observations. The researcher observed that the role assignment part of the process felt unfamiliar. He writes:

I was unsure of the different roles possible in a group. I researched and presented the teams with some options but then I asked the students to search online for different team roles that they felt would apply to their particular case and problem. Many of the roles teams assigned were the same. Every team created a role for a project coordinator, which they seem to have identified as a team leader of sorts. They all also identified a team member who was supposed to act as an editor or note-taker during meetings.
In reflection, the researcher wonders whether it would have been more effective if he had assigned roles to students or if he had given them a list with descriptions to choose among. He continues to describe how some of the teams had well-defined out team roles while others did not seem to want to fully develop their roles. He concludes by stating that the results will speak for themselves eventually but “the idea of having team members choose roles to play felt unnatural. I’d have rather assigned them or done away with them altogether.”

**What were the strengths?** In a way, defining and assigning roles helped some teams establish what they wanted to accomplish. At specific times during the instructional process, learners assigned roles and specific tasks to team members and that helped the team accomplish some of their goals.

**What were the weaknesses?** Assigning specific roles to team members before beginning the iterative collaborative problem solving process was found to be impractical. As the students stated in the focus group, the roles and tasks each person was assigned tended to emerge as the semester progressed and would vary from one task to the next. Although the CPS model states that roles shift over time, the students and instructor found it unnecessary and a hindrance to assign overarching roles at the beginning of the research period. Students admitted to only choosing roles because they were asked to, not because they agreed with the method. When asked if they found it beneficial, all students unanimously agreed that it was not helpful because their roles emerge over time. One student, Male #7, said, “Someone could do this or do that and I
felt that was better than everyone having to go to one person to do one specific thing. Everyone just kind of did it in a team-basis.”

**What improvements can be made?** Rather than dedicate a process activity to design and assign roles at the outset of the research-gathering period, as part of each task, students designate work among their team members in pursuit of the completion of each task. The instructor should work with the teams along the way to ensure that they are equally distributing work. This does not differ that greatly from Nelson’s (1999) original model. The improvement for this context is that overarching roles are no longer assigned and this process activity is replaced by one in which learners develop a long-term action plan.

Based on feedback from learners and participant observations as outlined in the previous process activity section, finding a potential problem solution and working toward it prevented learners from finding the best possible solution. Assigning overarching roles to team members was found to be superfluous as the teams assigned roles within each task as part of their collaborative problem solving actions. Rather than working backwards from the problem solution toward justification, the fourth process activity will ask learners to design a detailed, long-term action plan. Although it can be something that should be updated and amended as the students make progress, the action plan should define the tasks and research that learners need to accomplish in order to create a potential problem solution. Similar in spirit to the CPS model’s design plan in that it helps them organize their tasks and stay focused toward moving to the next assignment and end goal. A detailed action plan, not just a list of topics to cover and
research will help the teams progress (Halvorson, 2014). The teams should work with an instructor to define the types of assignments they will need and the specific parameters surrounding them. They will have to answer questions about how the teams will organize their research and present it to the instructor for feedback and what kinds of data (primary, secondary) will be necessary to complete a given task or assignment. In a way, this can be viewed as a calendar of assignments on a syllabus that an instructor may give students as a contract. A detailed description of this revised process activity, as well as all the others, is offered in Chapter 6.

Engage in the primary, iterative collaborative problem-solving process. This is the longest part of the process, in terms of time spent on it. While there were times at the beginning of the process when students completely re-evaluated their problem solution in light of newfound information, they had all found a solution with which to proceed by this phase. This phase incorporates a variety of participant methods, which are discussed later, and specific actions taken by both the learners and the instructor. This process activity consists of nine separate smaller activities, which are (a) refine and evolve the design plan; (b) identify and assign tasks; (c) acquire needed information, resources, and expertise; (d) collaborate with the instructor to acquire additional resources and skills needed; (e) disseminate acquired information, resources, and expertise to the other group members; (f) engage in solution- or project-development work; (g) report regularly on individual contributions and group activities; (h) participate in intergroup collaborations and evaluations; (i) conduct formative research of the solution or project.
Throughout this phase, teams continued to identify research they needed and designated tasks to individual team members. During most classes the instructor met with teams, discussed their progress and provided them with feedback. Learners brought their research to class to discuss with their teammates where it fit and what kinds of additional research they needed to complete. Classes were dedicated to inter-team meetings when teams were expected to give one another updates on their progress and give and receive feedback and suggestions. Other class periods were dedicated to students giving updates to all of their classmates who were, again, expected to give feedback and offer suggestions or share resources.

**Focus groups and interviews findings.** Since there is overlap in this process activity with the other activities that required students to refine their design plan and identify and assign tasks, some of findings in those specific activities are covered in other sections. Participants did not specifically address some of the other smaller activities at all. But those that were discussed are presented here. Similar to feedback in the third process activity where teams were asked to create a problem definition then a design plan based on their potential problem solution, they responded to feeling a bit stuck with their problem solution because they had gotten so far into researching about it. Intergroup collaborations and evaluations were discussed the most, as they became a prominent part of the learning experience throughout the semester:

Female #3: Just to go off what [Female #4] said when we did our presentations and having the students, like everyone else in the class give us feedback. I really liked that because, in the past years we’ve gotten feedback from [only instructors]
from our projects, our presentations. But this year, I think more other groups gave these groups more feedback and that was good.

Researcher: Do you think it helped you at all to give feedback in any way?
Male #2: I think it’s kind of better than having an instructor give you feedback because we’re all in similar situations, researching the same things so we can kind of fact check each other whereas an instructor, you’re coming to them with like “here’s what I found” and they can tell you if it sounds logical how it flows but your peer might know something more specific.

Learners saw the benefit in learning from one another about unique problem solutions through intergroup discussions that may have opened their minds to new ways of thinking:

Female #5: I was going to say that I really liked giving feedback and being able to see what other groups were doing too because when we first did that I was in a group with [name] and I had never heard of [other team’s problem solution] before so it was really interesting to kind of ask questions and see how that would work. So I liked that, as well. Because we got to not only see what other groups were doing but ask questions about it.

Some of the students then pointed out the benefit of receiving feedback from peers instead of instructors. In an environment like this, the learners point out, because the students conduct the research and fact-finding missions, they are able to relate to one another in a much different manner than the instructor can.
Male #4: Going off that it’s definitely more helpful to hear from your peers just because they’re like [male respondent] said, put in the same situation as you and doing research on the same stuff so it’s like they say ‘Oh that’s interesting, did you also think of this?’.

The intergroup collaboration took a turn toward the end of the semester when the teams decided to take a whole-class collaborative effort in designing their final products. Since they were developing problem solutions for a real client they made a concerted effort to ensure their research and presentations were differentiated and coordinated enough for each team to form a singular part of a greater whole. One student remarked on this level of inter-team collaboration:

Male #1: I liked how, through the feedback, toward the end especially the mid semester presentation, I really liked how we took our own direction and how we came together as a class to present different ideas. At first when we did it, it was kind of repetitive and I feel like sometimes the projects get that way when we all do the same thing. It’s like they hear the exact same thing over and over again and there’s not a lot of different perspectives. But this time we went with it and we saw who had the best ideas and diverged so I liked that.

On having to report regularly on individual and group activities and contributions, the learners had generally positive reactions. It seemed to help them move from one step to the next and collect their research:

Male #7: I thought it worked well. Every day our group had something due, we had just finished researching something. We always came back and talked about it
and talked about what we thought was good and maybe aspects we could use and moved onto the next part. It was kind of a standard procedure. What we’ve always done in [this program] is meet back and talk about what we found and just keep moving forward.

Female #6: That whole part really helps to make the group collaboration process more involved because through doing that you get to expand ideas that maybe one individual had or shut them down. It’s really good. I just forgot what I was saying halfway through that. But it was good.

A common theme that student participants discussed was the desire for more guidance and direction from the instructor. When meeting with the instructor to report on the work of the team and its individuals, one student suggested the instructor be more willing to suggest work or assignments for the team:

Male #2: I think when you work in groups you’d come around and we’d just kind of go through what we’re doing. That would be a good time to say, like, alright, for Monday bring some sort of well-researched response to this . . . . What would be posed as a question from us to you. I think it’s going to be obvious to the instructor that, well, this is what they’re in need of or what their problem is. Like for example, well we don’t know about certifications or something.

**Participant observations.** Several observations were made during this process activity. The researcher wrote that the response was positive when students and teams were asked to brainstorm and identify assignments that they could complete throughout the semester. The students identified primary research as an important aspect of the
process and many of their suggestions matched the ideas the researcher had. He wrote that “they are a smart group and it was very evident that they all had experience in PBL.”

He was surprised that the learners requested weekly check-ins on their progress. This is something the CPS model requires that students did not know about at the time. To that end, the researcher had already made plans to conduct these kinds of updates via the discussion board in and with periodic in-class check-ins that match with the observational rubric.

In a separate observation, the researcher wrote about his satisfaction with the progress and drive of the teams. “They really are thinking about the project and seem to need little motivation. I’m still going to have to drive some teams to continue to ask questions because they seem a little stuck and unsure how to move forward.”

Other observations throughout this process activity were that the teams were progressing at a high level. Their interactions were measured with the help of the observation rubric, the results of which are found later in the chapter. The researcher wrote that teams continued to find primary sources to provide insight and help with their work. “I do continuously remind them that I can help them locate and get in contact with people if they need my help but not one group has approached me needing assistance.”

What are the strengths? This process activity encompasses nine sub-activities, most of which are iterative. For the most part, the entire process activity was well received by the students and researcher. The observation rubric and student journaling (the results of which are found at the end of this chapter) confirm that it was designed in a way to promote student-directed collaboration and problem solving. Of particular interest
to the learners were the collaborations that occurred between teams and among all members of the class. Student feedback indicates that what they learned from these activities included strategies for giving and receiving critical feedback, content knowledge, collaborative strategies, and skills for long term project planning. From the researcher’s perspective, these activities helped keep teams on track and focused since they would have to prepare to share information and receive feedback.

Similarly, the learners were kept on task and enjoyed reporting regularly to and working with the instructor. As document analysis data suggest, learners appreciated the questioning the instructor offered and the way there was not as much direct instruction. This, they wrote, allowed for more creativity and self-direction in their development of their potential problem solutions. Findings from document analysis can be found at the end of this chapter.

*What were the weaknesses?* Although the observation rubric results and document analysis from student journaling reveal that the teams functioned well autonomously, focus group and interview results reveal the students’ desire for more direction and guidance. Their desire seemed to stem from wanting to continue to research and always have something new to bring to class. One student stated that the instructor could offer suggestions or instructions to members of teams on what to research for the following week or class. Others felt as though they wanted more direction from the instructor on which path to pursue next.

*What improvements can be made?* Because of the overwhelmingly positive response from learners and the researcher throughout most of this process activity, not
many changes were made to this process activity for its revised implementation. Although feedback from learners indicated that they needed more guidance to lead their progress from one task to the next, if each team is asked to create a detailed action plan before this process activity then they should have sufficient direction along the way. If the learners and instructor(s) maintain the schedule set with their action plan through the use of the document, calendar, etc. then the learners should have enough guidance.

The only other change made to this process activity is the inclusion of the subsequent activity’s usability test. As is described in the Finalize the Solution or Project sub section of this chapter, the usability test occurred too late in the instructional process for the students to benefit from it. Additional details are described in that section of this chapter.

What role does technology play? As a collaborative instructional method technology can be used to support inter-team collaborations, feedback, and idea sharing. The instructor can create an online database on the class Blackboard page where learners can share documents. He or she can share student documents with the whole class so that they can give one another feedback. Finally, he can use a mobile application such as GroupMe to connect all students in the class so that they can communicate, share ideas, and further enhance the community aspect of the instruction. GroupMe is a group text messaging application that allows users to create groups among their contacts and communicate with everybody in that group via their mobile devices. In a global learning environment, Cochrane (2013) found that mobile tools can have a positive effect on collaboration. Some of the outcomes he mentions can help establish “authentic learning
experiences, collaborative practice-informed research, virtual cultural exchange, and serendipitous learning” (p. 308). Mendoza and Alejandro (2014) found that learners prefer communication via a mobile app to an LMS and may even help them create a better end product because they are so connected to changes and communications. Other researchers have shown that learners enjoy and support communicating this way (Echeverria, et al., 2011; Arreymbi & Draganova, 2010).

**Finalize the solution or project.** This process activity consists primarily of participants conducting a usability test. The results of which are intended to influence the team’s final version of the problem solution. Nelson (1999) states that “this should be done in as realistic a setting as possible. For example, each group will want to test its proposed solution or product with subjects from the target audience in a setting and under conditions as close to real-world as possible” (p. 265). When the project is so high level that students are recommending problem solutions that they cannot feasibly test this becomes nearly impossible. In this first semester, for example, the teams were recommending specific facets of the development of a multi-million dollar development project, which is impossible to recreate. Therefore, the teams were asked to get feedback from knowledgeable professionals or those who could be considered subject matter experts. Some groups sought out professors, while others sought out professionals. Because of the change of the format being that learners sought to identify the feasibility of their problem solutions rather than its usability, it is referred to herein as a feasibility test. This name change carries over to the revised CPS model.
The other main part of this process activity entails the finalization of the project or problem solution. In the fall semester, this included the presentation of the findings and problem solutions to the client along with a compiled binder of research. The students worked in collaboration with the instructor to design the format of the delivery of the final product.

*Focus groups and interviews findings.* The overwhelming feedback was that this part of the process occurred too late in the process to allow for any significant changes to be made. The following exchange highlights the sentiment of having the feasibility test at the end of the project. This student notes its frivolity at being conducted when the teams would have virtually no time to make significant modifications depending on the feedback they receive:

Researcher: Was it helpful?

Female #7: Yes and no. Because we kind of knew what the outcomes would be from our research. It was helpful because she was able to tell us it works but at the same time we kind of had already made up our mind based on the research.

But, the learners appreciated being asked to conduct the feasibility test because, like the following student who was asked if it was beneficial, most were working on a project that requires skills and knowledge they do not yet possess:

Female #9: Yeah. I think it was helpful because it added a different perspective. At least I know from a PR background it’s always nice to have more of that marketing aspect and what people are hearing from what you’re saying or visually how it’s looking to be for understanding purposes.
While no participants opposed the feasibility test, in response to the suggestion that it occurred too late, some suggested doing it earlier in the semester:

Male #1: How we were supposed to seek out and get a professional opinion I think we should have done that earlier in the process so that we could have made it a bigger portion of our presentation to say whether or not we feel like this is feasible because if the professional says it isn’t then I don’t feel like we should have continued in that direction.

Male #1: I think that that was important [the feasibility test]. I feel like we should have met with him earlier personally, umm because I said that in class, as well. I feel that if we would have been able to find out whether or not this idea was feasible early on for most teams not even ours just for all teams we would have been able to have a better sense of direction where we would take this. It would just kinda prevent the option of us having a curve ball during the end of the semester.

During a one-on-one interview, one participant suggested doing the usability test twice, once in the middle and again with the same individual at the end since they serve as more of a feasibility test than usability. The following exchange demonstrates how late the test fell in this first iteration of the instructional method and why this learner would be more open to doing it late again only if there were a similar test performed earlier in the semester:

Female #9: I think yeah. If the feasibility test would have happened in reverse from the mid-presentations. We had the mid-presentation. Even left in the same
spot I didn’t mind it that late. But the feasibility test maybe week 7 or 8. We did ours really late.

Researcher: They’re supposed to be late, which makes it kind of tough.

Female #9: Ours was done week 12 but I think I would have liked the feasibility test week 7 or 8. It would have been like a progress check to see how we were approaching our project charge and from there kind of getting insight on how to go. Maybe even adding two feasibility tests I would have like to get like a mid-test and then a final one.

Researcher: Interesting. Everybody seems to agree that it’s nice and helpful but it should not be that late.

Female #9: I think it’s the fear of change. It’s scary to be told you need to research more when you’re in week 13.

Researcher: Right. So you think both.

Female #9: Yeah. I still like having that final recommendation so that you can track that progress. To see where you left, the changes you made to support that test, and then to see what the final recommendation would be. And then it’s up to the group if they want to change them or not.

During a subsequent one-on-one interview, a participant was asked to voice his opinion on the possibility of doing two feasibility tests. In his response he notes that his team received negative feedback during their late-semester feasibility test, at which point they would have had to re-conceptualize their entire problem solution. He responds in favor of having multiple feasibility tests:
Male #1: I agree. I think what would be the most successful is come with an idea, not even, you don’t even need background research. Just a preliminary meet with maybe a little bit of background research and why you feel that would be successful, talk to the professor or whoever you’re meeting with, get their intake on it, see if they think it’ll be successful based on what you have or based on their opinion and go from there. Because honestly, like umm for some of the, especially the wellness centers a lot of them realized that after they talked to people they didn’t think it’d be feasible for [the community] and it’s week 12 so, You know we’re going to give them our recommendation regardless of. I feel like that would have been probably just a better way to go about it.

**Participant observations.** During the feasibility test, the researcher observed that it was viewed by learners as a secondary consideration. “It seemed that because of the timing, the learners struggled to accomplish this task and, when they did, their findings were either simply confirmatory or too complicated at the end of their research process.” The researcher goes on to laud the idea of seeking out experts to offer guidance and direction and that as part of their data collection, learners sought out experts as part of their primary research. But he concludes by stating that the timing of the feasibility test was poor and it seemed to cause unneeded stress and additional work for the teams who were busy finalizing their research at the time.

When the teams finalized and presented their problem solutions, the researcher stated that he was surprised at the level of self-direction the learners were able to assume. “I think the autonomy that the CPS model allows for the students was integral to the way
they took over the design of the final presentation and the delivery of materials.” After
meeting with the client and presenting a synopsis of their current findings, the teams
brainstormed a way to organize everything into a unified product, with each team’s part
being a unique part of the whole. Although the instructor was present and added input or
feedback, he asked the students to lead this action. “I found the process to be more
beneficial to the learners to allow them the opportunity to not just direct their own
learning but decide the direction of the learning for the whole group of learners.” When
they presented and delivered their problem solutions to the client, he was extremely
thankful and seemed to appreciate not only some of the unique approaches the learners
took but their delivery, as well. They presented a collected binder of research to the
client, which was the students’ idea.

*What were the strengths?* The students reacted positively to the intentions of the
feasibility test. They appreciated being asked to seek out an expert’s opinion and
feedback on their recommended problem solution. The students took ownership of the
project and worked with the instructor to design the format of their final problem
solutions and determine how it would be presented to the client. They appreciated the
level of self-direction this allowed them to experience.

*What were the weaknesses?* The learners did not benefit from the feasibility test
occurring near the end of the experience since this prevented them from applying the
knowledge and feedback they had gained. Most of them reported that, having collected so
much research already dedicated to their initial problem solutions, they would have little
to no time to make a significant change if needed following the results of the feasibility
test.

**What improvements can be made?** As previously mentioned, Nelson (1999) states that the usability test should be conducted in “as realistic a setting as possible” (p. 265), meaning that the learners ought to conduct a pilot test of their problem solution with members of their target group. Because that was impossible for this context, the name was changed to feasibility test and it was conducted with experts rather than a target audience. In keeping with the spirit of the original test’s intentions, once learners have collected enough research to identify a potential problem solution they should examine its feasibility by consulting with an expert. This should take place earlier in the instructional period, before learners have started to design the final solution so that they will have sufficient time to research should the results of the feasibility test require it. It has therefore been moved to the iterative collaborative problem solving process activity, though not necessarily at the end. It should occur at a point when the team can hypothesize what a potential problem solution would look like. The instructor can work with teams to ensure that they are seeking out an appropriate expert and that they have sufficient research to create a potential problem solution. This can be another opportunity for the teams to collaborate and share feedback with one another. The collaborative environment can help the teams learn and identify resources for the feasibility study that they may not have otherwise been able to (Savery & Duffy, 1995; Bruffee, 1999).

**What role does technology play?** The presentation of the final problem solution to the client may require technology in the form of a PowerPoint presentation or
something similar. Because of the nature of working with real clients and because students have to deliver their research to them in an appropriate manner, the role of technology may vary from project to project in this process activity. Since the context is an internationally focus problem solving environment, there may be times when learners deliver their problem solutions online via real-time video chat or other manners. The amount of technology to employ in this process activity depends on the client and the problem solutions that students deliver. For this particular instance, students made use of simple PowerPoint presentations and delivered a hard copy binder full of their research because of the nature of the client. The facilitator needs to decide the right amount of technology to employ in this finalization process activity to ensure that the focus remains on the message and work the students accomplish and not the technology (D’Angelo & Wooley, 2007).

**Synthesize and reflect.** This process activity consisted of students reflecting on their knowledge in the form of a whole-class discussion and providing written feedback to the instructor in the form of both course evaluations (required by the university), and a PBL assessment form. The participants were asked to reflect on their own learning gains, the transferability of those gains, and to provide feedback to the researcher on their perceived effectiveness, efficiency, and appeal of the instructional method.

**Focus groups and interviews findings.** Students enjoyed having their voices heard and be given the time and space to reflect aloud. They also liked the open forum atmosphere since it allowed them to learn from their peers, as well:
Male #3: I think it’s very good at the end of any project to have an evaluation to realize what I did good what I did wrong so the next time you’re not going to do the same mistakes and you can hear from others as well and learn from others. So I think evaluation should be in the schedule.

They appreciated and took note that the instructor was truly interested in their feedback. The following exchange highlights student opinion toward this part of the process regarding their feedback being vital to the program’s development and improvement:

Female #3: I think it’s really beneficial to have the time for everyone’s voice to be heard because it can make the program better and better each semester. Going off of everybody’s suggestions and everything like that.

Male #5: It sounded like you learned some stuff today that you thought was interesting.

Researcher: Yes. I did.

Male #5: That’s important.

**Participant observation.** The researcher describes the way student participants were interactive and appreciative of the steps taken to reflect on their learning and offer their feedback and feelings toward the instruction. He writes:

I was surprised by the level of participation that students offered in the focus group and interviews. They seemed genuinely interested in not only helping me collect data but offering feedback to the program and being integral to its improvement. This is a class and a program that these students have put a lot of hard work into and have come out with some meaningful experiences, memories,
and relationships. But it floored me the way they reacted to being able to assist. I’ve been in focus groups where it’s like pulling teeth trying to get participants to talk but there almost every single participant contributed.

He also mentions that their discussion of perceived learning gains seemed to be beneficial and that they likely were able to identify what they learned not only from discussing and thinking about it but from listening and talking to their classmates.

What were the strengths? This process activity was well received by the participants and instructor – all of whom used the chance to reflect and learn. The focus group atmosphere created a positive environment for all. The learners were honest in their reflections and feedback because the instructor reminded them that any critique they had was a critique of the instructional method, not the instructor.

Assess products and processes. Nelson (1999) allows for flexibility in evaluating the learners in this process activity. In some instances, learners may work with the instructor to develop criteria for evaluating the outcomes of their work. In other cases learners may evaluate their own work and processes, which the instructor may choose to weigh in with his or her own evaluation. Learners, in this instance, were provided with feedback on their “(a) content knowledge and skills, (b) group-process skills, and (c) metacognitive strategies” (p. 265) in the form of written reviews given to each participant. Each learner was also given a final grade in accordance with university policy.

Participant observations. After giving each participant an evaluation of his or her learning gains in the three areas Nelson (1999) identifies, the researcher described the
way the students appreciated the individual attention paid to them. “They appreciated this attention and feedback because they thought it would help them work in the following semester with their classmates.” In delivering feedback to learners, the researcher found this type of direct interaction to be more effective and meaningful than a grade they may receive two or three weeks after the end of the semester.

**What were the strengths?** The students expressed appreciation at receiving personalized feedback in written form. They seemed surprised by the dedication that this instructional method has to the development of the participating learners. There were no observed weaknesses with this process activity. The CPS model allows for variation in assessment, including allowing learners to assess their own products as part of their final grade. Because there were no documented weaknesses for this process activity, no improvements were recommended for the first revision of the model.

**Provide closure.** In celebration of the work the class conducted throughout the semester, a potluck-style dinner was arranged for the class. Students used the time to reflect on the project, bond, and talk to the instructor and faculty members of the program.

**Participant observations.** The researcher observed the way that students interacted with one another and with the program’s faculty and staff, including him. “The students laughed and talked about the project, they talked about their final presentation, and they talked about what they were doing that evening or that weekend. It was the perfect culmination to the project.”
What are the strengths? Observations revealed that students enjoyed this process activity. Incorporating it at the end makes them see that what they are a part of is more than just what happens in-class, which reinforces the idea that the work they complete is real. It helps create an atmosphere of community. Finally, because the learners and instructor spend the time to reflect on and talk about the semester of work they just completed, this process activity can even act as a reflective activity after everybody has had time to process the reflections they have already made. There were no weaknesses for this process activity and thus no recommended improvements for its revision.

Comprehensive Guidelines or Individual Methods

For the CPS model, the comprehensive guidelines form a set of methods or actions that instructors are expected to follow and instill in the learners. They are guidelines for what individual participants ought to do and how they should act and interact. Nelson (1999) separates the comprehensive guidelines into four categories, (a) Instructor-Implemented Methods; (b) Learner Implemented Methods; (c) Instructor- and Learner-Implemented Methods; (d) Interactive Methods (p. 251). This sub-section describes pertinent findings regarding each method within the comprehensive guidelines.

Instructor-implemented methods. These methods provide a guideline for the instructor’s actions and roles. In this first instance of the CPS instructional method, the instructor offered feedback to learners as he saw that it was needed and he put students in teams to work on smaller projects to acclimate them to the environment. His focus in meeting with groups was question-asking and probing them to think about the problems faced in as many ways as possible. Finally, he provided instruction in the form of cultural
understanding and knowledge on the culture of the target client when it was deemed that students needed specific information. “In PBL, the teacher/facilitator is an expert learner, able to model good strategies for learning and thinking, rather than an expert in the content itself” (Hmelo-Silver, 2004, p. 245).

**Focus groups and interviews findings.** Much as was mentioned in the section covering interview data regarding the primary, iterative CPS process phase of instruction, participant feedback tended to focus on the students’ desire for more guidance and direction.

Male #4: I’d say you were almost a little too hands-off.

Female #3: Maybe a little bit more instructor feedback throughout the semester instead of, like you said, you just ask a lot of questions, which was good and did make us think. But maybe either in the group session or once a week or something, say group blah blah blah here’s how you’re doing I think you’re on track I think here’s your comparison to other groups.

The desire for feedback, as the previous student mentioned was an important issue. Participants mentioned how they wanted feedback on their work and reassurance on their progress more than they were receiving. The following quote describes how students felt they were not receiving enough validation for their work:

Female #7: No. For you to tell us what is good. I guess confidence. I think we could have kinda done it by ourselves but we weren’t too confident a lot of the time about the right path and which way to go down. We always needed that feedback to push us with our research.
Student participants liked most of the instructor’s roles, including that of asking questions to guide the learners through the learning process. The following excerpts demonstrate how asking questions of the students rather than supplying answers was desirable and helped give them ownership of the project:

Male #3: Yeah so I like the fact that you asked questions you do not necessarily give us an outcome because it kind of caused us to think what we really want and you gave us ownership, I would say. More ownership to the project and I really liked that.

Researcher: It’s supposed to do that. I’m glad it makes you feel that way.

Male #1: Honestly, the way it was set up with how you asked us questions I feel like we were given the ability to work independently . . . So I feel like having the presence of a professor based on this instructional method it kind of simulated our thinking.

**What were the strengths?** The instructor implemented methods, allowed the students in the class independence and freedom to guide their own learning. Nelson (1999) writes, “the primary responsibility for managing learning is shifted to the students” (p. 250). The instructor’s role as a facilitator rather than a knowledge distributor gave the learners the experience of directing their own instruction and project.

**What were the weaknesses?** Some learners felt that they needed more guidance throughout the project. Nelson (1999) writes that “the students determine what information and resources they need and how to obtain them, with the instructor available to provide guidance, feedback, and skill development as needed” (p. 250). Finding a
balance between allowing for learners to guide their own learning and offering them guidance can be challenging. Nelson (1999) writes that the instructor can provide more or less structure depending on how autonomous he or she perceives the learners to be. Other learners stated that they needed not guidance but reassurance that they were on the correct path.

**What improvements can be made?** In order to both allow the learners to be more guided in their pursuits and to maintain their autonomy as self-directed learners, the CPS model was revised to include the creation of a semester-long action plan, which was negotiated between the students and the facilitator and ultimately approved by the facilitator. For the first revision, this was intended to provide both the guidance and reassurance that the learners perceived they lacked during the first instance of the model.

**Learner-implemented methods.** These methods are actions that the learners implement in order to guide team interactions and research activities. These methods include learners determining how to contextualize and apply their gathered research and how to plan for and manage their time and human resources in order to reach their end goals.

**Focus groups and interviews findings.** Not many statements were made that were directly related to the two learner methods. Students pointed out that they were easily able to delegate individual tasks and manage their time that way. The following quote highlights the teams’ familiarity with this part of the process, as the student describes how teams delegated:
Male #7: Those roles are kind of assigned as the project progresses depending on what phase you have. Like it was contacting . . . then it was my job. If it was . . . then it was ______ job and so forth.

One student participant was particularly candid in his assessment of his team’s ability to account for time spent on task:

Male #1: Maybe just have us fill it out more often. Those sheets that we had. For example, we had the sheets where it would say what we were going to do next week. Maybe at the beginning of the week. Uhhh at the beginning of each class period write down what we have to do and what we need to get accomplished during class. Because, honestly, I feel like sometimes our team would not just my team but all teams in general would kind of take the class time and some people would be efficient with it and other times they would just watch videos or kind of joke around. Because everybody in [this program] is pretty close and umm I feel like if we had a list of things that we had to complete each class that we created on our own or even that was created for us that, you know we could just follow. I think it would be more efficient.

He mentions his team using action plan sheets given to them by the instructor to organize their work for the week and how, despite using these, his team had difficulty sticking to a particular task. He goes on to discuss the possibility of having a detailed, long-term action plan to keep teams more on task:

Male #1: Either way. I feel like just as long as we had some sort of plan of action going into it we’d be more efficient than, basically we were wasting time
worrying about time and we would like. We would seriously sit around, talk about what we were going to do next week or the week after. We weren’t even keeping in mind what we had to do that day of. So just kind of turned into a game of catch up.

What were the strengths? The CPS model allowed for the two learner-implemented methods to be strengths. The learners had to account for their time spent in class and outside of class and how to apply the knowledge and information they collected to create problem solutions. The learners were asked by the instructor to detail how they would allocate and spend their time during a given week. The learners were able to determine which team member would have a task accomplished and what his or her deadline was.

What were the weaknesses? Although the learners were often able to remain on task, some felt that they were unable to always account for their time working. While the learners divided work evenly and accomplished their goals, some reported a desire to be more disciplined in their work schedule. Nelson (1999) writes that “each group should be allowed to determine how their time can best be used in accomplishing the tasks they identify for themselves” (p. 252). While the decision these teams seemed to make was to not be focused and on-task all the time, the interview and focus group responses indicate that some learners were searching for ways to better spend their time and decide this as a whole group.

What improvements can be made? The action plan that learners were asked to create in the revised CPS instance was designed to move students toward a final project
solution and keep them on task. Because that addition was intended to address these issues, no improvements were made to this comprehensive guideline for the first revision of the CPS model.

**Instructor- and learner-implemented methods.** These particular methods include five separate activities that act as guidelines for actions by both the instructor and learners. Instructor guidance may differ as he or she determines the abilities and experiences of the learners to be able to guide their own learning processes. While these methods were followed, the instructor determined that, being these students’ third quarter in a problem-based environment, learners were prepared to direct their own learning.

**Focus groups and interviews findings.** As previously mentioned, learners reported a desire for more directed feedback during team meetings. The following quote represents this sentiment of wanting to know where a team is:

Female #4: Just some feedback on how you think we’re doing because I know a lot of times I was like, “are we on the right track” “are we ahead are we behind? Where are we,” kind of.

As mentioned in the instructor-implemented methods section of this chapter, learners wanted feedback so they could compare their progress to their classmates’. One instructor- and learner-implemented method discusses collecting resources and states that learners and the instructor can work together to identify and even obtain certain resources. Again, the instructor gave the learners less direct instruction on where to find resources. As was mentioned in this chapter’s instructor-implemented methods
section, some learners were uncomfortable without having specific assignments or direct guidance. This was best represented by the following quote:

Male #7: I feel like, while nobody wants more to do. I think we all enjoy that ability to feel like we had that freedom to research. But I think that some assignments would help guide some points and you wouldn’t get too focused on other things like people saying that you didn’t know about or that you just wanted to ignore for the time being. I think it helps you feel like you have something. At some point I was looking at the project and I didn’t have anything written down and I felt like it was all in my head. It wasn’t substantial.

When not meeting directly with teams and providing feedback or brainstorming research locations, the instructor has to be available when needed. The following quotes describes feelings toward instructor presence:

Female #1: I like the way you have a more hands off approach. You’re always there when we need you. But we can kind of find our own way when we’re doing our research and we can go about things how we thing best see them and I think it, I don’t know, it’s like a really different way from any other classes I’ve been in. I enjoy it.

Male #1: Honestly, I liked it a lot. Some of the criticisms from some people were that there wasn’t enough guidance. But I feel like that allowed us to be flexible. That’s why we were able to change our project charge into something completely different from what [the client] had asked for. So I didn’t really find any faults in
it personally. But I know that would be some of the concerns that other people had.

While certain learners stated the desire for more direct guidance, there were those who were pleased with the level of instructor presence. This collaboration should be taking place not strictly between teams and the instructor. Nelson (1999) notes that full-class collaboration (along with intra-team collaboration) is an essential part of problem-based or collaborative instruction. The learners responded positively to the interaction and resource sharing:

Female #4: I liked how this year there was a lot more group discussion and interaction. I feel like we didn’t really discuss as much in past years whereas this year we had a lot of group discussions in a big group and then we also broke into even smaller groups and had three groups critiquing each other and bouncing ideas off each other without you in the room or then with you in the room. I just think having that feedback and talking it out loud kind of helps you understand what you’re doing.

Researcher: Did anyone else . . . who else thought that was helpful? [all hands up] Did anyone dislike doing that? [no hands up] OK. Really? Nobody? Thank you.

**What were the strengths?** The instructor- and learner-implemented methods allowed the students to participate in full-class collaborations, which the students found to be beneficial. The group meetings were a strength because the instructor was able to ask questions of the learners to help guide them to finding solutions and continue to create their own paths.
**What were the weaknesses?** In this comprehensive guideline, like the others, the learners provide feedback stating that they needed more guidance or feedback on their procedures. One learner pointed to the structure that comes with having assignments for each team or student. Because the students did not have assignments given to them or assigned by them, they may have felt as though they lacked enough guidance at times.

**What improvements can be made?** The weaknesses in this comprehensive guideline were addressed in the revised CPS model through the creation of an action plan by teams and learners. This was intended to give the learners the kinds of assignments and work that would keep them focused and able to move through the semester with a comprehensive goal in mind along with step-by-step procedural actions.

**Interactive methods.** These social methods are described to help learners better cultivate collaborative and problem-solving skills. Nelson (1999) states that these methods are designed to help the instructor mediate any problems or conflicts and to help the learners collaborate and improve their problem solving skills.

**Focus groups and interviews findings.** Learners addressed specific outcomes that they saw in themselves when they applied to discussion. On the development of investigation and motivation for learning, one student said the following:

Male #1: To like kind of expand on what I said yesterday I feel that the way you asked us questions, you would question us and we would think on our own. So it stimulated our own thinking I like that. I feel like it allows us to be creative with our projects and go in our own directions and. Because that’s how it’s going to be
with a real client. The client will hire you because they need your help and they
don’t know where to go. So I feel like this is more real-world problem based.

Another interactive method requires individual accountability and responsibility for each individual member of a team. Although it was not addressed in detail, one learner mentioned the need for greater individual accountability and how this could be enhanced through specific assignments given to teams or members of a team.

**What were the strengths?** The interactive methods are guidelines to help the learners develop interactive skills and, in that sense, they were a strength as the learners collaborated with almost no issues. The learners were investigative and motivated to learn. The results from the PBL evaluation questionnaire (Table 1) indicate that the comprehensive guidelines supported group collaboration well.

**What were the weaknesses?** Some learners mentioned that the lack of specific focus from one task to the next diminished their teams’ accountability to one another. Individuals in a team are to be held accountable to one another for their individual share of work. For those teams that had trouble identifying work that would lead to problem solutions, maintaining accountability became a weakness of this comprehensive guideline.

**What improvements can be made?** Adding an action plan to the first revision of the CPS model was intended to address the issue of student-to-student accountability within teams. As the learner said, their inability to remain accountable stemmed from their team’s lack of a day-to-day plan.
**What role can technology play?** As was mentioned previously in this chapter, the mobile application GroupMe can be used to promote interaction since. As a mobile, always-connected way to interact, this mobile application can allow the students and facilitator to promote positive interactions away from the classroom.

**Learning Outcomes**

The desired outcomes of problem-based instructional methods vary among researchers. As is outlined in greater detail in Chapter 2, accounting for variation, the goals are often as follows: (a) Learners face an authentic problem; (b) analytic, problem solving skills should be acquired; (c) the instruction should support self-directed, student-centered learning; (d) The instruction should develop collaborative skills; (e) the instruction should motivate learners. The questionnaire learners completed follows these five stated outcomes and asks four questions related to each of the five goals. The results are presented in this section along with findings from interviews, focus groups, the observation rubric, and document analysis.

**Focus groups and interviews findings.** The focus group and interviews that students participated in served as both data-collection events and the synthesis and reflection phase of the instructional process. In addition to being asked to reflect on the instructional method, they were asked to reflect on what they learned regarding both content and skills. Their reflections on learning are diverse and cover a wide range of cognitive and social strategies and skills. Some perceived learning outcomes are simply stated. For example, Female #2, reflecting on problem solving skills in general said, “any other project I’ve ever worked on the skills the problem solving skills I’ve learned in here
have transferred over to other classes when working on those type of projects.” Other perceived learning outcomes are more wide reaching than transferring to other academic classwork. Facing real-world problems for real clients has taught the learners to be adaptable and flexible to changing situations and shifting client needs. The following quotes illustrate what students learned about being flexible:

Female #6: I feel like it’s also kind of taught you to like roll with the punches. So, like it’s kind of interesting because it’s not really always set in stone what you think your project is going to be. It can change in the blink of a hat or in one presentation. Like you think you’re on the right track and you’re really not. So it’s kind of taught you to really think on your feet. Female #10: I think it’s important to be flexible when working with these groups and realize that what you might have had in mind originally is not necessarily how it’s going to turn out in the end and you’re going to need to create different solutions maybe to the problem as you research more or find out new information from the client or just as the project progresses. So I think that’s really important to keep in mind.

Male #7: Always have plan B and plan C.

Adaptability and flexibility in research goals and work are points that participants touched on throughout the interviews and focus group. Similarly, tolerance for ambiguity is needed for success in a real-world problem-solving environment. One student identifies his learned tolerance for it as transferable to other environments:
Male #6: I think the ambiguity really helps you out with other projects because like consulting with any client a lot of the time the clients don’t really know what they need or they’re just like, ‘Oh I just need more customers or business to my site.’ And so they give you real simple like question or problems they have and you have to find out what they really need and what they’re really lacking and we have to do that with a lot of [this program’s] projects like discover what the client actually needs.

Another point of discussion for the learners was learning to work in a diverse team with a culturally unfamiliar client. Learners reported learning not only how to work with individuals who have dissimilar backgrounds and points of view but also learning how to work with clients from an unfamiliar culture. The following two quotes illustrate how the students have learned to not only work with but also respect the unique cultures they work with in this environment:

Female #7: I think the biggest thing that we all had to learn was to differentiate the culture we all have versus the culture they have so just kind of like not making that part of our decision.

Female #3: I think it’s true for me that these type of projects have taught me how to take into consideration the client’s cultural backgrounds and religious beliefs and working alongside that without letting it affect your project and kind of learning how to do business and research while maybe disagreeing or working with a client that is very different in your own cultural beliefs and having to manage that relationship and manage your work alongside that and not letting it.
On learning to work with not just people from different cultures but classmates with different experiences, one male learner said, “I’d say I’ve learned how to work with people of different mindsets and views.” Expounding on the idea of learning to work with people of different backgrounds and experiences, one student described the way it taught her about herself and how to work better in a team of any makeup:

Female #4: I think these projects have taught me to listen and learn how to listen because I feel like a lot of us are probably really bold and want our ideas heard probably in other groups outside of [this program] but here we’re all that way. We all have great ideas and sometimes you need to take a step back and really listen to what you’re group members are saying and take that into consideration that you’re not always the one who needs to be heard and you’re ideas aren’t always the right way to go.

Similarly, learners expressed not only leaving their comfort zone working with people. They were put into positions where they would have to work in unfamiliar disciplines. The following quote highlights how one team sought out information and resources in places they had never looked or thought to look before:

Female #8: I think what [Female #9] and I did well was we utilized other resources because we both are the same major with the same set of skills so we had to have – like we went to the library constantly to get. We had to use a bunch of different databases that we weren’t used to and business databases and look at financials and stuff like that in the beginning. So, just kind of putting ourselves
outside that comfort zone and really trying to understand it even though it’s not
something that we really learned about.

Many remarks were made regarding how the instructional process allowed and
couraged the learners to direct their own learning. While some of the quotes describing
their reactions already appear in other sub-sections of this section describing interview
and focus group findings, others describe the way the instructional method allows for
self-direction. The following participant describes the way her team had to work from the
beginning of the project until the end, directing their learning:

Female #7: I really liked how open it was. You kind of gave us the opportunity to
bring out our own ideas without really . . . You gave us the project charge but you
didn’t tell us this is what you have to do specifically. So it was a lot more
openness. Kind of using the skills that we gained from the past two semesters and
putting it to work by ourselves. You did give some feedback, which helped.

While she describes the way the instructional method requires learners to take charge of
their own learning she also describes the way it demands learners to use their existing
knowledge to solve problems. About three-quarters of the way through the semester, the
students decided to take all of the teams’ problem solutions and make them all parts of a
greater whole to deliver to the one client. The learners led this decision and the instructor
allowed the learners to collaborate to put together the design in a full-class collaboration.
The following student describes the reaction to this unique example of self-directed
learning:
Male #1: I liked how, through the feedback, toward the end especially the mid-semester presentation, I really liked how we took our own direction and how we came together as a class to present different ideas. Finally, because the instructional method makes time for self-reflection and evaluation, participants remarked on how that aspect helped. On being able to apply what is learned from evaluation and reflection, one male student said that reflection and self-evaluation should definitely be part of the learning process.

**PBL evaluation questionnaire results.** Near the completion of the first iteration of the implemented CPS model and just prior to the start of the focus group, participants were asked to complete a 20-item, 6-point Likert scale attitude questionnaire. All but three participants completed the questionnaire for an 87% completion rate. The test resulted in an alpha value of 0.89, consistent with the original author’s report (Yuan, et al., 2011). Overall, the median response was 5, indicating that participants felt that the instructional model effectively taught skills associated with problem-based learning (Yuan, et al., 2011). Of the sub-categories assigned by the instrument designer, the results in Table 1 indicate that the model was most effective at promoting group collaboration, with a median of 6. Each of the other four categories had median scores of 5, indicating that participants believed the model allowed for the construct professional knowledge, the development of problem-solving skills, the development of self-directed learning skills, and the nurturing of motivation for learning fairly well. The results in the full table can be found in Appendix C. It is presented in this section with only the main categories of learning and not the individual questions and results.
Table 1  

*Fall Semester PBL Evaluation Questionnaire Results (n = 20)*

<table>
<thead>
<tr>
<th>Item Categories</th>
<th>Mode</th>
<th>Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Construction of professional knowledge</td>
<td>6.0</td>
<td>5.0</td>
<td>1.07</td>
</tr>
<tr>
<td>2. Development of problem-solving skills</td>
<td>5.0</td>
<td>5.0</td>
<td>1.05</td>
</tr>
<tr>
<td>3. Development of self-directed learning</td>
<td>5.0</td>
<td>5.0</td>
<td>1.12</td>
</tr>
<tr>
<td>4. Improvement of motivation</td>
<td>5.0</td>
<td>5.0</td>
<td>0.98</td>
</tr>
<tr>
<td>5. Promotion of effective group collaboration</td>
<td>6.0</td>
<td>6.0</td>
<td>0.74</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6.0</td>
<td>5.0</td>
<td>1.03</td>
</tr>
</tbody>
</table>

**Observation rubric results.** During participant observations, the researcher used an observation rubric to identify teamwork and the effectiveness of students’ interactions. Results from the 10-item, 5-point scale observation rubric documenting team performance indicate that the fall semester participants were well acquainted with teamwork and autonomous, self-directed learners. On the 5-point scale, 5 is considered ideal and 1 is a low score given when teams are not collaborating or interacting as expected in problem-based instructional methods. The full rubric is found in Appendix A. Only one question, number five, was unanswerable given that the researcher was both the instructor and researcher. This question requires the observer to discriminate how much the facilitator explicitly reviews background material. To support the researcher’s observations, students were asked to respond to prompts on Blackboard to describe their interactions with their teams and the instructor. Each team was observed and scored on the rubric two times throughout the semester for a total of 10 observation days.
Document analysis. Throughout the semester during the implementation of the CPS model, students were periodically asked to respond to journal prompts on the Blackboard page that served as the class’ learning management system. Most of the prompts were designed to get the learners to think about their project, to start to action plan next steps, or to serve as the basis for in-class discussions. Some of the prompts were dedicated to the learners evaluating the instructional method, their interactions, or their experiences with the instruction in specific ways. These prompts parallel the questions on the observation rubric and allow for student response and observations of the same topics.

The learners were asked to respond to the following question: “Describe the interaction you have when working with your teammates. Do you interact and collaborate often? Are the interactions positive?” These question prompts relate to item 1 in the observation rubric. Students stated that their interactions occur mostly in class, at which point they share research, and assign and delegate tasks plan for future assignments. They all state that their teams were productive. But, two mentioned that their teams were only mostly productive and spent some of their in-class time on conversations not related to their research. The first one, Male #1, wrote, “They are generally productive, though they tend to be pretty chummy.” The second was more telling. Female #10 wrote, “I feel our work [in] class is a little productive but not fully used (class time) to its full benefit.”

The students were next asked more specifically about the quality of their team interactions. They were asked to respond to the following question: “Describe the way your team approaches potential problem solutions. Do you generally analyze and expand
upon them? Or are they accepted quickly by the group?” This prompt corresponds to the observation rubric’s items 2, 4, 8, and 9. Only the members of one team stated that they moved on quickly from discussions of problems and their potential solutions. But one of the members of that team, Female #6, wrote that problems were approached with an open mind and that they were “willing to hear criticisms and take them into consideration if they are in the best interest of the project.” All other members of the class mentioned that their teams spent considerable time presenting new findings, exploring all potential problem solutions, and applying appropriate criticisms to all ideas put forth. Male #4 wrote, “we always analyze and expand on our ideas. Our group loves to discuss our ideas. Everyone usually brings a different view or concept. . .” The member of another team, Female #8, wrote about the way she and her teammates view and handle ideas: “When new ideas/problems or solutions have come up, we proxy-research it to make sure we can use it or to find that it might not be beneficial for our project. We look into all members’ opinions.” Participants wrote about being critical to ideas and how this was their team’s method of analyzing potential problem solutions. Female #4 wrote, “In approaching potential problem solutions, we were all pretty clear and expedient in sharing our criticisms of the topics in question.”

Later in the semester, learners were asked about their interactions with the instructor. They were asked to respond to the following on Blackboard: “How has your team’s interaction been with the instructor? Did he point out additional background areas to look at or explain any points explicitly? How would your team function without his presence?” This prompt refers to items 5, 6, and 7 from the observation rubric. The
participants wrote that when meeting with the teams, the instructor was able to provide some direction and ideas that they may not have otherwise thought to include. Rather than explain something, the students wrote that the instructor offered ideas and potential areas to explore. Male #4 wrote the following: “Our team’s interaction with [the instructor] has been positive. He pointed out additional background information that he thought our team should look into.” The participants also mention that the instructor provides a sense of direction and a reliable resource, but they would be able to complete the problem solutions without him – only with different results. To that point, Male #3 wrote that if the instructor had not “offered his assistance we could have potentially not looked into the areas that he told us to look into.”

Student participants were prompted to answer the following question: “When you work with the instructor, describe that interaction. Do the students lead the discussion? Do students often talk the most?” This prompt refers to items 3 and 10 from the observation rubric. Student response unanimously agreed that learners lead the discussion and certainly spoke more than the instructor. Male #1 described the interaction in the following manner: “Our interactions with [the instructor] are typically student led and they help us discuss our ideas and the next steps that we need to take. It helps because he adds an objective perspective.” Male #4 wrote about the way this type of interaction led his team to seek a problem solution. He wrote, “typically, [the instructor] allows the students to lead the conversation, as we are encouraged to problem-solve on our own to generate a solution for our projects.”
Table 2

*Observation Rubric Fall Semester Results*

<table>
<thead>
<tr>
<th>Item Summaries</th>
<th>Average Team Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How frequent is the student-to-student interaction?</td>
<td>4.6</td>
</tr>
<tr>
<td>2. Does the team accept short answers or do they expand on answers?</td>
<td>4.8</td>
</tr>
<tr>
<td>3. Who does most of the talking, the facilitator or the students?</td>
<td>4.6</td>
</tr>
<tr>
<td>4. Does the team accept answers or do they seek to explain how or why something is true?</td>
<td>4.6</td>
</tr>
<tr>
<td>5. How does the instructor review background concepts and course material?</td>
<td>N/A</td>
</tr>
<tr>
<td>6. Does the facilitator or do the students set the role for the group?</td>
<td>4.8</td>
</tr>
<tr>
<td>7. Is the facilitator the focus of the group? Could the group function without the facilitator?</td>
<td>4.8</td>
</tr>
<tr>
<td>8. Does the group move on after solving a problem or do they discuss it further?</td>
<td>4.2</td>
</tr>
<tr>
<td>9. Does the team discuss the ideas and concepts behind the problems?</td>
<td>4.6</td>
</tr>
<tr>
<td>10. Does the facilitator or the students communicate the most?</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Finally, referring to items 1 and 10 on the observation rubric, learners were asked to respond to the following prompt: “Who takes responsibility in your team for the questioning, the answering, and explaining? Is it a group member? Is it ever the instructor?” Much like the aforementioned prompts referring to these two items on the
observation rubric, students wrote that the team members were almost exclusively responsible for the questioning, answering, and explaining. One team wrote that the instructor was the primary question-asker for their team but that the team members were always answering and explaining. Another team wrote that the instructor sometimes answers specific questions related to the project and steps to take but that sometimes those questions lead to more debate among the team members. Regarding the idea that all members of the teams take equal responsibility for asking, answering, and explaining, one team wrote, “everyone on our team contributes to questioning, answering, and explaining. There are certain topics that each of us is more familiar with, so it depends on the topic.”

**Summary**

This chapter described the findings from the implementation of the CPS model in the context of an internationally focused problem solving certificate program working with a real problem presented by the president of an Indian-influenced community in the rural Midwestern United States. Findings demonstrate several strengths of the CPS model in this context. The strengths of the CPS model were as follows:

1. Results from the questionnaire indicate that learners found that the model met the five goals of problem-based instruction, with a median score of 5.0 out of 6.

2. The use of technology supports the five goals of problem-based instruction in the CPS model.
3. In the focus group and interviews, students expressed satisfaction with and enjoyment of most aspects of the CPS model.

4. Results from the observation rubric and document analysis indicate that the CPS model supports effective team collaboration and self-directed learners. The findings in this chapter reveal parts of process activities and comprehensive guidelines that did not work well or needed improvement in this context. The primary weaknesses of the CPS model were as follows:

1. The model provides several options for team formation. In this context, because learners develop such a close sense of community, allowing them to form their own teams can be problematic. Even when the learners were attempting to meet the criteria the instructor laid out, they were met with personal challenges that caused unnecessary stress.

2. Identifying potential problem solutions without sufficient knowledge of the client, industry, or problem was problematic.

3. The learners struggled with a lack of direction and expressed a desire to know or be told where to go and what to do next.

4. The feasibility test occurred too late for the learners to apply the knowledge they gained from it.

The primary changes made to the CPS model after its first instance in the fall semester were directly related to the process activities. The addition of the mobile application GroupMe applies to the comprehensive guidelines but permeates through each of the process activities. Although the learners desired more explicit guidance and
direction, the instructor can help provide this through a process activity wherein the learners design an action plan with guidance from the instructor. Descriptions of what changes were made to each process activity appear earlier in this chapter along with rationale. Detailed descriptions of the final changes appear in Chapter 6. Nelson (1999) outlines the CPS model’s process activities in a table on page 258. That table is recreated here with the alterations made for the second instance in this context as Table 3. Table 3 presents changes made to the CPS model’s process activities for its first revision. Readers can use it in conjunction with Nelson’s (1999) table and the description of the process activities in this dissertation’s Chapter 2. Because the comprehensive guidelines added only the addition of the mobile application GroupMe to support collaboration and communication, no table with revisions to the comprehensive guidelines is presented in this chapter. Words in italics are the researcher’s own and those not italicized are from Nelson (1999) page 258. The only process activities that appear in Table 3 are the ones the researcher amended for the CPS model’s first revision.
<table>
<thead>
<tr>
<th>Process Activity</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Instructor and Learners Establish and Build Their Readiness to Engage in</td>
<td>Review the process with the students <em>with the aid of an online discussion board</em> (Krishnaiyer, et al., 2012).Carefully select the client and present the problem to the students to anchor instruction and learning activities (Lopez &amp; Lee, 2005).Provide instruction and practice in group process skills <em>within the context of the client and culture</em> (Gao, 2013; Morales, 2011).</td>
</tr>
<tr>
<td>Collaborative Group Work</td>
<td></td>
</tr>
<tr>
<td>2. Either the Instructor or the Learners Form Small, Heterogeneous Work Groups.</td>
<td>Form small heterogeneous working groups. <em>Make sure formation criteria take priority in forming teams.</em> Encourage groups to establish operational guidelines <em>including conflict management procedures</em> (Seren &amp; Ustun, 2007; Yalcin, et al., 2006; Sadri, 2012).</td>
</tr>
<tr>
<td>And then the Groups engage in Norming Processes</td>
<td></td>
</tr>
</tbody>
</table>
| 3. Groups Engage in a Preliminary Process to Define the Problem They Will Work | *Identify gaps in knowledge* (Yuan, et al., 2011; Barrows, 1986)  
<p>| On                                                                 | <em>Design a preliminary action plan and assign tasks to members</em> (Ramsay &amp; Sorrell, 2007; Barrows, 1986).                                                                                                       |</p>
<table>
<thead>
<tr>
<th>Process Activity</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. The Teams Design a Long-Term</td>
<td>Work with the instructor to create an action plan and timeline (Wang, 2010; Yunus, et al., 2012).</td>
</tr>
<tr>
<td>Action Plan</td>
<td>Define parameters of assignments and work (Halvorson, 2014)</td>
</tr>
<tr>
<td>5. The Group Engages in the Primary, Iterative CPS Process</td>
<td>Refine and evolve the action plan</td>
</tr>
<tr>
<td></td>
<td>Create a preliminary problem solution and conduct a feasibility test – Discuss with class and instructor (Savery &amp; Duffey, 1995; Bruffee, 1999)</td>
</tr>
</tbody>
</table>
Chapter 5: Findings and Analysis of the Revised CPS Instance

This chapter outlines the findings from the data gathered from the 14 female and 8 male (22 total) participants from the second semester of data collection wherein the revised instructional method was implemented. Like the first semester of research, data were collected through observations, document analysis in the form of journaling, focus groups, interviews, and a Problem Based Learning Evaluation Questionnaire. Findings from each data collection method are described within this chapter. Each section expounds upon any findings for each of the instructional method’s process activities, comprehensive guidelines (instructor-implemented, learner-implemented, instructor- and learner-implemented, and interactive), and problem-based learning outcomes as described by Hung, Jonassen, and Liu (2007). Not all data collection methods reveal findings for all process activities, participant methods, and PBL outcomes. Distinctions are made to differentiate findings from the first semester of implementation and the second semester to reflect the changes made to the model and its first revision. This chapter is shorter than the findings from the first instance of the CPS model in chapter 4 as the researcher grew closer to data saturation. There were fewer revisions made to the model following the conclusion of the revised instance at the end of the second semester. Participants were numbered based on the order in which they participated in interviews, focus groups, and participant journaling.

Process Activities

This section details findings from the focus group, interviews, and participant observations on the revised CPS model’s process activities. The nine activities led
learners and the instructor through the problem-solving process. The participants formed five teams, each of which had a unique problem statement. Three teams had unique clients from whom the problem statements came. The other two teams shared the same client but had separate problem statements. All clients were either based in or had operations in Vietnam. Findings from the learners and instructor’s experience demonstrate the revised CPS model’s fit in this context.

**Building readiness.** This process activity started with the instructor describing the instructional process that students would participate in throughout the semester and allowing students to ask questions and discuss the process. The in-class discussion was preceded by online discussion board entries on Blackboard. The participants said that they enjoyed the discussion and explanation of the research being conducted and the process of instruction that would occur throughout the semester. But they also stated that they would have appreciated an overview or reminder of each process as they happened throughout the semester. Cultural research and team-based projects followed this introductory, discussion activity. Students were asked to collectively design the type of work and research they would complete in pursuit of learning the culture of the client. Collaborating with the instructor, students were asked to complete a team-based presentation and research paper – each focusing on a different aspect of the culture. Each Friday during this process activity, students brought recent Vietnamese news stories to class to discuss and learn about recent news and history. As a team-building exercise, students participated in a professionally led team-focused personality assessment activity.
Focus group and interviews findings. Participant reaction to this process activity was mixed. Overall, students enjoyed it and saw its benefits but they wanted to move into the rest of the project much sooner. Just as much as they wanted that, participants simply wanted this phase to be shortened and without so much time spent getting ready to work. The students felt that the problems should have been presented earlier in the phase. As they were, they were introduced at the end of the phase as they would influence the following process activity, form and norm groups. The following quote describes student opinion toward this initial phase of the revised CPS model:

Female #20: I thought it was really interesting and I like that we learned a lot. I think the paper we did on culture was really really interesting. But I do have to agree about how long it kind of dragged out because at least in my opinion you can talk about something as much as you want but you're never going to fully understand it until you've experienced it. So there's certain preparation you can do for it but at the same time really there's not much you can do until you experience it. I really just believe that you get to know a country when you're there and you're there talking with the people so I think we could have just worked a little more on the project instead of some of the cultural aspects.

Although they wanted to work on the problem statements sooner, the students saw the benefit in learning about the culture of the clients and students appreciated being asked to create their own initial cultural assignment as part of the process.

Similarly, they enjoyed learning about the culture of the target country and its history but wanted this phase to focus more on recent history and culture:
Female #13: I think that doing the culture and history paper is beneficial because every culture started somewhere. But I think that there should have been a I don't want to say more focus on current events because that takes away the whole project thing but you know if we talked a bit more about the things that are happening currently and we did talk about things that happened in the past.

Part of the activities students chose to work on during this introductory phase involved reading and summarizing news articles for current history and culture. Students enjoyed this phase and stated that they would prefer to read and discuss the culture like they do the news rather than research and write about it in an academic paper:

Female #11: I think reading some stuff is OK.

Female #12: Yeah. I think reading about it and talking about it means so much more.

Female #20: As much as everyone felt they were really annoying I actually really liked doing the news summaries. I thought that was a really good way to keep up with current events. . . . I really enjoyed you know looking at news articles and finding out about the country currently. I thought that was really good beneficial thing for this program.

As a team-building exercise, learners participated in a professionally led personality assessment called True Colors. The assessment was self-report and helped the students identify their own working personalities. The benefit of this assessment is that learners get to see how they work and what they value while learning how to work with others by identifying their needs and values. Student feedback was positive but one
learner, Female #13 saw the benefit the assessment offered to the team-focused environment: “I really loved the whole idea of the colors thing. I thought that was great. It was cool to see the different dynamics we have going on in this class and how we can all work together despite our differences.”

The focus of the collaborative academic research paper was on the history and psyche of Vietnam and its people. As a team-based research paper, the instructor deemed it important to see how learners collaborate to write a piece of research. Student reaction indicates that they would much prefer to not write a paper. While they all had positive feedback on reading the news every week, some offered suggestions on reading news that was directly relevant to the client and problems they were researching, rather than the culture and country in general. The following conversation details the suggestions students have on making news reading more specific to their project:

Female #16: I actually had a suggestion on that. I really liked the news summaries.

Female #20: And I don't know if there are certain ways we can spin that toward certain conflicts or learn more about certain areas where our projects are maybe. Get the better general sense of you know just maybe like for example the [motor vehicle] industry for us maybe find some articles that kind of pertain to that. You know I mean even just stuff in general. General knowledge.

Female #14: Like having one like specific focus for a news article allows you to get more invested into like what you're reading whereas, you know I definitely agree with . . . it's fine and you touch the surface of that you know. But if you had
just some time to really focus in on one news article or two I think that would be
really good to keep like a deeper understanding of the actual article I guess.

Three participants put forward the idea that for recent cultural research there could be a
discussion or roundtable set up with nationals from the country who would be more well-
versed with current culture and recent history than potentially misinformed webpages or
specific and difficult to find academic research. The following student responses expand
on this idea:

Male #8: I agree because the history thing is essential and it's good to form a base
off of but a thing that I think would have helped even more would have been like
a focus group with Vietnamese students on campus. Either focus group or
presentation about present day Vietnam and their youth culture and something
like that.

Female #11: I like the idea of a roundtable. When we did it before it led us in a
different direction. It was one thing I liked was having the students come in.

The building readiness phase ended with the presentation of the problem statements as
delivered by the clients. No discussion and collaboration between learners and instructor
on designing an authentic problem statement occurred since the problem statements came
directly from the clients.

**Participant observations.** The instructor started the semester by asking the
learners to decide what cultural research they wanted to do and how they wanted to do it
(in a team-based activity). On the way they reacted, the observer wrote, “they were
shocked when I asked them right away what they wanted to learn and how they wanted to
learn it.” When the students put together assignments to work on, the observer noted that the students seemed motivated to work on the assignments they had created. “They were floored by the idea of learning this stuff and teaching it to one another.”

Students were asked to write a collaborative paper on the culture of Vietnam because of their stated desire to learn about the history of the country and to continue to practice team working skills on a written project. The observer noted that the students did not want to write a paper but he chose to have them do it in order to gauge their writing skills for later team assignments. He wrote that “the students really undervalue the writing assignments. Of course they would rather give another presentation but I have to see where their writing skills are.” Part of the intent was to identify any necessary teaching points or “just-in-time instruction” (p. 251) as part of the instructor’s role in the CPS model.

*What were the strengths?* The first process activity resulted in student learning gains that were essential to the completion of the project. The first task they had was to create a team-based cultural knowledge assignment and this established the student-centered learning approach of the class. This process activity provided the instructor with a baseline knowledge of how the students in the class interacted, what kinds of teamwork skills they had, and some of their academic strengths and weaknesses. The cultural assignments helped the students identify and learn about cultural aspects specific to Vietnam. The students enjoyed learning about the culture and history of the country, reading the current news, and discussing it.
At the start of the process activity, the learners responded to prompts on the discussion board to prepare them for the in-class discussion on problem based instruction and the semester that was ahead of everyone. Discussion board prompts yielded few questions and concerns. Most students expressed anticipation and adulation for the problem solving process. But the in-class discussion was beneficial because students and the instructor discussed the aims of the instruction along with the desired outcomes in terms of both learning gains and tangible project goals.

Conducting the team-centric personality assessment, True Colors, was perceived as beneficial and a good way for the learners to learn about themselves and their classmates. As the focus group quote in the section prior indicates, it allowed learners the chance to learn about themselves while getting to know one another in better working capacities.

What were the weaknesses? While learners designed the first team activity completely, the instructor designed the team-written research paper with the content of the information that the learners identified. Although the content was consistent with the students’ stated cultural learning goals, they did not enjoy writing a paper and wanted to focus much more on recent history and culture. The learners feel as though they gain more content knowledge from having discussions like news sharing or a round table to natives from the culture than they do from researching and writing a paper. Like the learners from the first semester, these students wanted to work with the clients and problem statements earlier in the learning process.
Results from the focus group indicate that some learners found some of the cultural background research to be unnecessary or undesirable. In this case, the instructor failed to communicate to the class the importance of understanding the history and culture of their working environment. The first revision of the model failed to either communicate the importance to the learners or intrinsically motivate them to want to learn this information.

**What improvements can be made?** Based on positive feedback from learners, the option for completing a team-centric personality assessment can be added as a team building exercise to this process activity. By participating in a personality assessment led by a trained professional, students are better prepared for collaborative work. Because of the closeness with which individuals work in collaborative environments, by learning to recognize and tolerate other personalities learners can form closer bonds and thus augment the chances of achieving the team’s goals (Richardson & DeVaney, 2008). Although this is not a significant departure from the original goals of the CPS model, which states that the learners should participate in team-based activities. Nelson (1999) is not specific about the types of team-based activities that the facilitator can use in this process activity.

Furthermore, while the facilitator may find it important for the students to write a team research paper for writing practice, to provide feedback to learners, or to gauge their abilities, consideration should be given to the needs of the learners in context of the project. For example, in the case of this project, the instructor deemed it important to create a case where learners can get writing practice and feedback in anticipation of the
deliverables the class would likely give to the clients. But the learners in this instance of the revised model worked with the instructor to define their learning objectives and develop a team-skills building activity focused on cultural learning. Bridges (1992) writes that in a student-centered problem solving approach, the learners look at the project and “decide on their learning objectives” (p. 109). Careful balance should be sought among student appeal, creating teamwork skills development exercises and activities, and preparing the learners for working with real clients.

Another improvement that can be made to this process activity stems from the lack of understanding for the need for cultural research identified in the previous subsection. When discussing the need to research the culture of the client, the facilitator needs to make the students aware of its importance. Similar to ensuring that learners understand the importance of conflict management the facilitator needs to take steps to ensure that the importance of this part of the process activity is not missed by the learners.

*What role does technology play?* Technology was used in the second semester to support the overview discussion of problem-based instruction. Learners used the online space to provide talking points for the discussion, ask questions that they may not have otherwise had the space to ask, and read the posts of their classmates. As part of their teamwork, learners used PowerPoint and Prezi (accompanied by content based questions, per the facilitator’s request) to teach their classmates about the culture of Vietnam. The instructor required content-based questions because research has shown that students have demonstrated positive learning gains when instructors combine content based
questions with technology enhanced instruction (Gier & Kriener, 2009). If learners decide to instruct one another as part of the way they define their learning objectives, then the facilitator should ensure that they enhance their instruction through the use of content based questioning.

Because of the effectiveness of giving all learners an equal opportunity to express their feelings or ask questions on the discussion board, this can act as a positive addition to the revised CPS model. Learners chose to give presentations to one another and were given the option to use whatever presentation tool they wanted. The visual presentation of their material to their classmates can add to the learning of the students.

**Form and norm groups.** Based on the results from the first semester, groups were formed by the instructor team based on the following of factors:

- The instructor tried to place students with team members they had not worked with the previous semester.
- Students with the same major were placed in different teams.
- Students whose first language was not English were placed in separate teams.
- A diversity of anatomical gender was sought for each team.
- If students were best friends or in an amorous relationship prior to joining the program they were not placed in the same team. But because of the nature of the program, most students become good friends over time.
- Students with disciplinary issues (attendance, in-class professionalism) were placed on separate teams.
Focus group and interviews. The second part of this process activity was
dedicated to the norming process. In preparation for working with their teams,
participants were asked to create ground rules and guidelines, particularly for a procedure
for conflict resolution. They were also asked to create a sense of team identity by giving
their teams’ unique names.

The reaction to this phase was positive. It was better overall than reaction the
previous semester, which was nearly unanimously negative. Student feedback suggests
that the groups that were formed were desirable, save for two students who clashed with
their teammates. Students would have benefitted from having more time to research the
individual clients and projects since, once they were assigned teammates, teams were
selected at random to choose the project they would work on. Another option students
suggested is to allow students to form teams based on their interest in the client/project.
This option was not chosen so that the instructors could have greater control over the
makeup of each team, given the diversity in language backgrounds, individual strengths,
and potential trouble-makers or perceived slackers based on the experiences of the
students’ instructors from the previous semester. Furthermore, because of who the clients
were, one project was deemed more desirable and since most learners preferred that client
teams were not formed based on client interest. Although only two respondents in the
class did not enjoy the way teams were formed, the following exchange among
participants demonstrates general student opinion:

Female #15: I did not like how the groups were organized this semester.

Female #14: I loved it.
Male #8: I think the way we paired it up was I think decent.

One of the two students who did not like their teams seemed to not understand that the teams were intended to be diverse and put them in situations where they would have to work and thrive with people who may have different personalities or may take different approaches to accomplishing work. She expressed concern for the difficulty that comes along with being placed in teams with people with such diverse working styles.

Female #21: I like how our groups are dynamic but at the same time I don't think my group specifically, I'm the type of person who wants to list everything out – like we're going to do this in this order and I don't think we really did that at any point. And it's just how my mind works and like sometimes for me personally I was a little bit scatterbrained because everything was just like in our heads all the time.

The first student who expressed dislike for this process of forming groups sided with the second respondent and was concerned about the communication issues that resulted from her team’s pairing:

Female #15: I thought you were going to let us choose our groups based on our friends and I think you should trust our professionalism in that. It was discouraging because I think there were people who were disappointed. I think it did not work out because apparently in our group there was a communication issue with our group.

This was an outlying opinion and the other classmates were quick to respond in support of group diversity and the experience of working with unfamiliar colleagues:
Female #14: I liked the way because I think that in the work world you don't get to choose who you work with and everyone has to work with someone you don't like at some point. And if you guys choose the groups each semester you're going to work with some people you do like and you're going to work with people who are a challenge some semesters. That's just the way it is in the real world and I really appreciate that because I think that choosing your own groups would have turned into a hey friends let's pair up.

Female #22: I think that would have happened.

Other learners suggested allowing teams to form based on interest in the problem statement or client. While many participants had different views on how to best accommodate this approach, the following quote represents those who wanted to formulate teams in this manner:

Female #16: I wish you would have asked our opinion on certain things and trusted our opinion and respect our opinions like on groups or on choosing our projects that we wanted to work on. There were some people who there were projects were exactly what they wanted to do with their career but they couldn't do that because it was all a heads or tails kind of thing. So I just wish you would have respected our opinions and our wants more than just thinking oh they're just going to choose whatever they want.

Not all learners wanted teams to be formed based on interest. The following student argues in favor of garnering a diverse experience and the benefits that she believes it offers to those who complete the project:
Female #11: I guess in defense of what we did do I do agree that all that stuff. I would have loved to do a different project but in defense of the method I do know people who have come out of the program who have talked up the program because of its exposure to other majors. Like I'm doing something right now that I never would have touched in any of my classes. I never would have read the stuff I read and I know that's the same for a lot of your projects. And it's not like I'm honing my PR skills but I think I'm honing my professional – as a professional in general. So there are times I wish it were a project I chose but at other times I think that exposure to other areas of professionalism was beneficial so in defense of the project I guess. But I see the other side too.

The second part of the process activity involved teams participating in a norming process to define a set of ground rules. Student reaction to this part of the process activity was primarily positive. The students seemed to understand the need to create a procedure for solving any problems that may arise. When they were shared in class, other teams were able to learn from one another and amend their own particular procedures. During focus groups and interviews, no suggestions were offered and the only feedback received was that experience was positive.

*Participant observations.* Choosing teams was hectic based on time limits and the observer wrote that he would have preferred to give the learners a class period to learn about the clients and problem statements before having them pick. But making a direct comparison to the previous semester, he wrote that the students seemed happier with their
teammates. Not all students were satisfied with their projects but they all seemed more than OK with the way they were placed into teams.

Regarding the development of operational guidelines including conflict management procedures the researcher wrote about emphasizing these to the learners. “They seemed to understand the importance I was placing on their need to learn conflict management skills and to try to resolve them before seeking help from anybody else.” When the learners shared their operational guidelines with their classmates, the facilitator noticed that not all teams had established operational guidelines for conflict management. They had rules established but no identified criteria for dealing with team members who did not follow the guidelines. The instructor asked the class to offer feedback to the teams who did not create conflict management guidelines and observed that the teams were able to collaborate and help one another achieve these goals.

What were the strengths? Forming groups and norming them was much better received in the revised CPS model than it was during the first instance. With two exceptions, students enjoyed the teams they were on and said that they enjoyed the way they were formed. While not all students were pleased with the clients they worked with, most were. On the PBL evaluation questionnaire the median score for the question gauging the relevance of this course to the students’ future work was a six, indicating that most learners found it relevant even if they worked on a project they would not have originally chosen. During the focus group, one student specifically mentioned that getting the opportunity to work with a client or discipline out of her comfort zone would be beneficial to her career.
Group norming was more effective during the revised CPS model. Despite the initial trouble some teams had identifying conflict management operational guidelines, because of the CPS model’s dedication to class collaboration these issues were quickly resolved. The CPS model does not allow for inter-team collaborations for group norming in this process activity. The decision was made for learners to share their operational guidelines and give and receive feedback because of the emphasis placed on this throughout the remainder of the model.

**What were the weaknesses?** Some students would have preferred to work with a different client or project than the one they did. With the way teams were formed by the facilitator, preference was not considered in a way that appeased all students. Furthermore, even though the teams all eventually created operational guidelines for conflict management, they did not know how to manage conflicts until they set out to learn. Although the instructor should work with the teams to help them through this process, if the students are going to be asked to resolve conflicts then they will have to know how to do so.

Results from the focus group indicate that some learners found it difficult to work in heterogeneous groups. The communication issues and varied working styles mentioned by two students, each from a different team, reveal a communication issue on the part of the instructor. The instructor failed to communicate to the class that differences among team members was an intentional result of the establishment of complementary teams and that a vital part of the model is the development of teamwork and collaboration skills.
**What improvements can be made?** This semester’s complex problem definitions were different from that of the first instance. Instead of one client with one problem definition, the class was faced with five unique problem definitions from four clients. In this scenario it becomes more difficult to please all students. In a case like this, where there are multiple clients and projects, there can be alternate options for group formation. One student suggested they rank their preferences of clients and projects and the instructor would try to accommodate and evenly distribute them. If the facilitator wishes to choose teams to ensure he or she creates heterogeneous grouping, this could be an option. Another suggestion was to let the students simply select the project or client with which they would like to work, negotiating among one another to divide themselves evenly and heterogeneously. These are not suggestions for improvement for the model, simply student suggestions. The improvement that can be made is that the instructor should make an effort to balance student interest and heterogeneous team distribution. The instructor attempted to create this balance and results from the questionnaire reveal that the learners found the semester applicable to their future work. The intention of the design of the authentic problem that students face is to be authentic and relevant (Barrows, 1986; Lopez & Lee, 2005). An appealing, relevant, and personal problem statement can help motivate learners, which is one of the five key outcomes of PBL.

Another improvement that can be made to this process activity stems from the instructor’s communication issue identified in the previous sub-section. When forming teams for the learners, the facilitator needs to make the students aware of his or her intentions in forming teams. By understanding that teams are intended to be
complementary, the learners could contextualize the team building personality assessment (if completed in the first process activity) and learn to work together in celebration of their individual differences.

The third improvement that can be made to this activity is to create a full-class collaboration sharing and feedback session for the operational guidelines and ground rules. As is the case when this occurs during the fifth process activity teams and students will be able to learn from and share resources with one another (Savery & Duffy, 1995; Bruffee, 1999).

*What role does technology play?* Technology did not play a large role in the revised model’s implementation. But when the learners are asked to create operational guidelines or ground rules, they have the option of the in-class teamwork time to use their laptop computers or mobile phones to research effective team rules. The instructor encouraged this but it was not required. Since the learners demonstrated a hesitation with identifying and describing conflict resolution procedures, the instructor could make it a requirement that the students conduct just-in-time research while constructing their guidelines (Collins & Halverson, 2009). With the inter-team collaboration that occurs when teams share their operational guidelines could be enhanced when teams have more resources to share and more resources that provide them with a wider range of ideas to inform their critical feedback (Savery & Duffy, 1995; Bruffee, 1999).

**Determine a preliminary problem definition.** During this phase, teams convened and looked at their problem definitions together to agree on a common understanding among their teammates. Students and teams were quickly able to start a
fact-finding and exploratory research phase. Because each team had a unique problem
definition, different teams began with slightly different initial research as they defined the
type of problem they faced. But with in-class discussions among teams, students, and the
instructor, most teams set out to research the industry of their client as part of their initial
design plan. Other teams first set out to research their clients’ competitors. Again, these
distinctions in research approach were due to the different ways teams understood and
defined their projects. But this phase was primarily dedicated to teams informing
themselves on their client, its makeup, culture, and history – since they were all new to
the process and the companies were new to them, their gaps in knowledge were
significant and significantly outweighed their existing knowledge. Once they conducted
their preliminary background research, teams reconvened, shared research, and began
work on the subsequent process activity. The students appreciated having the flexibility
and space for discussion to start their project the way they did. Because in Nelson’s
(1999) original CPS model, this phase included the creation of a longer-term design plan
and that was made into a separate process activity in the revised model the two phases
blend together. Most student feedback from the interviews and focus groups addresses
this.

Participant observations. The researcher observed the way teams negotiated the
meaning of their problem statements. While he noted that they did not have enough
information to fully understand the nature of the problems, they were able to determine
the sector in which their problem took place. For example, one team “determined that
they were investigating an HR problem and, when the rest of the class decided to conduct
an industry analysis this team wanted to do a competitor analysis . . . this will help them discover the root of the problem.” Participant observations go on to describe the differences between the CPS model and the revised instance. Comparing the way learners were asked to identify potential problem solutions and choose one to explore, the observer wrote that the problems students faced in the second semester would have made this too difficult. He writes that “most teams have a problem statement given to them by the client that reads not like a problem statement but more like the result of a problem.” For example, he writes, the one client asked learners to explore the problem of retention of new hires. Although this is a problem in and of itself, it is also the result of many factors – some of which the students may not even realize are possible since they are working in a foreign environment. “These problems are simply too complicated for this group of learners to have any sense of a potential problem solution at this point.”

Once the learners began their initial fact-finding phase they were able to identify more background information that helped them better identify different aspects of the problem. This, the facilitator observed, would help the students to define the tasks, research, and assignments that would encompass their action plans. “Just starting to research and find background information about their project and clients has helped the learners really pinpoint the gaps in their knowledge . . . this should go a long way in helping them create an action plans.”

**What were the strengths?** The strengths make up this entire process activity. From the researcher’s observations, the learners benefitted from discussing their problem statement and discussing them among all teams. Nelson (1999) writes that this discussion
is an important part of the process, yet is often neglected. The CPS model in itself

demands inter-team collaborations and during this process activity, that collective effort
allowed the teams to share and learn from one another. Although the learners did not
identify potential problem solutions, they did take time to identify both existing
knowledge and gaps they needed to fill. This is a strength because the learners came
together as teams to identify where their problem statement fits, which led them to
understand better what they would need to know to proceed.

What were the weaknesses? Although the CPS model allows for inter-team
collaboration and feedback sessions, they are not part of this process activity. Because the
idea to include whole-class collaborations and feedback was put in following the data
collection and analysis of the first semester, it was a weakness for the revised model as it
was written.

What improvements can be made? Because of the identified weakness and
because when the researcher implemented whole-class discussions, he observed it as a
strength, an amendment will be made to this process activity to allow for inter-team
collaborations as teams attempt to define their problem statements.

Design a long-term action plan. Instead of creating a design plan based on
identifying and revising potential problem solutions, teams were asked to identify the
information they would need to gather in order to hypothesize a problem solution. The
identified missing knowledge would become assignments to work on as part of their
long-term action plan. Teams used a calendar sheet to fill in their schedule and action
plan with assistance from the instructor. The action plan laid out the specific research
tasks teams would do and by when they would have them finished but also specific
tables like depth and breadth of research, primary vs. secondary research, and their
goal for the completion of the feasibility test.

**Focus group and interviews.** Student feedback was positive. They liked getting to
set their own schedules and the flexibility that came along with that. On the flexibility
inherent in a student-designed and maintained schedule, the following student’s quote
illustrates the class’ positive attitude:

Female #11: I really did like the ability to create our own work timeline so I
thought it was nice to do the calendars and like setting our plans and I liked
having the ability to change and move them according to how our research was
going because we had a couple timelines change that I don’t think would have
been as flexible had the instructor created the timeline. That helped us change a
lot of the focus of our research

Despite creating the action plan, not all teams were able to meet their own deadlines. The
following student reflects on this as she hints that her team could have used more
accountability:

Female #11: But then at the same time sometimes I felt like we kind of hit a lull
period where we weren’t doing work consistently together as a group because we
had kind of changed our timeline so things kind of got a little off and I didn’t feel
we were on track anymore. So I don’t know what the solution would be. . . And
we had a period where we weren’t doing enough work I think because we didn’t
know where to go. So I think it was good but then there was a little period where I felt a little lost.

Finally, Male #9 suggested having a scope instead of a timeline. A project scope would include a timeline of sorts in addition to things like the project goal, specific deliverables, tasks, responsibilities for each team member, and procedures for finalizing and approving work (assignments) for submission. This is the intention of the Action Plan, on a much larger and more detailed scale.

**Participant observations.** The instructor worked with teams to help them identify all the assignments and tasks they would need to complete in order to create a problem solution. He wrote that the students seemed appreciative yet intimidated of being able to set their own schedule for the semester’s work. “I think they liked it. They liked the freedom it gave them. But a lot of teams didn’t know where to start.” For future instances of the instructional model, the observer wrote that learners could use this as a time to share ideas among teams. A whole-class collaboration and idea sharing session could be more valuable to the learners than meeting with the instructor in one-on-one meetings. Since the collaborations the students participate in during the subsequent process activities are so valuable to them, doing so during this wide-reaching activity could have a similar impact. Otherwise, the facilitator observed that the process activity led all teams to create an action plan with research parameters and assignment details that he believed would lead each team to be able to identify a problem solution.

**What were the strengths?** Compared to the previous semester, the learners in the revised instance of the CPS model used the action plan to stay on track toward their
goals. The learners enjoyed the freedom and flexibility they were allowed by having the opportunity to create their own semester-long schedules. The action plan led the students nearly to the end of the projects, as they planned up to and through the proposed date for the completion of their feasibility test. It was a document that the learners and instructor referenced throughout the entire semester.

_What were the weaknesses?_ Although the learners expressed satisfaction with the action plan and its built-in flexibility, one team expressed their need for more accountability in staying on track. While the feelings they expressed of being without work at times may be due to their action plan’s initial poor-planning rather than needing to simply be pushed to move forward, the facilitator did not keep all teams accountable.

The other weakness, like the previous process activity, is that this activity did not account for inter-team collaborations. The observer wrote that, with a whole-class collaboration and the students can learn and share ideas with one another, like they do during other process activities.

_What improvements can be made?_ In keeping with the spirit of problem-based instruction, this process activity can be improved through the inclusion of student-to-student feedback. A whole-class collaborative feedback session would benefit the students as it does in the next process activity. During the focus groups, the student participants stated that they learned more from one another than they did researching on their own.

Furthermore, to keep learners working toward identifying the final problem solution, the facilitator should ensure during the action plan drafting phase that all teams
create a sufficient work load and distribution for the semester. The facilitator should
maintain this requirement for accountability throughout the semester and ensure that
learners add to their action plan if they need to. Halvorson (2014) wrote that using an
action plan is not necessarily beneficial. But creating a detailed action plan with specifics
built-in helps individuals accomplish their stated goals. The individuals responsible for
designing and following an action plan need to account for and address working issues
such as “What data must the team gather . . . who will run the reports, and when?” (p. 83).
As part of the next process activity, learners evaluate each task to decide what
information to acquire, who will do what, and any other details required to complete a
given task.

*What role does technology play?* Technology can play a large role in this process
activity. If the instructor is comfortable using technology, the action plans created by the
teams can be shared online with the instructor. This fourth process activity of designing a
long term action plan would benefit from the inclusion of technology by allowing
learners to design their action plans online in a shared document with the instructor. The
instructor and students can make changes to the online document and easily adjust it as
necessary. Furthermore, when there are multiple instructors working with the teams, as
there often can be in this particular context, an online document with each team’s action
plan, updated progress, and instructor feedback would allow any instructor to meet with
and offer feedback to a team at any given time. Wang (2010) found that teams sharing an
online workspace for collaboration allowed the instructor to identify learner progress,
collaboration, individual accountability. Finally, if each team’s action plan were
accessible to all members of the class, then other teams can use this space to share ideas and learn from one another. Not only will this create a common space for the learners and instructor to work, moving part of the instruction to a network like this can help build motivation and confidence (Yunus, Salehi, & Chenzi, 2012).

**Engage in an iterative collaborative problem-solving process.** This long process progressed as intended from learners creating their timelines/action plans. As teams moved through their project plans and work schedules the instructor checked in with them to gauge their progress and to try to ensure that they were exploring all avenues and asking the right questions. He sat in with teams when they conducted interviews or visits to companies for observations/interviews to act as a guide if needed. Like the CPS model in the first instance, this process went as expected, with learners maintaining a focus on reaching their next goal as outlined in their action plans. They came to class with additional research, discussed and debated learning issues and critically analyzed their findings. Many teams debated the cause of the problems. Some debated whether there was a problem or not. The instructor met with teams during in-class time, asked them questions, tried to make sure they were asking questions, and provided some research or information on the clients when necessary.

Intergroup collaborations were a focus of this process activity, where learners were expected to share findings with their classmates, who were then expected to offer feedback, suggestions, or resources. Much like what happened in the first CPS instance, teams were paired up to share feedback and offer critiques. Similarly, teams presented to
the whole class, where their classmates and other teams could offer feedback and suggestions.

Finally, near the end of the process activity or when learners had collected enough data to hypothesize a viable problem solution teams conducted a feasibility study with an expert. Since all teams were conducting primary research with experts already, they were able to identify an expert with whom they could conduct a feasibility student earlier in the semester.

**Interviews and focus groups.** There were times during this process when learners and teams had difficulty finding the data and answers they were looking for regarding a specific industry or their client or anything related to their project. Students asked the instructor what to do or what the answer was. In problem based instruction, the facilitator often does not have an answer. The facilitator often does not know exactly where to go to find the exact information students need. Furthermore, the intention of PBL is that learners get the experience of identifying the location of needed resources. In this process activity, the facilitator asked the learners where they had looked for the information and suggested different places they could look for information or people. Sometimes, the instructor asked the teams to think of other places to look without offering specific suggestions. The following quote describes how the way this was communicated frustrated some of the learners:

Female #13: Going along with what [Female #11] was saying I really liked the whole idea of us being able to kind of construct the path we decided to take but I also felt like, occasionally, not all the time, sometimes when we would ask for
advice or help it wouldn't be a – you need to do this on your own, this is how
we're doing it, you know. You'll figure out your own way . . .

The main piece of feedback during interviews and the focus group was that the students
did not always know where to go to find information and wanted more guidance on
where to go to find research or data.

Not only were teams asked to collaborate on their own and work together to reach
an end goal, part of this process activity involves inter-team collaboration and peer
feedback. These activities were well regarded by participating students and they wanted
even more in-class time to do so. The following brief exchange demonstrates the loud
response students offered when asked how they felt about team-to-team interactions and
feedback:

Many: Yes. Love it.

Male #8: The more feedback the better.

Female #17: We want that because we're so invested in what we're researching. I
think it was a great use of class time.

Male #9: It is a collaboration program.

The last part of this process activity was added following the revised instance of
the CPS model for this context. The feasibility test or usability test as Nelson (1999)
refers to it, was moved into the iterative collaborative problem solving phase. This
semester the learners completed this with about six weeks remaining in the work process.
Compared to the previous semester where learners completed this phase with two weeks
left, at most, it gave students a significant amount of time to take that feedback and
properly implement it in their project designs and solutions. Student reaction was positive and the students’ projects were shaped by their feasibility tests.

**Participant observations.** This iterative process activity yielded participant observations that spanned the length of its weeks-long application. The observer wrote that the learners benefitted from their action plans in ways that the students from the previous semester had not when designing their design plans, which provided less structure. Initially, they were much better at staying on task than the students from the previous semester. The observer wrote, “The students this semester are more able to move from one task to the next than the ones from last semester. The action plan seems to be helping them move forward with much more focused research.” Eventually, the fault in the action plan became apparent to the instructor:

I realize we didn’t set parameters for deliverables for the tasks for the instructor. Some teams are completing [industry analyses] and without a syllabus the learners don’t quite have the research in deliverable form for me. The students are clearly doing all the research and work but they also don’t have much to ‘turn in’ like they would with an assigned paper. Next time I should have the students create a deliverable aspect to the tasks they work on in their action plans.

The collaborative work between teams throughout this process activity helped drive their work and research as it did in the previous semester. The facilitator observed that the students were more willing to give one another feedback than he expected since, compared to the previous semester, these learners had experienced less time with problem based methodology.
Meetings with teams were observed to be productive as the instructor asked questions of the learners. But, these students were perceived to be less experienced with problem solving again because they seemed to be more in need of guidance. “It’s a tough balance,” the researcher wrote, “giving students guidance and allowing for them to find the path on their own. Sometimes they have a much more difficult time figuring out where to go to find information than the students did [Fall Semester].” While the facilitator observed this he continued to write that he talks with the teams to try to get them to think about where they can look to find information.

When the learners had amassed a sufficient amount of research, they completed the feasibility study to gauge the viability of their potential problem solutions. The timing and placement of the feasibility study was perceived to be more effective than it was in the first instance of the CPS model. The observer wrote, “the feedback from the students has been phenomenal compared to last semester. The feedback they got gave them advice not only on their hypothesized solutions but also on their research directions in general.” The experts with whom the teams consulted were able to tell the learners how feasible their problem solutions were and the kind of research they needed to complete in order to improve the solutions or find the best one possible. The facilitator wrote that the feasibility study appeared to be a good idea in principal but when conducted at a time when it could make as big of an impact as it did in the Spring Semester it became an integral part of the CPS model.

**What were the strengths?** As it was in the first instance of the CPS model, all parts of this process activity were strengths. On most days, the learners came to class
with research for their teams. They continued to analyze their problem statements, working toward potential problem solutions. When just-in-time instruction was needed, the instructor invited experts to the classroom, including one who came in and instructed students where to go for research. This was a strength because, as the students had less experience with problem-based instruction as those who participated in the first semester, they did not know what resources were available to them.

Team meetings with the instructor were a strength again, as the learners followed their action plan, gave one another critical feedback, and the instructor was there to help ask questions. Likewise, whole-class collaborations were a strength as the learners expressed nothing but positive feelings toward this part of the process activity. The instructor observed that the learners were willing to give one another a great amount of feedback and that they all benefited from this activity.

Finally, this revised process activity added the feasibility test, which occurred later in the semester in the first instance of instruction. Although the learners did not notice the difference from the first semester to the second, the instructor observed that this was a better placement for it since the learners reported receiving feedback that influenced their problem solutions and research focus.

**What were the weaknesses?** In the first semester the learners were unsure which research to conduct next. This was addressed through the implementation of the action plan in the revised CPS model. Although the learners in the second semester worked through this process activity and the instructor helped them identify questions to drive their research, the students were often unsure where to find the information they sought.
These learners were, again, less experienced with problem-based instruction than the ones from the first instance of the model and their unfamiliarity became apparent to the instructor when he saw that they needed greater assistance identifying resources. The CPS model states that “The instructor then provides assistance on how to acquire these needed resources” (p. 263) and the instructor did that at times – notably with the visiting expert who provided the just-in-time instruction. But he noted that, at other times, it was difficult to find a balance between getting the learners to learn how to identify the sources of their needed knowledge and offering suggestions on where to search. The CPS model does not address how the instructor can keep this balance and instruct the learners on identifying missing knowledge and how to find it.

**What improvements can be made?** In response to the stated weakness that the learners felt lost on where to find information, this process activity can offer a specific example of how the instructor can offer assistance for finding resources. As teams move from one task on their action plan to the next or from one learning issue to another, the instructor can provide assistance by helping the learners brainstorm a list of places to find research. If the instructor does not know where to go to find research, he or she can help the students brainstorm a list of people to talk to in order to find the resources they need. This will ensure that the instructor both models techniques to find research and allows the teams to be self-directed. Not only can the instructor help the teams brainstorm places where they can go to find the resources they need, it can become part of the full-class collaborations in which the teams participate throughout this process activity. PBL intends to develop investigative and problem-solving learners through the instructor’s
development of an authentic problem situation, questioning and modeling of problem solving methods (Hmelo-Silver, 2004; Hung, et al., 2007; Norman & Schmidt, 1992). As a facilitator and not a knowledge-dispenser, the instructor in PBL is supposed to help students learn how to find the correct path or resources, not show them where to go or what to do (Boud & Feletti, 1997).

**What role can technology play?** In this section in Chapter 4, the use of a piece of technology, an app called GroupMe, is suggested. Because it was not used exclusively in this process activity, the results from using it are not covered in this section.

**Finalize the solution or project.** This process activity excluded the feasibility test from the first semester’s instance. In the revised instance this process consisted of learners finalizing their problem solution and creating and delivering it to the client. Learners worked with the instructor to design the format of the presentation to the client. Students used the PowerPoint software to deliver the information orally to the client along with a summary of their work.

**Interviews and focus groups.** Learners did not say much about this process activity, perhaps because it occurred so late in the instruction. But they were pleased with the direction their research took and the end product they created. During a one-on-one interview, Male #10 said, “I’m real happy about how our project turned out. We worked so hard on it” Similarly, others responded that this would be a project that they can put on their resume. On having discussed this project in an interview during the semester (before the project was finished), Male #8 credited it with having a profound impact by saying, “I
have to owe it to this program and I have to owe it to the teammates that I had because I wouldn't have gotten that with the degree that I have.”

**Participant observations.** The researcher wrote that the way the semester came to a close was an effective way to end the instruction. The students put forth time and effort to prepare their presentations and documents for delivery. The observer stated that it was nice to see teams decide what kinds of additional documents they wanted to deliver. The instructor felt that the delivery and content of the students’ work exceeded expectations, the researcher also made observations of the clients and their reactions. “There was a strong delivery of the final problem solutions and the semester’s climax felt appropriately weighty and challenging.”

**What were the strengths?** The strength of this model was that it allowed for the learners to work collaboratively with the instructor to organize the design and delivery of their final problem solutions. Some learners had different documents to present at the solution of their projects.

**What were the weaknesses?** With very little of this process activity besides finalizing the project, collaborating on the design of its presentation, and then its delivery, this process activity had fewer sub activities to comment on. No weaknesses were perceived in the revised instance of the CPS model.

**Synthesize and reflect.** During the focus group students were asked to provide feedback to the instructor regarding the instructional method, process, and anything else about the semester that they wanted to discuss. Participants were asked to reflect on what they had learned regarding problem solving, group/teamwork, working on a long-term
project, and any other transferable skills. These questions and discussion points garnered the greatest level of participation from the students. Nearly every student was able to pinpoint and discuss his or her own unique learning gains. Because special focus is dedicated to expanding on the perceived learning gains of the learners in a following subsection, interviews and focus groups yielded little results for this process activity.

**Participant observations.** Immediately following the completion of the focus group, students thanked the researcher for being given the space to have their voices heard and to be an integral part of the instructional method moving forward. Much as he observed the first semester, the researcher wrote how the learners sincerely appreciated this activity. This process activity also serves as a way for learners to evaluate themselves and the researcher observed that, in reflection, the students seem to learn from one another in hearing their takeaways and learning gains. During the focus group, the learners were talkative and responsive but often went off the topic of conversation. The researcher had to refocus learners without interrupting them because, he said, “I think it was important for them to express themselves and give feedback on everything they feel.” Keeping the learners focused on one question can be challenging but if they have no opinion on a question and want to offer feedback regarding a separate topic, the researcher observed that it seemed cathartic to them either way.

**What were the strengths?** This process activity allowed the learners to reflect on their learning and offer feedback to the instructor on the instruction in which they just participated. The learners were able to identify what they had learned and how they had been able to apply that learning in other situations or how this experience has already had
or will have an impact on their careers or internship experiences. Because no weaknesses were documented and this process activity did not reveal new data from the revised instance of the CPS model, no improvements can be made for this context.

Assess products and processes. In the revised instance, learners were again provided with feedback on their “(a) content knowledge and skills, (b) group-process skills, and (c) metacognitive strategies” (p. 265). These were delivered as written reviews to each participant. Like they were in the first semester, each learner was given a final grade in accordance with university policy.

Focus group and interviews. While this phase went as well as it had in the previous semester, student participants in the focus group wanted to see the implementation of face-to-face peer evaluations. They also wanted to see evaluations from the instructors at the close of each project/semester in the form of personal conversations rather than the written evaluations they were given. This, the participants state, should not simply be an evaluation of the final problem solution and their learning gains, teamwork skills, and metacognition. Rather, it would be a comprehensive evaluation and discussion of all the work they had done and where they can improve in any aspect for either the following semester or any experiences outside of the program.

While Nelson’s (1999) final Instructor- and Learner-Implemented Method states that “part of the grade can reflect an evaluation of an individual by fellow group members” (p. 254), nothing as specific as face-to-face peer evaluations is described. However, she does provide an option for the instructor and students to collaboratively develop the criteria for final evaluations. Part of this process activity is dedicated to discussing and assessing
each team’s group processes but not one-on-one discussions or evaluations. The following short discussion highlights the learners’ idea of completing face-to-face peer evaluations:

Male #8: I think that peer evaluations in this professional setting should be done. I think I can take criticism from any one of you and not take it personally. Like take it, accept it and grow from it. I respect our instructors and everyone in this room immensely. I think it would not only benefit us personally but further our personal ability our group's ability and the program's ability and it would help us understand things that we ourselves might not be aware of.

Female #21: I would rather fix my problems than have somebody hold a grudge against me because I don't do something.

Female #13: I think we're all responsible enough for that to understand constructive criticism. Like I think if that's an official part of it.

There were other students who suggested doing so anonymously. The following interchange of dialog represents both those students who would prefer anonymous peer evaluations and those who recognize the importance and difficulty of implementing such a procedure.

Female #21: You could make it anonymous form.

Female #14: Definitely anonymous.

Male #8: I think it would make people that much more have to step up their game that much more.
Female #20: I think it should definitely be done in a positive way because like we don't want to discourage people from working hard.

Another participant offered a personal experience on why he would prefer anonymous reviews:

Male #9: For our evaluations [in another program] for some reason they chose to make them not anonymous so you knew exactly what everybody was saying. And unlike this program, we didn't want to be there so everybody just kind of [complained] about everyone. But it's kind of helpful because you had like someone think one thing and nobody else think the other thing. You go with that person that has to lie. Some people did it because it was like a personal issue. But here everybody here wants to be in this program so it makes evaluations that much more valuable because if your evaluation is poor or you did poorly on something it's not because you weren't motivated or you didn't care. It's because of some sort of other issue.

While his bad experience seems to highlight the potential pitfalls of a poorly designed peer review system, he seems confident that his classmates and other students joining this program or in this context would produce different results.

**Participant observations.** The instructor gave the learners personalized feedback, like he did in the first semester. He observed their satisfaction and appreciation for the feedback, which was similar to the way students reacted in the previous semester. In evaluating the work that students performed and its evaluation, the researcher wrote:
I evaluate the solutions or projects for each team but my goal is to make this point irrelevant. To have student teams that have received the right feedback and enough guidance to have the best solutions possible. If they follow the process and the model then there is no reason their research can lead them to any other solution.

**What were the strengths?** The strengths of this process activity remain as they were in the first instance of the CPS model. The students appreciated receiving personalized feedback and there is variation in what the CPS model allows for assessment. From the first instance to the revised instance, no new strengths were observed or recorded.

**What were the weaknesses?** From the perspective of the participants in the revised instance of the model, the weakness was that this process activity did not include summative peer reviews. The learners felt that in a collaborative environment where they would be asked to work together with their peers again the following semester, they would benefit from receiving candid yet constructive feedback from one another.

**What improvements can be made?** Because the learners work together for multiple semesters, they may benefit from receiving feedback from one another. This can be an option added to this process activity. But, as the learners observed, this activity within the process activity will have to be carried out carefully to ensure that the feedback is constructive, good spirited, and delivered in a way that protects the wellbeing of all involved participants. In problem-based learning environments, peer feedback can help students who perform poorly (Kamp, Dolmans, Van Berkel, & Schmidt, 2012).
Feedback should work together with self-reflection and Archer (2010) writes that face-to-face feedback can be helpful. In a study investigating effective feedback in problem-based medical education, the results from Hewson and Little’s (1998) study finds that learners welcome feedback “especially when it is based on their performance and tailored to their goals” (p 116).

**Provide closure.** Much like the first CPS instance, the second semester closed with a celebration with food and cheer. Students celebrated with one another, with instructors and faculty from the program and they talked about the project. There was music, dancing, and new friends. And after that students met up to continue the celebration into the evening.

**Participant observations.** Although most of their conversation centered on topics that were not related to the instruction or the project, some students discussed the semester they had just finished. Most of the time was dedicated to decompressing and the participant observer wrote how this time spent with the learners allowed him to get to know them on a more personal level. He wrote about how this process activity could even benefit future learning sessions of these particular students. “If we would work together again, I’m sure it would be much more productive now that the students and I have found more common ground.”

**What were the strengths?** All parts of this process activity were perceived as strengths again in the revised CPS model. Because no weaknesses were documented, no improvements can be made to the CPS model for this context.
Comprehensive Guidelines

In the revised CPS model, the comprehensive guidelines serve the same function as they did in the first instance in the fall semester. They are a set of methods or actions that instructors are expected to follow and instill in the learners. They are guidelines for what students and facilitators ought to do and how they should act and interact. They are methods and actions that learners and facilitators implement collaboratively, as the situation dictates. Nelson (1999) separates the comprehensive guidelines into four categories, (a) Instructor-Implemented Methods; (b) Learner Implemented Methods; (c) Instructor- and Learner-Implemented Methods; (d) Interactive Methods (p. 251). This sub-section describes pertinent findings regarding each method within the comprehensive guidelines.

Instructor-implemented methods. These methods provide a guideline for the instructor’s actions and roles. In the revised instance of the CPS instructional method, the instructor carried them out in much the same way he did in the first instance. The instructor offered feedback to learners as he saw that it was needed and he put students in teams to work on smaller projects to acclimate them to the environment. His focus in meeting with groups was question-asking and probing them to think about the problems faced in as many ways as possible. Finally, he provided instruction in the form of cultural understanding and knowledge on the culture of the target client when it was deemed that students needed specific information. He also provided instruction through a guest instructor from the university library who helped learners navigate the online tools and databases with which many were unfamiliar.
Focus group and interviews. It was already mentioned that learners would prefer a bit more guidance from the instructor and the idea of not asking students to simply go find information but when they seem to be at an impasse to get them to brainstorm areas where they can go or look (or people to talk to) to find the information they need. This is a more specific addition to the existing method to Nelson’s (1999) first instructor-implemented method. She writes “The most significant change is that the primary responsibility for managing learning is shifted to the students. The students determine what information and resources they need and how to obtain them, with the instructor available to provide guidance, feedback . . . as needed” (p. 250). When students have exhausted their existing knowledge on searching for information then this would be needed. The following example demonstrates students who wanted guidance not on finding resources but staying on task and sticking to their long-term action plan:

Female #11: I think that. I think that our team maybe could have . . . I don't remember exactly if we asked for feedback on what more we should be doing but I felt like I lacked a little bit of instruction which I think was your point but I think there we might have just needed a nudge from professor/TA or something. Like hey, why don't you do this for two days from now or do this for tomorrow because I see where you're going with this in the long run. Instead of there being kind of a larger map to what we have a larger thing do maybe a little assignment that you thought might get our minds moving again. But we would have had to come to you too.
Finally, in this particular project, each student team often works on its own unique project for a unique client with a unique problem statement. During the first iteration of the CPS model student teams all worked for the same client with the same problem statement. As can be the case in the former situation, each project/client requires a different set of skills and knowledge (or disciplinary focus) from all the others. The participants felt that some of the need for a certain amount of guidance may be attributed to not having enough individualized instructor attention:

Female #16: It's good to have opinions from everybody but I feel it would have been better to have one instructor or TA per group. One person to go to and to get advice from because having multiple people glance over your essay and not really give you any substantial constructive criticism – it's more damaging to our project than having one TA who already knows your project, who already knows you and what you've gone through and what your project has.

**What were the strengths?** The strengths of the instructor-implemented methods remain the same from the first instance of the CPS model. Instructor questioning helped students guide their own learning, yet the model is flexible enough to allow the facilitator to provide resources otherwise inaccessible to the students, such as documents that come from the client. Just-in-time instruction was a strength in the revised instance of the CPS model because it allowed the facilitator to help direct learners to research databases with which they were unfamiliar. The instructor's methods were a strength in that they allowed the learners to direct much of their own learning and projects.
What were the weaknesses? Learner feedback indicated that the students wanted more direction and help from the facilitator on where to find research or data. Although the learners are responsible for identifying what they need to know and how to find it, the facilitator is there to offer guidance. In the first semester, the weakness was that the students wanted more guidance from the instructor in terms of identifying next steps and tasks. In the revised model, students had their action plans to help them move forward, but sought guidance for identifying and locating resources. The other weakness is that the facilitator did not keep the learners apprised of each process activity and changing expectations as the instructional process proceeded.

What improvements can be made? In the fifth process activity, the improvements that were made after the instance of the revised CPS model include helping the learners identify resources they need by modeling brainstorming activities with them. The intention is to retain the aim of PBL in developing learners who know how to solve problems and can identify the paths they need to pursue to find appropriate solutions. The improvement made to this process activity, then, is that the facilitator, who acts as a resource and tutor, does so by modeling the desired problem solving behavior (Boud & Feletti, 1997).

Learner-implemented methods. Nelson’s (1999) learner implemented methods state that learners are responsible for applying the acquired research and information to solving the problem in addition to allocating time spent on activities and dividing work among team members. Part of applying the research is getting learners to critically analyze the research they find for both relevance and quality. Again, teams were asked to
create a timeline/action plan for the entire semester of work. This allowed them to tailor their work schedule to their outside schedules and kept them accountable for all their completed work.

Focus group and interview. At the start of each new assignment or research part of the project, teams would account for each member’s contributions. When meeting with the instructor, teams were asked to complete a progress report detailing the work each team member had completed and the work he or she would be completing next. In order to reach a final problem solution, the teams had to synthesize all their research and determine the pertinent information to lead them to an equitable problem solution. Not many students made mention of having to critically analyze resources, but one student made particular mention that she had to at one point, with negative results:

Female #12: I wasn't sure that the information I was using was even reliable at that point.

Despite her negative experience with the information and research she found, this quote demonstrates that she and her teammates were critically analyzing their research and determining how to use it.

What were the strengths? Observations and participant feedback indicate that the revised CPS model continued to allow student participants to critically analyze research and apply it to their projects. Teams accounted for group and individual time in pursuit of final problem solutions.

What were the weaknesses? Not all teams felt that they were sufficiently able to stay on task and continuously account for time spent on activities. In the first instance of
the CPS model, one team reported the same situation and the addition of the action plan in the revised instance was intended to combat this problem. Because this was an isolated incident with only one team in the revised instance and was not a recurring issue, it may be a result of a lack of sufficiently detailed action plan. Because of the nature of this weakness, no improvements are recommended to this comprehensive guideline.

**Instructor- and learner-implemented methods.** These methods were followed as they had been in the first semester. Learners were asked to draft a plan for the execution of the steps necessary to find a problem solution and the instructor worked with each team to make sure they had an adequate plan and that they were asking enough questions. The instructor met with most teams during each class meeting to discuss team progress and address any issues/questions.

**Focus group and interviews.** Learners were evaluated constantly for their progress and work throughout the semester. Feedback from participants indicated that students wanted the feedback and evaluations between instructor and student to be more formal and summative, as previously mentioned. Finally, the students suggested keeping a record of progress for all teams, which were done in the form of status reports. They seem to indicate some kind of record progress for each team that could be shared among instructors when more than one is working with individual teams.

On instructor-led face-to-face evaluations, the following exchange among participants demonstrates the strong desire for it and student perception toward it having long-lasting repercussions:
Female #12: I think that this goes into strength based leadership as well so if we all are using these evals to not only tell people I'm looking for more of this. Telling people, like these are the things you're really good at to make sure you're using your strengths as well, would be something very productive for everybody. Female #13: I think a good way would be for you [the instructor] to do it too, to be like this is where you're at so far, this is where you're not.

Female #22: I had a job where I did that. Obviously it was very different from that but in the middle they told you how you were doing. And I know from that I mean I don't like evaluations because they make me nervous but it did help a lot and it did definitely change and the way it was done was very positive and wasn't like mean or hurtful. It just say, like hey this is you know like look for this like try and work on that more. And I thought it was really helpful.

Female #17: It's only going to help us in like a career too.

The following student outlines her idea of keeping a more detailed progress record that could be open to multiple instructors or simply one instructor in charge of multiple teams working on different projects:

Female #17: If instructors kept a record of the progress of each group so that they could know exactly where everyone stands – just updates. Because of course there are multiple projects going on it's understandable that you might get lost with all the stuff you have to manage but to make it easier on yourselves just to keep a record of each group and to keep yourself up to date with everything we've been accomplishing.
**What were the strengths?** The instructor- and learner-implemented methods worked well and led to a level of collaboration that allowed the learners to feel self-directed, as evidenced in Table 5. Learners were encouraged to share resources and feedback with one another and in-class sessions were dedicated to inter-team collaborations. During group meetings, the instructor and students used the time to share ideas and give and receive feedback. Finally, the CPS model’s comprehensive guidelines allow the facilitator the flexibility to evaluate the learners and for them to perform self-evaluations or teammate evaluations in different manners.

**What were the weaknesses?** Student participants offered suggestions for improvement to the instructor- and learner-implemented methods. They suggested having open dialog peer feedback sessions and to have the instructor offer face-to-face feedback and evaluations. Furthermore, one learner offered the suggestion of using the action plan as a resource to keep daily updates and progress reports accessible to all facilitators when more than one works with the learners during the semester.

**What improvements can be made?** Face-to-face peer feedback is being added as an option to the eighth process activity and as a guideline for instructor- and learner-implemented methods is being added to this comprehensive guidelines. While learners do receive formal, written evaluations, face-to-face feedback can be added because, as Archer writes (2010), this type of feedback can be beneficial to learners.

**What role does technology play?** The addition of the shared action plans to the revised model helped the learners and primary facilitator stay abreast of big-picture work. But it did not keep records of day-to-day activity that could be shared with other
instructors. As a comprehensive guideline that carries throughout the semester, the addition of keeping a running record of daily work will be added as an improvement to the instructor- and learner-implemented methods guideline.

**Interactive methods.** In promoting positive interaction and teamwork, the instructor team asked students to read about teamwork in order to create their own guidelines and processes for communication, conflict management, and decision-making. Trust is built among team members by maintaining accountability for entire teams in addition to individual team members. Interactive and out-of-class full-class activities were planned to enhance the sense of community for the class. The whole class was taken on an overnight retreat to help build a sense of community and trust in one another.

Endeavors were taken to give the students greater ownership of their learning. By asking them to help design assignments and have a voice in any work being done can give the students greater ownership of the projects than many of their other classes. By making the projects more relevant and giving the students greater ownership, they will be more intrinsically motivated “to learn, inquire, collaborate, and problem solve” (Nelson, 1999 p. 255). As part of participating in team-building activities, learners participated in a professionally led personality assessment. Finally, the learners joined a group-chat app through a GroupMe, which allowed them to receive communication and interact with the facilitator. They were encouraged to create their own group and did, which they used to chat and share resources.
Focus group and interviews. The positive reaction and feelings toward the sense of community that developed as a result of the overnight trip is reflected in the following participant’s statement:

Female #14: I like the sense of community that this program forms and I think that the bonding trip was a really absolutely wonderful experience and I loved that. I wouldn't change that for the world. . . . I think there should be a group party or something like that. Our class is really close and we get along and I like it. I think that the sense of community is great.

To a similar point, one respondent describes how the interactive methods employed helped her build a sense of trust in others in team-based settings. She describes how much it has influenced her personal and professional life outside of the program:

Female #16: So, personally. I have a problem with like trusting people to do things because I like in my head I know like a certain way that I imagine it's going to be done or imagine like how the finished product is going to look like and like there would be certain times when I wouldn't put myself or want to do everything but in this program last semester and this semester forced me to just let someone else do it and trust somebody else to do it and like yeah. So like that has also like gone into like all the student organizations . . . that I worked on and just like trust people to do many things without having to be there without having to like look over their shoulder just like putting your trust in someone.

The interactive methods and focus on learning about team interaction and setting ground rules helped others learn conflict management skills. The following respondent describes
how she learned constructive conflict management skills through the CPS model’s
interactive methods:

Female #12: I think that conflict management has been interesting. It's been
interesting to see how we handle conflicts in different ways and understanding
constructive ways to handle a conflict and figuring that out for the future.

The implementation of the GroupMe app was perceived as a beneficial addition to the
course and most participants stated that they liked receiving messages this way from the
facilitator. They mostly enjoyed having the space there to chat with one another and
easily share messages and information. The following interchange highlights the opinion
of learners toward the implementation of this app.

Female #13: I loved being able to use my phone to send a message to everybody
in class.

Female #16: Yeah. I like how we used social media to communicate with one
another.

Researcher: How did the rest of you feel about that?

Male #8: Loved it.

Female #14: I wish all of my classes did that.

What are the strengths? As the learners state, the interactive methods and the
revised CPS model supported the development of social skills and interdependence. The
learners expressed satisfaction with and appreciation for the team-building personality
assessment. The quotes chosen highlight student development in trust building, conflict
management, community building, and communication via the GroupMe app. Because
no weaknesses were documented, no improvements are recommended for this comprehensive guideline.

**Learning Outcomes**

The benefits of problem-based learning instructional methods have been well-documented by researchers and explained in the second chapter of this dissertation. In addition to the results from the 20-item questionnaire completed by the participants, parts of the focus group and interviews were dedicated to the learners reflecting on their own learning gains. To help demonstrate the effectiveness of this instructional method, their perceived outcomes are discussed herein.

**Focus group and interviews.** Despite some learners who did not enjoy working with a diverse team where learners either had different working or communication styles, there were others who expressed appreciation for the purposeful diversity of teams. The following student respondents describe their experiences working in this team-based environment:

Female #19: One of the – a very very important thing about this program that I really love is that it teaches people to work in groups. Because I just watched my friends complain about having to work in a group all the time and I'm just like I know how to do that why are you complaining? It's normal. It's part of life. So I really value that – I'm not I'm OK with group work now compared to I still watch people hate group work all the time.

Male #8: I think I've share this with a few people but when I was working on the project last semester – while working on [this program’s] project was one of my
persuasion classes and it made me realize the opposite of what . . . said how much I can't deal with group projects now. . . I feel like I'm in middle school compared to [this program]. And it's the professionalism and all that. And really it's like I'll go down to a group meeting and they'll be like, no I don't really care about this paper, I'm cool with getting a D. And I'm a student who has been like straight A's for a long while and I was [angry] I got a B+ in that class and I can guarantee you it's because of my teammates. But [this program] isn't that and when I come into class and I know that either they will pull their weight or their on it they're on it they know what's up they respect.

One student talked about the fact that students are being given the opportunity to work on long term projects and they’re learning to do so autonomously or by setting their own schedule and pace. She discusses the value of the CPS model since it teaches several skills involved in project planning and management. She goes on to state that it is unlike any projects she gets to work on in any other class:

Female #17: Something that I've taken from these group projects and applied in other classes that I think is really useful is being able to plan your own project and allow for flexibility and execute it in a timely like in a timely manner. Like in 15 weeks. That's not something else that other classes do with group projects and least not that I've had. And I think that that's really valuable.

In this regard, the participating students not only get the opportunity to learn all the skills required to problem solve, they also get the experience that they can later talk about and reference to potential employers.
Similarly, while many of the skills students learn participating in the CPS model can translate to their professional lives, there are experiences they gain that simply talking about can make them more competitive applicants in whatever path they pursue following graduation. In reference to her own college experiences, one student mentioned that, although there are many opportunities available to her in her college, this is the only experience she can get that offers her a unique experience to talk about:

Female #11: But I feel like for mine like I would have lived without [this program] but I'm glad I'm not going to. It's going to give me kind of a I think a different kind of edge so I don't know if that's helpful at all. But I think some people think they might not need this program or like or whatever. But I think that everybody could use a little [of this program]. It's a big difference.

Another student participant talked about the experience offering a distinctive talking point that has helped her separate herself from competing applicants in a job interview.

Female #11: Where it doesn't exactly apply to like the work on the computer I might be doing but for some reason the interviewer always asks me about it and so I think that it's a good like overall anybody in any major can add this and can talk about it even if they don't necessarily need it for that interview it's always going to be something that the interviewer asks you about. In the small amount of interviews that I've had since I've been able to put this on my resume they always ask me about it and I always like to talk about it to so that's kind of an added thing for me.
Although the content of the projects that she and her teammates focus on may not be exactly the focus of her major, it does offer educational experiences and learning gains that she can specifically point to in order to demonstrate her qualifications.

**PBL evaluation questionnaire results.** Near the completion of the revised instance of the CPS model and prior to the start of the focus group, participants were asked to complete a 20-item, 6-point Likert scale attitude questionnaire. All but one participant completed the questionnaire for a 95% completion rate. The test resulted in an alpha value of 0.89, consistent with the original author’s report and the first semester’s results (Yuan, et al., 2011). Overall, the median response was 5, consistent with the first semester’s median score of 5. This, indicates that with the changes made to the revised CPS model, participants felt that the it effectively taught skills associated with problem-based learning (Yuan, et al., 2011). As was the case in the fall semester, of the sub-categories assigned by the instrument designer, the results in Table 3 indicate that the model was most effective at promoting effective group collaboration, with a median of 6. However, unlike the first instance of the model, two categories have higher median scores of 5.5 each. Table 4 demonstrates the direct comparison of median scores from the first instance to the implementation of the revised CPS model. Those are the construction of professional knowledge questions, and the development of problem-solving skills questions. The other two categories each had median scores of 5, indicating that participants believed the model allowed for the development of self-directed learning skills, and the nurturing of motivation for learning as well as the first instance of the...
model did. As in chapter 4, the full table can be found in Appendix D. Presented here are scores for each main category of the learning outcome goals for PBL.

Table 4

*Spring Semester PBL Evaluation Questionnaire Results (n = 21)*

<table>
<thead>
<tr>
<th>Items</th>
<th>Mode</th>
<th>Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Construction of professional knowledge</td>
<td>6</td>
<td>5.5</td>
<td>0.93</td>
</tr>
<tr>
<td>2. Development of problem-solving skills</td>
<td>6</td>
<td>5.5</td>
<td>0.96</td>
</tr>
<tr>
<td>3. Development of self-directed learning</td>
<td>6</td>
<td>5</td>
<td>1.21</td>
</tr>
<tr>
<td>4. Improvement of motivation</td>
<td>6</td>
<td>5</td>
<td>1.26</td>
</tr>
<tr>
<td>5. Promotion of effective group collaboration</td>
<td>6</td>
<td>6</td>
<td>1.27</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>5</td>
<td>1.17</td>
</tr>
</tbody>
</table>

Table 5

*PBL Skills Questionnaire Comparison*

<table>
<thead>
<tr>
<th>Evaluation Category</th>
<th>Fall Semester Median Score</th>
<th>Spring Semester Median Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Knowledge</td>
<td>5.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Development of Problem-Solving Skills</td>
<td>5.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Self-directed learning skills</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Motivation improvement</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Effective group collaboration</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
The results in Table 5 demonstrate the differences between the median scores from the fall semester (CPS model) and spring semester (revised CPS model). The median is higher in the revised instance in the spring semester in two categories, the development of professional knowledge and the development of problem solving skills, though not significantly different.

Observation rubric results. To guide participant observations, the researcher used the observation rubric to identify collaboration, the effectiveness of students’ interactions, and the quality of their problem solving discussions. Results from the 10-item, 5-point scale observation rubric documenting team performance may demonstrate that the spring semester participants were newer to problem-solving methods than the fall semester students were. The students participating in the revised CPS model were more likely to accept short answers than the ones from the Fall Semester. However, their interaction was observed to be more frequent and the students spoke more and communicated more during the revised instance. On this 5-point observation scale, 5 is considered ideal and 1 is a low score given when teams are not collaborating or interacting as expected in problem-based instructional methods. The full rubric is found in Appendix A. Only one question, number five, was unanswerable given that the researcher was both the instructor and researcher. This question requires the observer to discriminate how much the facilitator explicitly reviews background material. To support the researcher’s observations, students were asked to respond to prompts on Blackboard to describe their interactions with their teams and the instructor. Each team was observed and scored on the rubric two times throughout the semester.
Document analysis. Throughout the revised instance of the CPS model, the learners responded to question prompts on the class Blackboard learning management system. While many of the prompts were part of the instruction and prompted learners to think about their work and own research, others were dedicated to data collection. The prompts on Blackboard are coordinated with the questions on the instructor’s observation rubric. This section details the findings from students’ journal entries.

Relating to item 1 in the observation rubric, learners were asked to respond to the following prompt: “Describe the interaction you have when working with your teammates. Do you interact and collaborate often? Are the interactions productive?” The learners wrote that they primarily work together and collaborate in class. They wrote that they tend to work to identify research goals in class and then set out to accomplish those goals before coming back to class to share information. The learners wrote that they stay in touch and communicate outside of class via SMS, the GroupMe, and a shared Dropbox folder. Male #10 wrote “When we work together we are great at staying on task and getting things assigned quickly.” Female #21 wrote that the interactions her team had were balanced, “we all get to say our input and contribute evenly.” Only one respondent wrote that his team’s interactions were unproductive when some learners would leave a meeting early. Otherwise, all respondents wrote that their teams were productive and their collaborations were frequent.
Table 6

Comparison of CPS and Revised CPS Observation Rubric Scores

<table>
<thead>
<tr>
<th>Item Summaries</th>
<th>Spring Average Team Score</th>
<th>Fall Average Team Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How frequent is the student-to-student interaction?</td>
<td>4.8</td>
<td>4.6</td>
</tr>
<tr>
<td>2. Does the team accept short answers?</td>
<td>4.4</td>
<td>4.8</td>
</tr>
<tr>
<td>3. Who does most of the talking, the facilitator or the students?</td>
<td>4.8</td>
<td>4.6</td>
</tr>
<tr>
<td>4. Does the team accept answers or do they seek to explain how or why something is true?</td>
<td>4.4</td>
<td>4.6</td>
</tr>
<tr>
<td>5. How does the instructor review background concepts and course material?</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>6. Does the facilitator or do the students set the role for the group?</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>7. Is the facilitator the focus of the group? Could the group function without the facilitator?</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>8. Does the group move on after solving a problem or do they discuss it further?</td>
<td>4.4</td>
<td>4.2</td>
</tr>
<tr>
<td>9. Does the team discuss the ideas and concepts behind the problems?</td>
<td>4.6</td>
<td>4.8</td>
</tr>
<tr>
<td>10. Does the facilitator or the students communicate the most?</td>
<td>4.8</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Relating to items 5, 6, and 7 on the observation rubric, learners were later asked to respond to the following prompt: “How has your team’s interaction been with the
facilitator? Did he point out additional background areas to look at or explain any points explicitly? How would your team function without his presence?” Learners wrote that the instructor helped them think about new ideas, pursue additional avenues for research, and promote discussions. Female #18 wrote that the facilitator led a discussion with his team that led to their final problem solution. “[The interaction] has almost exclusively been in a discussion setting but that [sic] necessary in order to achieve the best solution possible.” The learners wrote that their experience with the facilitator has been related to discussion and that the he allowed them to take control of their projects. Male #10 wrote, “[the facilitator] pointed out a few additional points for our group to look at . . . However, he left it up to the team to really decide the future direction.” Other learners pointed to the facilitator’s role as keeping them on schedule with their action plans. Finally, the learners wrote about the facilitator’s presence and what it meant for their team. Some learners wrote that without the facilitator they would still move forward, but would not have been able to identify certain research objectives or paths. Female #17 wrote that the facilitator served as a means of staying on task, “without [him] our group would still be on track and have discussions, it just wouldn’t be as organized and on schedule.”

Relating to items 3 and 10 from the observation rubric, students were asked to respond to the following prompt: “When you work with the facilitator, describe that interaction. Do the students lead the discussion? Do students often talk the most?” The learners wrote that the facilitator often let the team members talk and lead their discussions. Male #11 wrote how the facilitator helped them lead their own discussions, “[he] allows students to really lead the discussion, which helps students figure thing [sic]
out on our own. He helps get the discussion started.” These discussions were perceived as productive by learners. One student wrote that these interactions led to constructive outcomes for her team. Male #9 summarized the facilitator’s role in the team discussions as a “moderator.” He went on to write that “by allowing the students to lead discussions, [the facilitator] enables them to carry on in the direction that they feel most efficient and that will render the most success.”

Next, relating to items 1 and 10 on the observation rubric, learners were asked to respond to the following question prompt: “Who takes the responsibility in your team for the questioning, the answering, and explaining? Is it a team member? Is it ever the facilitator?” The learners wrote that each member of their team is primarily responsible for the questioning, answering, and explaining. Some learners wrote that they sometimes sought answers from the facilitator who sometimes answered and sometimes leads them to ask additional questions of themselves. One learner wrote that the facilitator asked them more questions than they were asking themselves. But the other students wrote that they were all equally responsible for every question, answer, and explanation. Female #17 wrote, “Our team operates with a group mentality. Every member takes on every role, this is done in a way that propels the team forward that enables them to achieve the most success.”

Later in the semester, relating to items 2, 4, 8, and 9 on the observation rubric, learners were next asked to respond to the following prompt: “Describe the way your team approaches potential problem solutions. Do you generally analyze and expand upon them? Or are they accepted quickly by the group?” The learners wrote that their teams
are open to all ideas and they discuss anything that their teammates bring up. Half of the respondents reported being able to quickly accept hypothesized problem solutions to move their research forward. This may be due to the learners not working on potential problem solutions until later in the semester than the participants from the first CPS instance. Female #20 wrote, “we seem to quickly accept them, but just because our research supports it.” Two other learners echoed this sentiment, noting that they may be able to move forward quickly, but only because they have collected enough data to support their decisions. Furthermore, the learners did report spending time discussing ideas their teammates had. Male #12 wrote, “We usually discuss every idea’s pros and cons.” Male #9 expanded on this idea and wrote, “we look at our problem and discuss it, trying to consider all important and relevant aspects.” Male #10 wrote about he and his teammates talking and arguing among one another. This finding supports the observer’s rating of the ability of learners in the revised CPS instance to expand on their answers.

Summary

This chapter outlined the findings from the revised instance of the CPS model in the context of an internationally focused problem solving certificate program working with five real problems presented by four clients either based or with operations in Vietnam. Findings demonstrate five primary strengths of the revised CPS model. The strengths of the revised model are as follows:

1. Results from the PBL Evaluation Questionnaire found that the model met all five goals of problem-based instruction with a median score of 5 out of 6.
2. Results from the observation rubric and document analysis indicate that the revised model continued to support collaboration and self-direction.

3. Technology can play a role in supporting the CPS model and meeting the goals of PBL.

4. The addition of the action plan provided teams with direction throughout the semester.

5. The other revisions made from the first CPS model’s instance were met by the learners with positive reactions and did not negatively impact the effectiveness of the model.

Findings from this chapter indicate three primary weaknesses in the revised model. The weaknesses are as follows:

1. Although learners benefitted from the action plan and had sufficient direction of where to proceed, they did not always know where to find research or how to learn where to go.

2. Inter-team collaborations are beneficial to the learners in this environment, and can be expanded to other process activities.

3. Technology can help teams and facilitator(s) keep a record of day-to-day progress, which is particularly important when there is more than one facilitator.

The identified weaknesses from the revised model do not lend themselves to revisions that were as significant to the model following the first instance. With only three primary weaknesses, the final revision to the model will not differ greatly from the
first revision for this context. But they do influence a final revision. Other findings indicate that additional options for procedures can be added to certain process activities, such as the option for peer-to-peer evaluations, but these are not as wide-reaching as some of the changes to core structure of the model that followed the first instance. A detailed description of the final revision of the CPS model for this context is offered in Chapter 6.
Chapter 6: Final Discussion, Conclusion, and Recommendations

This chapter presents a summation of the key findings regarding the CPS model’s implementation and revision. This research study presents the findings and recommendations for the implementation of a collaborative problem-solving model into an existing PBL learning environment. The result of this study is a revised CPS model to fit this context augmented with research-based additions in order to better suit the needs of the learners and facilitators. The context was an internationally focused, undergraduate client based problem-based certificate program at a large Midwestern university. This study primarily followed formative research methodology but was guided by other methodologies to accommodate for this method’s inherent deficiencies. The guiding research questions were as follows:

1. In the context of a client-based internationally focused undergraduate problem solving program’s classes at a large Midwestern university, what are the strengths and weaknesses of the Collaborative Problem Solving Model?

2. What changes should be made to the model to make it better fit this context and do these improvements impact the integrity of the model?

3. What role does technology play in the design of the CPS model in this context?

This research study took place over the course of the academic year 2013-2014. Nelson’s (1999) CPS model was implemented in the context of a large Midwestern university’s global problem-solving program in the fall semester with 23 participating learners. Data collected throughout the semester and following the model’s instance
informed a revision to better fit the context, which was implemented in the following spring semester with 22 participating learners. Data were collected in the same way during and the second instance to inform a recommendation for a final revision of the CPS model to best fit this context. The significant findings are presented herein with supporting research and how they influenced the final revision of the CPS model for this context. This chapter is organized by the presentation of the model’s strengths, its weaknesses and how they influence recommendations for improvements, and suggestions for the implementation of technology to fit both the model and the context. Finally, the researcher presents recommendations for practitioners and future research.

**Strengths of the CPS Process Activities**

**Instructor and learners establish and build their readiness to engage in collaborative group work.** The first process activity in the CPS and revised models revealed four specific strengths. They are as follows:

- The discussion board prompts helped lead the in-class discussions and provided a space for all learners to reflect and express themselves. This finding is supported by that by Ertmer, Sadaf, and Ertmer (2011) who found that learners exhibit higher levels of thinking when faced with open-ended question prompts in an online environment and they are given time to process their thoughts. Separately, since the learners wrote questions or expressed sentiments that they did not reveal in class, the discussion board environment can support the space that students need to relay their unique message (Krishnaiyer, Mushahar, & Ahmad, 2012).
• Reviewing the semester and instruction at the beginning was a strength. It prepared the learners for the rest of the work. During the focus group for the revised CPS instance learners expressed appreciation for being involved in the discussion of how they would be learning and how this process can be effective. This finding supports the fundamental aim of this part of the process activity. Nelson (1999) states that “the primary goal of this phase is to help the learners understand what they will be engaging in and why” (p. 257).

• Framing the team-building activities in terms of cultural learning was a strength. The learners found that it helped them understand the significance of some of their problem solutions later. This finding supports Gao’s (2013) assertion that understanding a client’s unique culture is essential to success in business practices. Similarly, Morales (2011) wrote about the importance of being familiar with the target demographic of the culture one works with in a business environment.

• Team-building exercises were beneficial as most learners enjoyed them and helped them learn to work together better. The team-based activities serve to prepare the learners to work in teams, as Nelson (1999) states. At the start of instruction, the team-based activities set the precedent that the learners would be participating in a socially constructive environment where they would be constructing their knowledge through their interactions with one another (Baden & Major, 2004; Savery & Duffy, 1995; Bruffee, 1986).
Either the instructor or the learners form small, heterogeneous work groups, and then the groups engage in norming processes. The second process activity in the CPS model revealed three distinct strengths. They are as follows:

- Group norming was a strength in the revised model as the learners shared their ideas and the one team adhered to its conflict resolution guidelines. This finding is supported by researchers who state that problem-based instructional methods can teach learners conflict management skills (Seren & Ustun, 2007; Yalcin, et al., 2006). This was a strength because, unlike the first instance when there was an unresolved conflict that led to a dysfunctional team in which only two of the three members ended the semester as active contributors, the active attention paid to conflict resolution led the team in the revised instance to seek a resolution. This finding is supported by Sadri (2012) who writes about unresolved or poorly resolved conflict and the negative impacts it can have on a team’s productivity, working environment, and wellbeing of the team members.

- The heterogeneous teams that were created worked together effectively, achieving their goals at a high success level. In both instances of the CPS model, teams of learners were formed based on set criteria. In these corporate-focused projects (with international and cultural aspects), the learners’ participation in PBL can help prepare them to work with peers. Yeo (2008) confirms the findings that the CPS model supported effective team collaboration in the CPS model and its revision. PBL is used in workplace training for learners to develop social skills to work together. Furthermore, Nelson (1999) states that collaborative work has
become a part of most individuals’ daily lives and that these interpersonal skills have become more important in education. In a combination of the client-based project (CBP) model with PBL, Liu and Olson (2011) confirmed the findings in the present study with their findings that student collaboration led to a high quality of work and project outcomes.

Groups engage in a preliminary process to define the problem they will work on. The third process activity in the CPS model revealed three distinct strengths. They are as follows:

- Negotiation of a common understanding of the problem was a strength, as the observer wrote that this helped the teams identify how they would approach their problems. The teams of learners worked together to understand and define their problem and then worked with other teams to give and receive feedback. This finding is supported by research in social construction. Bruffee (1986) says that learners create knowledge by rationalizing and validating their beliefs socially. Vygotsky’s (1986) zone of proximal development supports this finding because the students that shared their ideas received feedback from the learners who had greater cognitive skills, which shaped their problem definitions.

- Identifying learning issues and gaps in knowledge were strengths because these acts led learners to identify their research goals. This finding is supported by PBL research in that one of the primary goals of this type of instructional method is for students to learn to gaps in their knowledge (Barrows, 1986; Yuan, Williams, Yin, Liu, Fang, & Pang, 2011). Driscoll (2005) writes that a constructivist learning
environment should encourage the students to direct their own learning and processes. This finding demonstrates that the CPS model and its revision support a constructivist learning environment.

**The teams design a long-term action plan.** The fourth process activity in the CPS model revealed one key strength. It is as follows:

- The action plan in the revised CPS model helped learners outline their semester and kept them more on track in the second semester than in the first. This finding is supported by research on constructivist learning environments, wherein the attention shifts toward the learners who become the constructors of their own education rather than recipients of knowledge (Molenda, 2008). This finding supports Halvorson’s (2014) research that indicates that a detailed action plan helps team members achieve the goals they set for themselves. The CPS model in its original state had learners creating a design plan, which would help guide the teams’ research and project work throughout the process (Nelson, 1999). This finding supports the original intention of the CPS model.

**The group engages in the primary, iterative, CPS process.** The fifth process activity in the CPS model revealed four unique strengths. They are as follows:

- Inter-team collaborations appealed to students and were a strength. They learned strategies for giving and receiving critical feedback, content knowledge, collaborative strategies, and skills for long term project planning. This finding is supported by the present study’s social construction conceptual lens. Bruffee (1986) writes that knowledge is the product of social interactions and is subjective.
to the community from whence it derives. Gergen (2003) writes that the natural world is not the only place knowledge comes from. Learners acquire knowledge through active engagement and negotiation of knowledge with others in a special relationship, such as the teams that the learners worked in throughout their participation in the CPS model and its revision. Just as the findings from the fourth process activity did, this finding supports the research on the zone of proximal development (Vygotsky, 1986; Vygotsky, 2012).

- Team meetings with the facilitator were a strength because the learners wrote that the instructor’s questioning helped them identify paths and elaborate on their research. This finding supports PBL research that defines the instructor’s role as a guide, facilitator, or question asker rather than a knowledge-dispenser (Hmelo-Silver, 2004; Hung, et al., 2007; Norman & Schmidt, 1992; Boud & Feletti, 1997). Because the instructor is not seen as the holder of the correct knowledge, Savery and Duffey (1995) explain that the interactions between teams and the facilitator fit Vygotsky’s zone of proximal development. These interactions give the students control over their own learning and processes, which is a finding supported by social construction (Boud & Feletti, 1997; Molenda, 2008).

- The inclusion of just-in-time instruction was a strength because it allows the instructor the flexibility to work with groups of students at different levels of experience and knowledge. This finding is supported by research on the role of the instructor in PBL. Stinson and Miller (2006) write that the facilitator’s role, in addition to acting as a guide, is to provide the learners with access to subject
matter experts. Nelson (1999) writes that in the CPS model, the facilitator can provide direct instruction when necessary or resources when learners would otherwise be unable to acquire the knowledge or skills that result from the intervention. The finding of this strength was based on the instructor providing resources and access to experts. This is supported by Jonassen (1997) who writes that a facilitator can provide authentic resources to aid the learners as they would otherwise not have access to such documents.

- The relocation of the feasibility test in the revised CPS model was a strength because it allowed the learners to make changes to their research and hypothesized problem solutions and guided some of their research. This finding is supported by Savery and Duffy (1995) who write that in PBL learners should be encouraged to test “ideas against alternative views and alternative contexts” (p. 6). Additional research on PBL demonstrates that learning can take place as a result of reflection and investigation (Yeo, 2008). Although the learners are reaching out to an expert to give them critical feedback, they have to critically reflect on their work along with the SME. Constructivism supports the finding that participating in this critique of their project work can lead to learning gains because the learners’ experiences with the experts would allow them to create new knowledge (von Glasersfeld, 1995).

Groups begin to finalize their solutions or projects. The sixth process activity in the CPS model revealed one key strength. It is as follows:
• Student ownership of the project was a strength as the students took charge in collaborating on the decisions made to guide the presentation of their final problem solutions to their clients. This finding is supported by constructivist and social construction research, indicating that since the students were given control over their own learning they built on their existing knowledge through collaborations (von Glasersfeld, 1995; Molenda, 2008; Boud & Feletti, 1997). Driscoll’s (2005) conditions for creating a constructivist environment include learners needing to negotiate their learning and to be self-directed, both of which, in practice, this process activity allowed learners to do.

The instructor and learners engage in activities to help them reflect and synthesize their experiences. The seventh process activity in the CPS model revealed two unique strengths. They are as follows:

• The reflection on learning was a strength because the learners were able to identify what they learned and even how they could apply it to other situations. This strength is supported by Driscoll’s (2005) fifth condition for creating a constructivist environment, which states that learners should be made aware of their roles in the learning process and have opportunities for self-reflection and analysis. Hung, Jonassen, and Liu (2007) write about the importance of self-reflection and how reflection can allow learners to develop greater problem-solving skills because of their experience with the type of metacognitive thinking required for reflection.
• The whole-class discussion led the learners to have conversations with one another; building on ideas and helping their classmates identify what they learned. This finding is supported by social construction research. The knowledge that the learners created from participating in the class discussion led them to construct knowledge based on that social experience (Berger & Luckman, 2011; Bruffee, 1986; Gergen, 2003). In the two instructional instances that were the basis of this research study, the researcher conducted a focus group as part of data collection and in order to meet the guidelines of this process activity.

**The instructor, and, when appropriate, the learners assess their products and processes.** The eighth process activity in the CPS model revealed one unique strength. It is as follows:

• The personalized in-depth feedback given to learners was a strength as they appreciated it and it provides them with the detailed assessment needed to make progress as learners. Feedback is one of the primary responsibilities of the facilitator in a PBL environment (Hung, et al., 2007). As an authentic learning process and because of the context in which the learning occurred, PBL research supports this finding since learners are given feedback authentically and not in the form of a test grade (Savery & Duffy, 1995). The feedback is much more relevant to the learners’ experiences and future work than a grade on an exam might be.

**The instructor and learners develop an activity to bring closure to the learning event.** The ninth and final process activity in the CPS model revealed one key strength. It is as follows:
• This process activity helps to further enhance team bonding by creating a familial atmosphere. This finding is supported by Nelson (1999) who writes, “closure is an important but often-neglected aspect of any social activity, including group-based learning” (p. 266). This process pays respect to their learning and the process they went through.

**Strengths of the Comprehensive Guidelines**

**Instructor-implemented methods.** The strength of the instructor-implemented methods lie in the instructor’s role in allowing the learners to direct their own learning through his or her questioning and just-in-time instruction. This finding is supported by PBL research documenting the role of the facilitator as a questioner and how this helps develop self-directed and motivated learners (Stinson & Milter, 2009; Hmelo-Silver, 2004; Nelson, 1999; Savery & Duffy, 1995; Boud & Feletti, 1997).

**Learner implemented methods.** The strength of the learner-implemented methods is that learners are asked to determine the application of their acquired materials and account for time and work management, two components of self-directed learning. This finding is supported by PBL research that describes the role of the learner as needing to develop self-directed, analytic, and problem-solving skills (Hmelo-Silver, 2004; Hung, et al., 2007; Norman & Schmidt, 1992).

**Learner- and learner-implemented methods.** The full-class collaborations were identified as a strength of the learner- and learner-implemented methods. The learners stated that these were learning points for them. The learners stated that they learned more from working together with one another than they did researching on their own. This
finding is supported by research on social construction. This strength has been highlighted in other strengths where collaboration and communication were identified as strengths. Many research articles have been discussed in those sections and throughout the literature review that demonstrate how social interactions lead to increased learning and knowledge for learners (Bruffee, 1986; Berger & Luckman, 2011; Gergen, 2003; Vygotsky, 1986; Vygotsky, 2012).

The other identified strength is that the CPS model allows for the instructor to evaluate learners in many ways, providing feedback for learners in various forms. This finding is supported by Savery and Duffy (1995) who write about different implementations of PBL using different forms of evaluation depending on their context. Bloom’s Revised Taxonomy will help a facilitator describe the knowledge that learners are expected to acquire and will help guide assessment (Bloom, et al., 2001).

**Interactive methods.** The purposeful development of team-based skills was a strength of the comprehensive guidelines that make up the interactive methods. Through the team-building activities, the learners were encouraged to use and develop appropriate social skills. These findings are supported by research on team building activities and their effects on team outcomes. In a meta-analysis of three large research databases, Klein, et al. (2009) found that research indicates that team building activities have a significant impact on certain team outcomes including problem-solving, goal setting, and interpersonal relations.
What Were the Weaknesses and What Improvements can be made to the CPS model for this context?

**Build readiness.** Based on the identified weaknesses or areas for improvement, the first process activity in the CPS model revealed four changes that are being recommended to the model for this context. They are as follows:

- The option for a teamwork focused personality assessment activity can be added as an option for building teamwork skills. This recommendation is not a requirement and it does not differ in spirit from the original model in its intention to develop team skills. This recommendation is supported by Richardson and Devaney (2008) whose research demonstrates that learners can create a better relationship and become more likely to achieve their goals by learning to recognize and tolerate their teammates’ unique personalities.

- Learners should be encouraged to create the team-based assignments and work as products of the learning objectives. In a PBL method, identifying learning objectives is a part of the learners’ primary goals (Bridges, 1992). In the CPS model, the learners should work to identify their learning objects and work with the instructor to try to meet the (Nelson, 1999). By being given the task of identifying tasks to meet their goals and objectives, the CPS model can better support self-directed learning by giving the learners more ownership of their learning (Boud & Feletti, 1997; Hmelo-Silver, 2004). When designing learning activities the facilitator should seek balance among maintaining student appeal, preparing them to work with the clients and projects, and developing team skills.
• Culturally-focused team-based and readiness building activities and tasks should be added as an amendment to this process activity. Familiarity with the culture of operation is important for the success of any organization or company (Gao, 2013). The culturally centric activities should be directly related to the problem statement and client when possible. The learners in the first semester gained insight into unique current cultural trends that they said gave them better understanding into certain ways to approach their problem solutions. Learners should recognize the importance of understanding the culture of the target demographic or the client’s target demographic and working environment (Morales, 2011).

• Using a discussion board to preface the in-class discussion is an improvement made to the CPS model for this context. Using a discussion board can help learners in PBL courses reflect and think more about the in-class activities (Krishnaiyer, Mushahar, & Ahmad, 2012). The recommendation is discussed in greater detail in later sections of this chapter.

**Form and norm groups.** Based on the identified weaknesses or areas for improvement, the second process activity in the CPS model revealed two changes that are being recommended to the model for this context. They are as follows:

• Because learners in this context work together closely for four semesters, choosing teams can be asking them to discriminate among their close friends. Learners in the first instance found choosing among their classmates – even doing so based on the criteria the CPS model describes – to be unpleasant. The
instructor needs to be aware of the potential pitfalls of asking the learners to perform this activity with their close friends. When allowing learners to form their own teams, he or she needs to choose criteria that will force learners to choose teams not based on working or personal relationships. For example, when working with multiple problem statements or clients in this context, the instructor can allow learners to form teams based on their interests in the problems or clients. One of the previously identified five main goals of PBL instruction is to create a problem that is both relevant and appealing to the learners (Barrows, 1986; Lopez & Lee, 2005). By allowing learners to choose among projects or clients, the instructor can have greater control in ensuring that the problems are appealing and personal. When forming teams, the instructor needs to make sure that the learners are aware that the intention of the instructional model is for them to work in complementary heterogeneous teams with individuals who may have different working styles.

- In the first semester, one team experienced an issue on their team with one member who was not contributing as much as the others. Despite having created ground rules for operation in this process activity, the other members of the team chose to avoid confronting the individual and reach out to the facilitator for help. The facilitator should emphasize the need for conflict management as teams develop ground rules. PBL methods can help students develop conflict management skills (Seren & Ustun, 2007; Yalcin, Karahan, Karadenizli, & Sahin, 2006). But if the learners simply avoid conflict rather than attempt to face it, they
may not get as rich of a learning experience they might otherwise. Because PBL and the CPS model seek to prepare learners to be successful outside of the classroom, conflict management becomes an even more important skill to develop. Proper and healthy conflict management can help create better working groups (Sadri, 2012). In this part of the process activity, the facilitator can lead a class discussion for the students to share their ideas and give other teams feedback on their ground rules. This activity allows the students to learn from one another, share resources, and critique their own work (Savery & Duffy, 1995; Bruffee, 1999).

**Determine a preliminary problem definition.** Based on the identified weaknesses or areas for improvement, the third process activity in the CPS model revealed two changes that are being recommended to the model for this context. They are as follows:

- Learners in both instances of the model developed an initial research design plan during this process activity. This led them to identify gaps in their knowledge and where they could go to acquire this knowledge. After collecting initial background research, learners met with their teams, shared their findings, and revised their design plan. These activities appear in PBL methodology and were not changed from one semester to the next (Barrows, 1986; Yuan, Williams, Yin, Liu, Fang, & Pang, 2011). In practice, the learners in this context did not have enough knowledge of their client or the problem to proceed with creating potential problem solutions. The change being made is that learners will not
create problem solution hypotheses until they have designed a long-term action plan and collected more research through the iterative CPS process in the fifth process activity. In PBL methodology, learners hypothesize the problem solution and proceed to confirm or deny their potential problem solutions. But they do this only after they have enough information to fully understand the problem (Hmelo-Silver, 2004; Ramsay & Sorrell, 2007).

- The other improvement being made to this process activity for the final revision is the inclusion of full-class discussions and collaborations among teams as the learners work together to define their problem statements. As it does in other process activities, inter-team collaboration allow learners to share resources and information and give one another feedback (Savery & Duffy, 1995; Bruffee, 1999). In practice, the teams diverged on their problem definitions but used this time to give one another feedback, particularly from the students with more experience working with clients.

**Design a long-term action plan.** Based on the identified weaknesses or areas for improvement, the fourth process activity in the CPS model revealed two changes that are being recommended to the model for this context. They are as follows:

- This new process activity replaced the Define and Assign Roles activity from the initial CPS model. However, it is not a completely new activity to the CPS model. Learners create a design plan that guides their research in the initial instance. But this design plan was too vague and learners felt the need for greater direction throughout the semester. In the final revision of the CPS model, learners are asked
to create a detailed action plan that addresses what research the team needs, who
will do what by when, what will be given to the instructor for feedback and by
when, and any other details they will need to work through the semester. An
action plan by itself may not address the students’ issues of needing more
direction. In order for it to be effective, the action plans need to be as detailed as
the teams can make them (Halvorson, 2014).

- The other improvement made to this process activity is the addition of inter-team
collaborations. The benefits of these collaborations are stated throughout this
chapter. But, in practice, the learners said that they learned more from
collaborating and working together than they did working and researching on
their own.

Engage in an iterative collaborative problem-solving process. Based on the
identified weaknesses or areas for improvement, the fifth process activity in the CPS
model revealed two changes that are being recommended to the model for this context.
They are as follows:

- The first improvement to this process activity was the inclusion of the feasibility
test (formerly the usability test) after the first instance. In practice, the learners
found that conducting the feasibility test right before they finalized their projects
in the following process activity was too late. Although conducting this activity
gave them useful feedback, they were much too far along in the process to have
time to make significant changes or improvements to their work. In the revised
instance, the learners used what they learned from the feasibility test to guide both
their research and their problem solutions. The feasibility test is a feasibility test and not a usability test because in the original CPS model, a team should “test its proposed solution or product with subjects from the target audience in a setting and under conditions as close to real-world as possible” (Nelson, 1999, p. 265). Because the teams in this context routinely work with clients on large-scale projects involving target audiences that are not in the United States, a replication of the problem solution is impossible. In the revised CPS model, learners are asked to complete a feasibility test with experts who look at their hypothesized solution and provide them with feedback or direction.

- In the revised instance, although learners had better guidance from one task to the next because of their action plans, they had difficulty identifying the location of research or knowledge they needed. The facilitator in PBL helps learners find the right path; he or she does not tell them explicitly what to do (Boud & Feletti, 1997). When learners have difficulty finding research, the facilitator can suggest places they can look, but they need to learn to identify resources as part of their learning. In the final revision of the CPS model, the facilitator can model appropriate behavior for identifying resources (Hmelo-Silver, 2004; Hung, et al., 2007; Norman & Schmidt, 1992). This can be done through leading the teams through a brainstorming exercise. Learners can be encouraged to share resources and offer feedback to other teams in situations when the teams are having difficulties.
Assess products and processes. Based on the identified weaknesses or areas for improvement, the eighth process activity in the CPS model revealed one change that is being recommended to the model for this context. It is as follows:

- Learners in the revised instance of the CPS model stated that they wanted to receive personal feedback from one another. These students work together for four semesters and their argument was that they would benefit from the feedback because they would be working together again. In the final revision to the CPS model, this is an option added to this process activity. Learners in collaborative work tend to welcome constructive feedback when it focuses on their performance “and tailored to their goals” (Hewson and Little, 1998, p. 116). Peer feedback has been shown to help poorly performing students (Kamp, Dolmans, Van Berkel, & Schmidt, 2012). The facilitator needs to keep in mind that this can be difficult and the focus should be on constructive and positive feedback. He or she should keep in mind that face-to-face feedback can be helpful but it can be most effective when combined with self-reflection (Archer, 2010).

What Were the Weaknesses and What Improvements Can be made to the Comprehensive Guidelines?

Instructor-implemented methods. Based on the identified weaknesses or areas for improvement, this comprehensive guideline revealed two changes that are being recommended to the model for this context. It is as follows:

- In the final revision, an additional comprehensive guideline is added to the instructor-implemented methods. The facilitator should model appropriate
problem solving behavior (Boud & Feletti, 1997). The rationale for this improvement was that the learners had difficulty identifying the sources of research and information they sought. In order to help the students learn how to work to figure out where they can find what they need, the facilitator should not show them where to go. Rather, he or she should work with the learners and how them how to learn how to find the information.

**How Can Technology be Used?**

Throughout the data collection phase and in the implementation of the CPS model and its revision, the primary technology tools used were as follows: Discussion boards, an LMS (Blackboard), and a mobile group-chatting app (GroupMe). Other pieces of technology were used, chiefly those in the Microsoft Office Suite like Word or PowerPoint. Only presented here are technology tools that can alter the design of the CPS model and its implementation. Each primary tool is discussed in a sub-section below. One other category of technology software that could be used in the CPS model is discussed following the sections outlining the findings regarding the use of the primary tools during the data collection phase. That sub-section details the potential use and integration of a shared online space for learners and facilitators to share progress and updates outside of the LMS. This section recaps the ways in which technology was used throughout the study combined with the research as highlighted in chapters four and five.

**Learning management systems.** The Blackboard LMS was used throughout the two semesters to serve as a hub for documents, document submission, a discussion board, course information, official announcements, and open forums for student questions.
Students were given spaces for their teams to interact, upload documents, share resources, and maintain a schedule. In the revised instance, the learners created an action plan in the form of a detailed timeline, which was added to the team pages on the class Blackboard page. In a PBL course, the LMS can act as a hub for progress reports to keep facilitators and learners in teams working toward the same goal (Clark, Mulligan, Kataoka, & Baba, 2011). In the present study, unless the learners were required to participate in an activity using the LMS, they did not use it. When they collectively defined assignments with the facilitator, these were uploaded to the LMS for assessment and feedback. They responded to question prompts on Blackboard’ discussion board pages, they accessed documents and resources posted by the facilitator, and they read the announcements posted. Yu, Sun, and Chang (2010) support these findings. Their research indicates that learners most frequently use an LMS for uploading assignments and checking grades. The findings from the present study indicate that, in this context, an LMS should be used to support the revised CPS model as a repository of information, links, and documents, course announcements, and a hub for the discussion board.

Because the discussion board was used extensively throughout the CPS instances it is discussed in more detail in the following section.

**Discussion boards.** Discussion boards were used throughout the two semesters to prompt learners to answer questions. They can be used to precede in-class discussions, to push learners to critically plan and evaluate their progress through the instruction, and provide a space for learners to give and receive feedback. In this study, learners used the discussion board to ask more questions when prompted than they did during in-class
discussions. This finding is supported by Tosun and Taskesenligil (2011) whose research indicate that learners may be more willing to ask questions on a discussion board than they would in class because it creates a safer environment. Other research indicates that the online environment supports greater participation because of its nature. It allows the space for all learners to have their voices heard, irrespective of the time constraints that can prevent some from speaking in class. (Krishnaiyer, et al., 2012). Throughout the research, learners were given question prompts to respond to that asked them to update their progress, critically analyze any hypothesized solutions they may have, and their future research goals. This forced the learners to evaluate their work and set smaller, daily goals. Question prompts throughout the problem solving process can guide learners to stay on task, help them critically analyze the problem solving process, and consider alternate hypothesized problem solutions (Du, Yu, Alinzock, 2011; Ge, Chen, & Davis, 2005). Divergent question prompts, or ones that have any number of unique responses, can lead learners to higher levels of thinking per Bloom’s Revised Taxonomy (Ertmer, Sadaf, & Ertmer, 2011).

**A mobile group-chatting app.** A group chatting app, GroupMe, was used to relay communications to student participants in the class, chat about the class and projects, and clarify issues in the revised CPS instance. All communication sent via the GroupMe app was posted to the course Blackboard page to ensure no learner was disadvantaged who did not wish to participate via his or her mobile device. Learners had their own GroupMe group-chat to talk about any topic they wanted. This was free from any instructor participation. Although the instructor created an open, shared space on the
course Blackboard page for learners to share information and ask one another questions, it went unused throughout both instances of instruction. In the revised CPS model, learners replaced this function by using the class and instructor-free GroupMe group-chats. This finding is supported by Mendoza and Alejandro (2014) who found that learners chose to communicate with the instructors more frequently using a similar mobile communication app (LINE) than through the LMS. Other researcher point out that learners prefer communication via mobile devices to the alternative (Arreymbi & Draganova, 2010; Echeverria, et al., 2011). Group chatting on a mobile app can have a positive influence on collaboration by creating an environment that is conducive to authentic learning and just-in-time learning (Cochrane, 2013). The findings from this study indicate that mobile communication can be an integral part of the way information is delivered to learners as they prefer it and actively engage in using it.

**A shared online timeline and workspace.** The LMS serves as a hub to keep information about the class and a space where learners can interact. Findings in this study indicate that learners shared documents and resources, and communicated through other means, away from the LMS. They used email and group SMS. To collaborate on documents, the instructor observed that the student participants used Google Drive. To share documents, they used Dropbox. These are tools that the learners can access from their mobile phones or, in the case of Google Drive, perform functions that are simply not possible in Blackboard (synchronous editing and interacting). A similarly accessible tool can be used as a shared online action plan and updated progress report. This can allow a facilitator to easily identify a team’s progress – particularly when working with more
than one team, which happens in this context (Wang, 2010). If all members were able to view other teams’ online action plan and progress report, they would be able to give and receive feedback and learn from their more experienced classmates (Vygtosky, 1986). Creating a network with a common space for the learners and instructor to interact and provide just-in-time feedback in a space that would be readily available to the learners can help enhance learner motivation and confidence (Yunus, Salehi, & Chenzi, 2012). A Google calendar is a tool that is free and easily accessible, would allow all users to join, modify, and annotate, and available as an app on the Android and iOS mobile operating systems (third party app on iOS) and can be synchronized with the calendar on both of those mobile platforms (Google Calendar, 2014; Sync Google Calendar, 2014; CalenMob – Google, 2014).

Summary

This purpose of this research study was to implement and evaluate Nelson’s (1999) Collaborative Problem Solving instructional method in the context of a large Midwestern university’s client-based internationally-focused undergraduate problem-solving program, a client- and problem-based certificate program. The model was implemented once as a pure instance in the fall semester 2013-2014. Data were collected and analyzed following the first instance of the CPS model to inform a revision, which was implemented the following spring semester 2013-2014. Each revision was augmented with research to support the additions or changes recommended. The research questions that guided this study were as follows:
1. In the context of the client-based internationally-focused undergraduate problem solving program’s classes at a large Midwestern university, what are the strengths and weaknesses of the Collaborative Problem Solving Model?

2. What changes should be made to the model to make it better fit this context and do these improvements impact the integrity of the model?

3. What role does technology play in the design of the CPS model in this context?

The study had a total of 45 undergraduate students, each of whom participated in the course of a period of 15 weeks.

The study revealed the following seven strengths of the CPS model and its revised instance:

1. Results from the questionnaire indicate that learners found that the model met the five goals of problem-based instruction, with a median score of 5 out of 6.

2. Students expressed satisfaction with and enjoyment of the CPS model.

3. Results from the observation rubric and document analysis indicate that the CPS model supports effective team collaboration and self-directed learners.

4. Results from the observation rubric and document analysis indicate that the model supported collaboration and self-direction.

5. The addition of the action plan provided teams with direction throughout the semester.

6. Technology can play a role in supporting the CPS model and meeting the goals of PBL.
The revisions made from the first CPS model’s instance were met by the learners with positive reactions and did not negatively impact the effectiveness of the model.

The CPS model revealed several weaknesses for this context. The model’s first instance revealed the following four weaknesses:

1. In this context, allowing learners to form their own teams can be problematic.
2. Identifying potential problem solutions without sufficient knowledge of the client, industry, or problem was problematic.
3. The learners struggled with a lack of direction and expressed a desire to know or be told where to go and what to do next.
4. The feasibility test occurred too late for the learners to apply the knowledge they gained from it.

The revised instance of the CPS model in this context revealed the following three weaknesses:

1. Although learners benefitted from the action plan and had sufficient direction of where to proceed, they did not always know where to find research or how to learn where to go.
2. Inter-team collaborations are beneficial to the learners in this environment, and can be expanded to other process activities.
3. Technology can help teams and facilitator(s) keep a record of day-to-day progress, which is particularly important when there is more than one facilitator.
Table 7

Changes Made to CPS Process Activities for this Context

<table>
<thead>
<tr>
<th>Process Activity</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Instructor and Learners Establish Readiness to Engage in Collaborative Group Work</td>
<td>Review the process with the students with the aid of an online discussion board (Krishnaiyer, et al., 2012). Present the authentic problem to the students to anchor instruction and learning activities (Lopez &amp; Lee, 2005). Learners are encouraged to create team-based assignments within the context of the client and culture to practice group process skills (Gao, 2013; Morales, 2011; Boud &amp; Feletti, 1997)</td>
</tr>
<tr>
<td>2. Either the Instructor or the Learners Form Small, Heterogeneous Work Groups. And then the Groups engage in Norming Processes</td>
<td>Form small heterogeneous working groups. Balance student interests and a heterogeneous makeup. Encourage groups to establish operational guidelines including conflict management procedures (Seren &amp; Ustun, 2007; Yalcin, et al., 2006; Sadri, 2012). Participate in intergroup collaborations and evaluations.</td>
</tr>
</tbody>
</table>
Table 7: continued

<table>
<thead>
<tr>
<th>Process Activity</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Teams Design a Long-Term Action Plan</td>
<td><em>Work with the instructor to create an online action plan and timeline</em> (Wang, 2010; Yunus, et al., 2012). <em>Define parameters of assignments and work</em> (Halvorson, 2014) <em>Participate in intergroup collaborations and evaluations.</em></td>
</tr>
<tr>
<td>The Group Engages in the Primary, Iterative CPS Process</td>
<td>Refine and evolve the <em>action plan</em> Collaborate with instructor to acquire additional resources and skills needed <em>including brainstorming the location of needed resources</em> (Hung, et al., 2007; Norman &amp; Schmidt, 1992) <em>Create a preliminary problem solution and conduct an initial feasibility or usability test – Discuss with class and instructor who this will be with</em> (Savery &amp; Duffey, 1995; Bruffee, 1999)</td>
</tr>
<tr>
<td>The Instructor, and When Appropriate, the Learners Assess Their Products and Processes</td>
<td>Evaluate the processes used <em>Learners participate in face-to-face peer feedback when the learners want to participate in it</em> (Archer, 2010; Kamp, et al., 212; Hewson &amp; Little, 1998)</td>
</tr>
</tbody>
</table>

Based on the identified weakness and opportunities to strengthen the model, it was revised for the second semester, which is described throughout Chapter 4. The CPS
model incorporates two unique parts: The process activities and the comprehensive guidelines. Excluding the use of technology tools (which are presented separately), the following table outlines the main process activities and their sub-activities. Table 7 describes the entire model and the italicized writing indicates additions to the model that resulted from the data collected throughout this research study. All citations within the table are the researcher’s. Because no changes were made to process activities 6, 7, and 9, they are not present in the table. Any text in this table that is not italicized comes from Nelson (1999, p. 258). Because of the size of the full table including all original process activities, in order to fit it to one page, Table 7 presents only the additions or changes made to these activities as a result of this study. Readers should compare Table 7 with Table 3 in Chapter 4 or Nelson’s (1999) table on page 258. The next table, Table 8, outlines the uses of technology for the revised CPS model in this context.

**Recommendations for Practitioners**

This study presents a CPS model for an internationally-focused, client based certificate program. It should provide insight into the way instruction in this environment is perceived by learners and what works well and what can be improved. A practitioner should be aware that every group of learners is different and what works for one group may not work for another. One of the recommendations for improvements, face-to-face peer feedback, is only a recommendation for the learners who want it to occur. Research supports this recommendation and the benefits it can have on participants, but a facilitator should be careful to ensure that the group of learners is mature enough.
Table 8

*How Technology can be used to Support CPS Model in this Context*

<table>
<thead>
<tr>
<th>Piece of Technology</th>
<th>Use in CPS Model for this Context</th>
</tr>
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</table>
| Learning Management System | • House the course syllabus and course reference documents (Clark, et al., 2011)  
• Allow learners to submit documents online (Yu, et al., 2010)  
• Post links to course materials outside the LMS |
| Discussion Board | • Provide an online space where learners can respond to questions that inform discussion (Tosun & Taskesenligil, 2011; Krishnaiyer, et al., 2012)  
• Prompt learners throughout their problem-solving process to improve their critical thinking (Du, et al., 2011; Ge, et al., 2005; Ertmer, et al., 2011) |
| Mobile Group-Chatting Application | • Use an app to communicate with participating learners (Mendoza & Alejandro)  
• Encourage learners to create their own group-chat (Cochrane, 2013; Franklin, et al., 2013) |
| A Shared Online Timeline and Workspace | • Create an online, shared action plan where teams and instructors can interact (Wang, 2010)  
• Encourage learners to view other teams’ online work and interact with them (Vygotsky, 1986) |
This model and all PBL models emphasize student ownership of their learning and self-direction. They are encouraged to take an active role in their learning process, including designing what would be called assignments in a traditional classroom. A facilitator should encourage this active participation but must be mindful to maintain a balance between what learners want to do and what they will need to do so they can receive and learn from instructor feedback. Similarly, the facilitator should pay attention to student desires and ensure that he or she is not asking them to complete a task that will not be relevant to their learning goals or their needs in the projects.

The CPS and PBL models demand a different approach from the instructor than other classrooms. As Nelson (1999) writes, “This requires that instructors be flexible and tolerant of a certain degree of ambiguity in what exactly is to be learned and how this will take place” (p. 249). The facilitator needs to be comfortable not telling students what to do to accomplish their goals. He or she needs to learn that asking learners the right questions and modeling problem solving techniques is more important to their learning in this environment than direct instruction.

A facilitator needs to be aware that with added self-direction that learners are given, they are encouraged to take control of their learning. Findings from this study indicate that learners do not always understand why they need to research or learn certain skills or information. The findings indicate that some learners did not understand why it was important to focus on conflict management skills, be placed in heterogeneous groups, or learn about the culture of their client. Research has been presented within this research study and Nelson’s (1999) original publication to demonstrate the importance of these
three items. A practitioner should proactively communicate the importance of each step within this revised instructional method. Alternatively, Bikowski & Vithanage (in press) demonstrate that learners can become better collaborators when set goals for themselves, a technique that a facilitator can use with learners as they set ground rules for conflict management, actively seek to learn to work in a heterogeneous group, or learn to apply what they learn about the client’s culture.

The benefits to the learners in participating in this reflective activity, while present in the research study, are part of the original CPS model’s process activities. The addition of one-on-one interviews and an attitude assessment for data collection may have led the learners to participate in more self-evaluation and reflection than they might have without the presence of a researcher. Practitioners may look into the addition of using the attitude assessment and one-on-one interviews as part of the seventh process activity.

Finally, practitioners are encouraged to read Nelson’s (1999) original text in conjunction with this revision. It has more in-depth explanations about the conditions necessary for this type of instruction, the comprehensive guidelines and a better explanation of how one would proceed step-by-step through the process activities.

**Recommendations for Future Research**

Future research should be completed in this same context. Because the projects learners work on change every semester in this environment and the clients shift frequently, the projects that the learners worked on in this study will never be exactly the
same again. Different projects and clients may yield different recommendations for improvements to the CPS method.

Furthermore, this study evaluates a 15-year-old instructional model and introduces technology strategically based on best-practice research. Future research should continue to be conducted to evaluate the best use of technology and the implementation of new technology. The type of mobile group-chatting app that research indicate learners flock to for communication and collaboration (and away from the clunky LMS), GroupMe was conceived only in 2010, eleven years after the publication of the CPS model.

**Limitations**

An inherent limitation of evaluating an instruction methodology is created by the boundaries presented by the limited context in which the instances occur. The resulting instructional methodology will, perhaps, be bound to undergraduate students who join the large Midwestern university’s global problem solving program. Despite the fact that two instances of the methodology were tested, the transferability of the resulting instructional methodology will be unknown until it is implemented elsewhere. As Reigeluth and Frick (1999) state, almost no instructional design is without its flaws because of constantly changing needs, technologies, and varying contexts.

Additionally, because formative research lacks the wealth of methodology researchers and prescriptions as more well-developed and well-used methods, parts of the data collection and analysis phases were adapted from grounded theory and phenomenology theories. However, active attention was paid to adapt formative research
with fitting guidance from these other methods. By looking at the foundational principles
of this methodology and documenting them, the researcher tried to mitigate the concerns
presented by an under-used methodology.
References


*Description and requirements.* (2014). Retrieved from http://www.ohio.edu/glc/descriptionAndRequirements.cfm


Olusola, A. J., & Alaba, S. O. (2011). Globalization, information and communication technologies (ICTs) and open/distance learning in Nigeria: Trends, issues and


Appendix A: Observation Instrument

Facilitator: ___________________________

Course: ________________________________

Viewer’s name: ________________________ Date: __________ Time in: __________

Time out: ______________

In the following items are two statements describing the group along a continuum. Please think about where along the continuum this group lies, and circle the number closest to that point.

1. There is little student to student 1  2  3  4  5  6 There is frequent student-to-  student interaction in this group

*If you had trouble assigning a value to this group, please explain:*

2. The group accepts short answers. 1  2  3  4  5  6 In this group answers are  Answers are rarely expanded Upon (by either students or Facilitator).

*If you had trouble assigning a value to this group, please explain:*

3. The facilitator does most of the 1  2  3  4  5  6 Students do most of the talking.

*If you had trouble assigning a value to this group, please explain:*

4. When identifying answers, this 1  2  3  4  5  6 In this group the facilitator or the group (facilitator or students) does not often ask or explain how or why something is true.

*If you had trouble assigning a value to this group, please explain:*


5. The facilitator helps students solve problems without explicit review of background Concepts or course material.  
   The facilitator points out that particular ideas are important for solving the problem and reviews some background concepts or course material.

   *If you had trouble assigning a value to this group, please explain:*

6. The facilitator sets the direction for the group.  
   Students play a role in setting the direction for the group.

   *If you had trouble assigning a value to this group, please explain:*

7. The facilitator is the focus of the group, and there is a sense that without the facilitator, the group could not function.  
   The students are the focus of this group. There is a sense that the group could function even if the facilitator were absent.

   *If you had trouble assigning a value to this group, please explain:*

8. When the group has solved a problem, they move on to another without additional discussion.  
   The group sometimes continues discussing a problem even after an answer has been arrived at.

   *If you had trouble assigning a value to this group, please explain:*

9. The group seems more concerned with identifying answers to the particular questions to discuss and understand ideas, concepts and strategies.  
   The group (students and/or facilitator) seems very concerned with using worksheet questions than with discussing ideas/concepts behind the problems.

   *If you had trouble assigning a value to this group, please explain:*
10. The facilitator takes responsibility for most of the communication (e.g. questioning, answering, explaining).

The group as a whole takes responsibility for most of the communication (e.g. questioning, answering, explaining).

If you had trouble assigning a value to this group, please explain:
Appendix B: Questions from the PBL Evaluation Questionnaire

1. The course made me use previous relevant knowledge and experience.

2. The course helped me to interpret, analyze, and apply key concepts precisely and rationally.

3. The course furthered my in-depth understanding of relevant knowledge.

4. The content of the course is useful for my future work.

5. The problems used in the course were challenging to discuss.

6. The course increased my ability to solve real-world problems.

7. The course encouraged me to consider alternatives when solving problems.

8. The course helped me to make reasonable inferences and conclusions to address problems or issues.

9. Problem situations encouraged me to continue to study on my own.

10. The course helped me to identify gaps in my knowledge.

11. The course helped me improve my ability to identify a variety of resources to meet my own learning needs.

12. The course helped me to think independently.

13. The course encouraged me to take an active role in my learning.

14. The course motivated me to learn more.

15. The course stimulated my interest in learning.

16. The course encouraged my participation through the discussion of problems.

17. The course stimulated group discussion.

18. The course promoted open discussion of differing opinions.
19. The course increased my ability to work effectively on a team.

20. The course encouraged me to share what I learned with the entire group.
### Appendix C: Table 1 Full Results of the PBL Evaluation Questionnaire

**Fall Semester PBL Evaluation Questionnaire Results (n = 20)**

<table>
<thead>
<tr>
<th>Items</th>
<th>Mode</th>
<th>Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction of professional knowledge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The course made me use previous relevant knowledge and experience.</td>
<td>6.0</td>
<td>5.5</td>
<td>.92</td>
</tr>
<tr>
<td>2. The course helped me to interpret, analyze, and apply key concepts</td>
<td>6.0</td>
<td>5.0</td>
<td>.83</td>
</tr>
<tr>
<td>3. The course furthered my in-depth knowledge of the subject matter.</td>
<td>5.0</td>
<td>5.0</td>
<td>1.16</td>
</tr>
<tr>
<td>4. The content of the course is useful for my future work.</td>
<td>6.0</td>
<td>5.5</td>
<td>1.33</td>
</tr>
<tr>
<td><strong>Development of problem-solving skills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The problems used in the course were challenging to discuss.</td>
<td>5.0</td>
<td>4.5</td>
<td>1.21</td>
</tr>
<tr>
<td>6. The course increased my ability to solve real-world problems.</td>
<td>6.0</td>
<td>6.0</td>
<td>1.03</td>
</tr>
<tr>
<td>7. The course encouraged me to consider alternatives when solving problems.</td>
<td>5.0</td>
<td>5.0</td>
<td>.75</td>
</tr>
<tr>
<td>8. The course helped me to make reasonable inferences and conclusions</td>
<td>5.5</td>
<td>5.0</td>
<td>.88</td>
</tr>
<tr>
<td>to address problems or issues.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Rating</td>
<td>Additional Feedback</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Development of self-directed learning</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Problem situations encouraged me to continue to study on my own.</td>
<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. The course helped me to identify gaps in my knowledge.</td>
<td>5.0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>11. The course helped me improve my ability to identify a variety of resources to meet my own learning needs.</td>
<td>5.0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>12. The course helped me to think independently.</td>
<td>5.0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td><strong>Improvement of motivation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. The course encouraged me to take an active role in my learning.</td>
<td>6.0</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>14. The course motivated me to learn more.</td>
<td>5.0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>15. The course stimulated my interest in learning.</td>
<td>5.0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>16. The course encouraged my participation through the discussion of problems.</td>
<td>5.0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td><strong>Promotion of effective group collaboration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. The course stimulated group discussion.</td>
<td>6.0</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>18. The course promoted open discussion of differing opinions.</td>
<td>6.0</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>19. The course increased my ability to work effectively on a team.</td>
<td>6.0</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>20. The course encouraged me to share what I learned with the entire group.</td>
<td>6.0</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.0</td>
<td>5.0</td>
<td>1.03</td>
</tr>
<tr>
<td>-------</td>
<td>-----</td>
<td>-----</td>
<td>------</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix D: Table 4 Full Results of the PBL Evaluation Questionnaire

*Spring Semester PBL Evaluation Questionnaire Results (n=20)*

<table>
<thead>
<tr>
<th>Items</th>
<th>Mean</th>
<th>Mode</th>
<th>Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Construction of professional knowledge</em></td>
<td>5.25</td>
<td>6</td>
<td>5.5</td>
<td>0.93</td>
</tr>
<tr>
<td>1. The course made me use previous relevant knowledge and experience.</td>
<td>5.24</td>
<td>5</td>
<td>5</td>
<td>0.70</td>
</tr>
<tr>
<td>2. The course helped me to interpret, analyze, and apply key concepts precisely and rationally.</td>
<td>5.05</td>
<td>6</td>
<td>5</td>
<td>0.92</td>
</tr>
<tr>
<td>3. The course furthered my in-depth knowledge of the subject matter.</td>
<td>5.05</td>
<td>6</td>
<td>5</td>
<td>1.16</td>
</tr>
<tr>
<td>4. The content of the course is useful for my future work.</td>
<td>5.57</td>
<td>6</td>
<td>6</td>
<td>0.68</td>
</tr>
<tr>
<td><em>Development of problem-solving skills</em></td>
<td>5.23</td>
<td>6</td>
<td>5.5</td>
<td>0.96</td>
</tr>
<tr>
<td>5. The problems used in the course were challenging to discuss.</td>
<td>5.14</td>
<td>6</td>
<td>5</td>
<td>0.96</td>
</tr>
<tr>
<td>6. The course increased my ability to solve real-world problems.</td>
<td>5.38</td>
<td>6</td>
<td>5</td>
<td>0.67</td>
</tr>
<tr>
<td>7. The course encouraged me to consider alternatives when solving problems.</td>
<td>5.24</td>
<td>6</td>
<td>6</td>
<td>1.09</td>
</tr>
<tr>
<td>8. The course helped me to make reasonable inferences and conclusions to address problems or issues.</td>
<td>5.0</td>
<td>6</td>
<td>5</td>
<td>1.14</td>
</tr>
<tr>
<td><strong>Development of self-directed learning</strong></td>
<td>4.92</td>
<td>6</td>
<td>5</td>
<td>1.21</td>
</tr>
<tr>
<td>9. Problem situations encouraged me to continue to study on my own.</td>
<td>4.43</td>
<td>6</td>
<td>5</td>
<td>1.57</td>
</tr>
<tr>
<td>10. The course helped me to identify gaps in my knowledge.</td>
<td>4.95</td>
<td>6</td>
<td>5</td>
<td>1.28</td>
</tr>
<tr>
<td>11. The course helped me improve my ability to identify a variety of resources to meet my own learning needs.</td>
<td>5.0</td>
<td>5</td>
<td>5</td>
<td>1.0</td>
</tr>
<tr>
<td>12. The course helped me to think independently.</td>
<td>5.14</td>
<td>6</td>
<td>5</td>
<td>0.91</td>
</tr>
</tbody>
</table>

| **Improvement of motivation** | 4.91 | 6 | 5 | 1.26 |
| 13. The course encouraged me to take an active role in my learning. | 5.29 | 6 | 6 | 1.06 |
| 14. The course motivated me to learn more. | 4.86 | 5 | 5 | 1.24 |
| 15. The course stimulated my interest in learning. | 4.48 | 5 | 5 | 1.36 |
| 16. The course encouraged my participation through the discussion of problems. | 4.90 | 6 | 5 | 1.41 |

| **Promotion of effective group collaboration** | 5.26 | 6 | 6 | 1.27 |
| 17. The course stimulated group discussion. | 5.14 | 6 | 6 | 1.49 |
| 18. The course promoted open discussion | 4.95 | 6 | 6 | 1.77 |
of differing opinions.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>19. The course increased my ability to work effectively on a team.</td>
<td>5.57</td>
<td>6</td>
<td>6</td>
<td>.81</td>
</tr>
<tr>
<td>20. The course encouraged me to share what I learned with the entire group.</td>
<td>5.24</td>
<td>6</td>
<td>5</td>
<td>.83</td>
</tr>
<tr>
<td>Total</td>
<td>5.07</td>
<td>6</td>
<td>5</td>
<td>1.17</td>
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</tbody>
</table>