THE HIGHER EDUCATION OF WOMEN IN THE KINGDOM OF SAUDI ARABIA: RELATIONSHIP OF GENDER AND ACADEMIC PERFORMANCE IN HIGH SCHOOL TO THE SELECTION OF COLLEGE MAJOR AMONG UNDERGRADUATE STUDENTS

A Thesis
Presented to
The Graduate Faculty of The University of Akron

In Partial Fulfillment
Of the Requirements for the Degree
Master of Arts

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May, 2014
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ABSTRACT

This study was conducted at a public university located in the geographical center of the Kingdom of Saudi Arabia (KSA). The study included two research questions designed to explore the relationship between gender, high school performance, and college major selection among students in the KSA. The first research question examined the relationship between student gender and choice of college major among college students in the KSA. The second research question examined the relationship between high school performance and college major based on student gender.

This study had three major findings. It found a significant relationship between student gender and choice of college major. It also found a major achievement gap in the measurement of student high school performance. The gap existed between the two standardized measures, GAT and SAAT, and the non-standardized measure, high school GPA. Finally, results of the study showed that the difference in high school academic performance of students in each of the four-college majors mathematics, chemistry, physics, and natural sciences was significantly related to the students’ gender. This finding was true only for two of the three measures of the high school academic performance: high school GPA and SAAT.
The findings of this study suggest that high school students, particularly female students, should be offered free educational courses and seminars specifically designed to enhance the students’ knowledge and teach students how to achieve well on the GAT and SAAT. The results also suggest that high school students should be informed of the importance and power of high school performance. Educators, researchers and policy makers should know that high school performance is strongly tied to both the selection of college major and college performance.
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CHAPTER I
INTRODUCTION

The selection of college major is considered a crucial decision that can affect students for the rest of their lives. This is especially the case in the new millennium when opportunities have become more strongly tied to higher education. Specializing in the field of science could make a significant difference in students’ lives. It could help them earn more, live better, and get jobs faster. Thus, solid communication between higher education institutions and the job market regarding supply and demand could promote and accelerate the development of the whole country. It would allow higher education institutions to prepare graduates who are ready and qualified to join the workforce, which can lead to a stronger economy and reduced unemployment rate. In the Kingdom of Saudi Arabia (KSA), educational researchers have not examined the contributing factors of Saudi students’ college major selections, especially in the sciences. Above all, Saudi women’s experiences of higher education remain a relatively under-explored area of study.

The KSA’s Ministry of Education was established in 1953; however, it was only responsible for male students’ education (Al-Bassam, 1984) until 1959 when the government announced the opening of the first public schools for girls. These schools worked in tandem with the Katatib, which were private home schools that offered education for girls prior to 1959 (Smith & Abouammoh, 2013). In 1960, the
government established an organization called the General Presidency for Girls’ Education (GPFE) (The Ministry of Information, KSA, 1979). GPFE was responsible for women’s education until the year 2002. That year, the government of the KSA issued a call to merge the Ministry of Education with the General Presidency for Girls’ Education (Smith & Abouammoh, 2013). The merger of the two departments was considered an effort toward increasing the educational quality for both female and male students in the KSA. In fact, women’s education in the KSA has made substantial progress in a relatively short period of time. The number of female students who joined the educational system in the KSA has skyrocketed from a mere 5,200 in 1960 to more than 2,000,000 in 1999 (GPGE, 2000). In the year 2008, there were 2,898,630 female students and 3,100,851 male students (Central Department of Statistics & Information, 2008).

In the KSA, students join public school when they turn 6 years old. At this age, they become eligible for elementary school, which runs from first to sixth grade. Students then transfer to middle school (seventh, eighth, and ninth grade), and eventually high school (10th, 11th, and 12th grade). In the KSA, public school education is free to all students, citizens and non-citizens, but higher education is free to Saudi citizens only. In the KSA, the public higher education system is exclusively for Saudi citizens who carry a Saudi passport; the children of foreign workers, for example, are not allowed to join this system unless they are awarded scholarships.

Islamic education and gender segregation are distinguished characteristics of the public school education in the KSA (Smith & Abouammoh, 2013). Students are required to take Islamic courses and attend gender-segregated schools. Gender
segregation is a policy that is applied in all schools from first grade all the way through graduate school. Additionally, these two characteristics, Islamic education and gender segregation, are well supported by the majority of Saudi population.

In 1970, the Saudi government opened Riyadh College, the first higher education institution for women. The college was established to train female teachers for intermediate and secondary level teaching (Al-Bassam, 1984). Educating teachers was the core mission for the first female institution of higher education in the KSA, and teaching remains a popular college major for Saudi women. In the KSA, there are 6,357,504 students enrolled in public school education 3,084,767 are female students and 3,272,737 are male students (Central Department of Statistics & Information, 2010). This matches up with the gender percentage in the general Saudi population, in which 49.1% are females and 50.9% are males (Central Department of Statistics & Information, 2010). When it comes to college campuses, however, the story is quite different, as female students represent the majority of the college population at 63% (Onsman, 2011). Similarly, the number of female college students in the United States is higher than that of male college students, with 57% of degree recipients in 2004-2005 being females (US Department of Education, 2005).

However, the majority of female students in the KSA select their college majors in education, humanities, and social sciences (Onsman, 2011). Although the Ministry of Health (MOH) in the KSA has been greatly concerned with and has tried to address the severe shortage of qualified nurses (Al-Ahmadi, 2002), female students are still less motivated to major in high demand fields like nursing.
Statement of the Problem

According to Smith and Abouammoh (2013), “About 30 years ago, it was possible to describe Saudi Arabia as ‘the society of men’ because men monopolized professional work as well as all kinds of political, economic, and social authority. But now this image has started to change, and women are carrying out important roles across all of these spheres” (p. 118). In order to carry out these important roles, more women are interested in gaining a college degree in the KSA, as it is considered the first step toward active participation in the public sphere.

Thus, women in the KSA are more motivated to pursue college degrees today than they had been in the past. They still limit their choices of college majors, however, to the traditional female fields such as humanities and social science fields (Onsman, 2011). This has led to a high number of female graduates from these fields in the KSA, while simultaneously causing a shortage of female graduates in other fields. In fact, this unbalanced situation is one of the reasons behind KSA’s high unemployment rate and the low representation of women in the work force. In the KSA, women represent only 14.4% of the national workforce, even though they represent the majority of college attenders (AlMunajjed, 2010).

The selection of college major is affected by many different social, academic, and demographic factors such as student gender. In the United States, Griffith (2010) noted that it is less likely for female students to join science, technology, engineering and mathematics (STEM) majors, and if they do, they are less likely to stay in these majors. On the other hand, female students are more motivated than male students to
pursue education majors and they now “represent the overwhelming majority of teachers in U.S. elementary schools” (Galman & Mallozzi, 2012, p. 243).

Supply and demand suggests that majors in the fields of technology and the sciences are extremely important in this day and age. Thus, it is critical to examine the relationship between gender roles and the selection of science majors among undergraduate female and male students in the KSA. Other issues, such as performance in high school, are also important factors in students’ college major decisions. For instance, strong high school academic performance in science and math appears to influence career choices and success.

**The Purpose of the Study**

This study aimed to describe the relationship between student gender and college major selections among college students in the KSA. This study explored the relationship between high school academic performance and college major based on student gender. This research was inspired by other studies that examined these trends at American universities.

**Research Design**

Group comparison research studies can be described as “empirical, quantitative studies that either (a) compare groups that differ on the independent variable to determine whether they also differ on the dependent variable or (b) compare groups that differ on the dependent variable to determine whether they also differ on the independent variable” (Gall, Gall & Borg, 2010, p. 243). This study compared the college major selections of female and male students in the KSA. It also compared the
high school academic performance of students from different college majors. The study was conducted in one of the largest public universities in the KSA.

This study answered two research questions:

1. Is there a relationship between gender and college major selection among college students in the KSA?

2. Are there significant differences in high school performance (measured by SAAT, GAT, and high school GPA) among college students in the KSA with different college majors while taking students’ gender into consideration?

**Significance of the Study**

Higher education in the KSA has a short history compared to other developed countries such as the United States. Thus, much needs to be done in order to improve the quality of the KSA’s education system. People in the KSA are highly conservative and gender is considered a sensitive topic, especially when it comes to the field of education. This is exemplified by the policy of gender segregation from first grade through graduate school. The unique social characteristics of Saudi society increase the need for studies on gender as it related to the field of education, as few are currently available. This study contributes to that particular area of research.

In the broader sense, Saudi women are dealing with issues such as the high unemployment rate; it is a real issue of concern where women represent only 14.4% of the national workforce (Al-Munajjed, 2010). As a primary source (Gall, Gall, & Borg, 2010, p.54), this study was designed to bring attention to the important topic of college major selection in order to bridge the gap between workforce and college education. It
can be used as a primary source of knowledge and information for educators, policy makers, and researchers.

The investigation of academic performance in high school and how it is related to college major in general compared performance between female and male students. Two measures of students’ performance in high school in the KSA are standardized exams. The intent of this study is to shed light on the use of standardized exams, how standardized exams relate to the selection of college major, and how this policy works for female and male students.

**Summary**

This chapter included an examination of the selection of college major and the significance of that decision as applied to the educational system in the KSA. The chapter focused on the educational context, purpose, problem, and significance of looking at the relationship between gender and college major selections among college students in the KSA, as well as the influence of gender and high school academic performance on the college major selections of college students in the KSA.

The following chapter, Chapter II, is a review of research literature regarding gender and the selection of college major. Chapter II also offers an in-depth analysis of the educational system in the KSA as compared to that of the United States. The third chapter explicates the research design, process of data collection, and method of data analysis. The fourth chapter describes the data analysis. The fifth and final chapter explores the implications of this study and presents recommendations for pursuing gender equity in the higher education system of the KSA.
CHAPTER II
LITERATURE REVIEW

Introduction

This chapter is divided into four sections. The first section of this chapter provides an overview of the educational system in the Kingdom of Saudi Arabia (KSA). The second section examines research literature regarding the relationship between students’ transition from the secondary education to college and their selection of college majors. The third section examines how different factors such as student personality, family life, ethnicity, the occupation of parents and family members, being a member of a minority group, the initial college experience, and gender contribute to the selection of college major. The fourth section examines the relationship between academic performance in high school and the selection of a college major.

The Educational System in the Kingdom of Saudi Arabia

There are some similarities and differences between the American and Saudi educational systems. Saudi students enter first grade when they are 6 years old and finish elementary school upon completion of the sixth grade. Afterward, students go to middle school for seventh, eighth, and ninth grade. Ultimately, students go to high school, which includes 10th, 11th, and 12th grade. Then, they go to college.

In the KSA, the first step of the transition from high school to college begins in the 11th grade. This is when students are given the choice to select one of two
educational paths. “This determines the emphasis in their curriculum,” according to Rugh (2002). “It also tends to predetermine the course of specialization a student can take in college” (p. 45). The first path focuses on chemistry, physics, biology, and mathematics, and the second path focuses on humanities, art education, and Islamic education. On the second path, students are not required to take science courses; meanwhile, students on the first path are required to take courses in Arabic language, English language and Islamic education. Thus, the first path allows students to choose whichever college major they want to study, but the second path limits student college major options by prohibiting them from joining health and STEM fields.

The public school education in the KSA is free and supported by the government. According to Onsman (2011), “The public education system provides students with free education, books, and health services” (p. 521). Higher education is not only free for all Saudi students, but they also receive stipends to help them pay for living costs during their college years. In the KSA, there are 24,000 public schools, 24 public universities and 26 private colleges and universities (Onsman, 2011). The education sector is a major expense of the government, which designates about 26% of its national budget to education (Siddiek, 2011).

In recent years, the Saudi government has strongly invested in higher education, especially for women. It has opened colleges and universities across the country to encourage students to pursue a college degree and make it easier for them to attend, while instituting a series of initiatives to provide women with easy access to higher education (Ministry of Higher Education, 2010). Traditionally, Saudi women do not move out of their parents’ homes before they get married. Thus, attending college was
almost impossible for women who lived in cities or villages that did not have colleges or universities. Today, however, there are more than 300 colleges and universities to accommodate women across the KSA (Ministry of Higher Education, 2010). Therefore, attending college has become considerably easier, especially for women.

This effort has led to a drastic increase in the enrollment of women in the KSA’s universities, as women now represent 56.6% of the total number of students (Ministry of Higher Education, 2010). Although this accomplishment is considered a big movement forward, the mission is far from over, as the majority of unemployed Saudis are women. It was recently found that 363,619 women are unemployed in the KSA versus 265,425 men (Central Department of Statistics & Information, 2013).

Since the selection of a college major is the first step toward establishing a career, it plays a major role in job distribution. There is a strong relationship between college major and career choice (Sax & Bryant, 2006). In the case of the KSA, for example, women still limit their choices of college majors to the education and art fields. As a consequence of that, the country now has a disproportionately high number of female graduates from these fields. This is partially a result of their concern about the workplace environment of different fields. Generally speaking, Saudi women feel more comfortable in a female-only environment, and the KSA’s policy of gender segregation that is applied in all schools and universities makes a career in education at a female-only school an appealing choice to many Saudi women. Yet, according AlMunajjed (2009):

It is true that Saudi society has its unique social characteristics; however, the Saudi government should invest more in specific specializations and skills
so as to build a balance between tradition and the demands for the productive participation of women in society (p. 1).

In the past, Saudi women were more focused on their homes and less engaged in social life. Today, however, the situation has changed, and Saudi women have become more interested in having a job and joining the workforce.

In order to support the movement of Saudi women adopting a more active role in society, they should be given more opportunities to join the workforce and offered jobs that fit their social traditions. After banks in the KSA opened female branches and gave Saudi women the opportunity to work in an environment aligned with their cultural traditions, more women started to select finance and accounting majors. This demonstrates that Saudi women are ready to select a college major that not only prepares them for jobs that interest them, but also provides them with a comfortable work environment.

Social traditions play a major role in students’ college major selections. For instance, due to the norm of gender segregation in the KSA, a majority of Saudi women tend to avoid college majors that could lead them to a mixed-gender work environment. Thus, the relationship between gender and the selection of college major among students in the KSA is a crucial topic that needs to be investigated. It is crucial because women are significantly underrepresented in the workforce, and it seems that their concern about maintaining gender segregation influences their college major selection, and ultimately in what field they work.

As a contribution to the movement of Saudi women toward higher education and becoming more active members of society, this study investigated the relationship
between gender and the selection of college majors among students in the KSA. The study was not designed to be a magic bullet for the high unemployment rate in the KSA. Rather, the study was aimed at inquiring into the factors that contribute to the college majors’ selections of students in the KSA.

**College Transition and the Selection of College Major**

Moving from K-12 education to higher education is not just an educational transition. It is also a major life transition, especially in terms of family and social life. The age of 18 is the time when students graduate from high school. It is also the time when students become legally independent in countries like the United States. So it is common among American youth to move out of their parents’ homes and start their own lives when they turn 18. This is not the case in the KSA, however, where youth typically continue to live with their parents until they get married.

Attending college becomes a major part of the life journey for female and male students in the KSA. The lack of knowledge about college, however, is considered a significant issue that students deal with after they graduate from high school. Some students have a clear plan and target a specific college major, but there are naturally other high school graduates in the KSA who are undecided and confused about their college plans. This confusion starts right after students receive their high school diploma, when colleges start accepting admissions applications.

As a matter of fact, college major selection is an issue of concern among college students not only in the KSA, but also in other countries and cultures. Picking a college major can be a daunting experience, but preparing students for this decision throughout their educational career (K-12) can help them successfully cope with this experience.
The selection of a college major is a life-changing decision that students face in the early stage of their undergraduate journey because the outcome of that decision goes far beyond their college years. As Porter and Umbach (2006) point out, “The choice of a college major can be one of the most important decisions a student can make” (p. 429).

Today, the trend of college major selections is strongly tied to the outside world, especially when it comes to job opportunities and the job market. In the KSA, for instance, college major selection trends are a significant factor behind the high unemployment rate of women, and, according to Calvert and Al-Shetaiwi (2002), “Government efforts to train and educate Saudi women have been considerable, however, female education has lacked the specialization required by the private sector. Hence the unemployment of university women graduates” (p. 121.)

It is fair to say that the college major selection is the actual starting point of a student’s career. In fact, “college major is strongly correlated with career choice” (Sax & Bryant, 2006, p. 53). Students who want to be engineers will choose an engineering major because it will prepare them for this particular field. Having an engineering degree is also the first requirement of any application for an engineering position. In today’s society, students need to think deeply about their fields of study and target majors that make them more competitive.

Recently, college has become a part of the life journey for female and male students in the KSA, especially for female students. According to Rugh (2002), “Today slightly more than half of the students in Saudi [attend] post-secondary institutions, and slightly more than half of the graduates are women” (p. 47). The social roles of women in the KSA have drastically changed over the last decade. At one time, Saudi women
focused on their homes and were less engaged in the social life outside of their homes, relying on the men in their lives to work and earn in order to support their families.

Today, however, Saudi women have become more interested in seeking jobs and joining the workforce. Thus, they have become more motivated to pursue college degrees in order to be more competitive in the job market, and there is a movement of “women in Saudi Arabia today… vigorously pursuing higher education and professional careers, and seeking to become active members of society” (Ministry of Higher Education of KSA, 2010, p.1).

This movement indeed has been acknowledged and supported by the Saudi government. According to Mahdi (2008):

The 8th Development Plan (2005-2009) in Saudi Arabia, for the first time since 1970, has devoted a separate chapter discussing the role of women in development. It provides specific objectives targeting their participation rate in the labor force. More specifically, the plan encourages women to enroll to the fields of science at both the secondary and higher education levels (p. 73).

It is also noteworthy that the Saudi Government has recently made a considerable effort to support and encourage women to pursue higher education. In 1970, the government opened the largest female-only university, Princess Noura Bint Abdul Rahman University. In 2010, the university received $238.8 million U.S. dollars from the Saudi government (Onsman, 2011). A year later in 2011, a new campus was developed to accommodate 40,000 students and 12,000 staff. It also has a 700-bed teaching hospital (Pavan, 2013, p. 26). The campus of Princess Noura University extends over 8 million square meters north of Riyadh, and this $5 billion campus is the first green campus in the KSA (Reisberg, 2011).
In addition to supporting and encouraging women toward higher education, Saudi Government also encourages women to study abroad in countries such as the United States, United Kingdom, Canada, Japan, Australia, and China. In 2005, the Saudi Government initiated the King Abdullah Scholarship Program (KASP). This program sponsors qualified female and male students from the KSA to study abroad (Denman & Hilal, 2011). KASP gives equal funding to female and male students and “On the undergraduate (Bachelor’s degree) level, students are allowed to study medicine, medical sciences, and health sciences. On the graduate level (Master’s degree and Ph.D.), the program allows students to study a diversity of fields” (Ministry of Higher Education, 2014, p.1).

Indeed, the aforementioned movement of Saudi women toward higher education is considered a positive step. A shortcoming of this movement, however, is in the college major selection process. The issue of Saudi women preferring educational and human majors “has led to a surplus of humanities graduates in particular, many of them unemployed” (Calvert & Al-Shetaiwi, 2002, p. 114). As consequence, Saudi women suffer job crowding in related fields (Mahdi, 2008).

Thus, it is very important for students in the KSA, especially women, to recognize that the world is more competitive than ever. They need to be taught that it is no longer just about having a college degree. Rather, they must attend to the fact that a college major plays a key role in the rest of their lives, the importance of which is increasing with each passing day. In the KSA, for example, colleges and universities produce a great number of college graduates every year. Still, however, there is an existing gap between the supply of these institutions and the demand of the job market.
especially for Saudi women, as the majority of them continue to select their college majors in the education, humanities, and social fields (Onsman, 2011).

In short, college is considered a major transition period of life. It is a transition stage from youth to adulthood, during which students become nascent independents and responsible for their own life decisions. The selection of a college major is one of the earliest and most important decisions that students face in life (Porter & Umbach, 2006). The selection of college major is actually the starting point of students’ careers because college is designed to prepare students for the job market and enhance their knowledge and critical thinking in the field they select.

**Factors Contributing to the Selection of College Major**

In the United States, previous studies show that students’ college major decisions could be affected by factors such as their gender, academic performance in secondary education, and personality. Porter and Umbach (2006) found that students in a specific major have personality similarities. Students with sociable personalities tend to prefer educational majors because they like to work with people. On the other hand, students with unsociable personalities may prefer to work with machines and materials and so they ultimately select engineering or other science majors.

Furthermore, family life is a great source of knowledge for students, especially when it comes to college and post secondary education. That is why college is considered a tough journey for first generation students who do not have as much knowledge about college life as some of their other peers. As a consequence, issues that are considered obvious to some college students may be difficult for first generation
students to deal with due to a lack of direction. Thus, first generation students may face more obstacles.

Ethnicity is also strongly related to the selection of college major. It may seem fair to say that students choose to study in a particular major because they are more interested in that field, and that it has nothing to do with their race or ethnic background. Reality, however, presents a different story. Ethnicity has been found to be a major factor in students’ choices of college majors, and in his study regarding race and ethnicity in the United States, Dickson found that race and ethnicity have a clear effect on students’ choices of majors (2010). For instance, the number of engineers in African American communities is less than that among Caucasian Americans.

With the exception of foreign workers, Saudi society is almost homogeneous. Thus, race and ethnicity are not issues of concern. Moreover, foreign workers in the KSA typically send their children back home to attend college, and the reason for this is rooted in the Saudi government’s rejection of private colleges and universities. Thus, there were only public institutions of higher education and these institutions could only admit citizens of the KSA. Today, however, private colleges and universities are allowable under Saudi law, making it possible for foreign students to study in the KSA. The scholarship program for international students was similarly limited in the past, and this has also changed in order to allow and attract international students.

Being a member of a minority group could also affect students’ decision regarding their college major. In fact, the National Science Board (2007) found that it is less likely for minority students to complete their college education in STEM fields compared to their non-minority peers. Chen and Thomas (2009) have also indicated that
it is less likely for minority students to major in STEM fields, and even if they do, they are more likely to switch away from these fields. In the KSA, however, there is no racial or ethnic minority, because the country is racially and ethnically homogenous.

Because of the lack of a racial or ethnic minority in the KSA, gender is the main issue of concern in higher education, and it plays an important role in students’ selection of a college major. In the KSA, women’s preference for careers in education and humanities is a major factor behind the high unemployment rate of women.

Moreover, issues like the initial college experience could also make a difference in the selection of college major. Students may change their educational plans because of these experiences. Griffith (2010) found that students’ undergraduate experiences in STEM field departments were related to their decisions to stay in STEM majors. The same study also showed that receiving good grades in STEM courses was a motivator that can encouraged students to stay in these departments; receiving higher grades in STEM courses during the first year was shown to be positively related to students’ decisions to continue (Griffith, 2010). Griffith also examined the effect of students’ performance in STEM courses and their academic achievement in STEM majors. The second part of this study examined the effect of academic performance in high school on students’ college major selection. In short, it is more likely that students who perform well in high school will also do well in STEM courses.

The relationship between gender and the selection of college major has been an important social and educational topic for a long time. The underrepresentation of women in scientific fields is an issue that has been studied by scholars for more than 30 years (Clewell and Campbell, 2002). Although today’s women are more drawn to
scientific fields than ever before, they are still less likely than men to select a major in some scientific areas such as math and physics. Above all, they are significantly less likely to choose a career in a physical or mathematical science than a medical, educational or social service field (Morgan, Isaac, & Sansone, 2001).

On the other hand, male students seem to have a higher propensity toward scientific majors compared to female students and they have been found to be more interested in physical and mathematical science careers than women (Morgan, Isaac, & Sansone, 2001). It is actually worth noting here that even though students have recently become more interested in STEM majors, this trend does not extend to the physics major. In fact, it has been found that “Physics lags behind the overall growth rate of the undergraduate population” in the United States (Hazari, Sonnert, Sadler & Shanahan, 2010). The 2009 American Community Survey (ACS) found that although women represent 49% of the labor force in the USA, there are only 2,500,000 workingwomen who graduated from STEM fields compared to 6,700,000 men (Beede, Julian, Lagdon, McKittrick, Khan & Doms, 2011).

Although the initial choice of college major is considered an indicator of motivation and commitment toward a degree in this field, there are students who change their minds and steer away from their first choices of college majors toward other areas of interest. Dickson (2010) found that women who initially choose an engineering major were more likely to transfer to another major. Remaining in scientific majors was found to be more difficult for female students than for their male peers, and the National Science Board (2007) reported that women are less likely to continue in STEM majors than men.
Beede et al. (2011) found that women are underrepresented in STEM fields, including college majors and work fields. In their report, they suggested a possible link between the underrepresentation of women in STEM fields and factors, such as gender stereotypes and the lack of female role models, in these fields. They suggest that these two factors might contribute to the underrepresentation of women in STEM jobs and college majors (Beede et al., 2011).

In the United States, Ethington, Smart and Pascarella (1988) studied women’s entry into male-dominated occupations. They found that women’s strong performance in both high school and college inspired them to join science professions dominated by men. They also reported that precollege aspirations encouraged women to join male-dominated science and non-science professions (Ethington et al., 1988).

In addition, the gender of the faculty in science departments could also affect students’ college major decisions. Qian and Zafar (2009) studied the effect of faculty gender in scientific and engineering departments on student choices to pursue these majors. They found a positive relationship between the number of female faculty members and female students, but this was only found in the engineering field. Furthermore, they did not find a similar correlation between male faculty members and male students in female-dominated majors.

Female faculty in engineering departments can be important role models for female students who choose to pursue careers in engineering. Having a role model is essential for female students as well as any other minority groups. Yet when few women pursue advanced degrees in STEM, it is difficult to provide future generations of women with “role models” in these fields.
Ethnicity is a factor that plays a significant role in the college major selections of women in the United States. The National Science Foundation (2011) found that women of color have stronger intentions to join STEM fields in their freshman year than white women. The same study also found that in the year 2008, 29% of first-year Asian Pacific American female students stated that they are interested in majoring in STEM fields as compared to only 13.4% of white American women (National Science Foundation, 2011). In addition, African American women were found to be more positive about science than their white peers (Hanson, 2004).

In summary, college major selection is affected by several social and personal factors. Researchers in the United States have investigated the effects of some of these factors on college major selection among American students and they have ended up with interesting results. Race and ethnicity, for instance, were found to be related to college major selection (Dickson, 2010). Moreover, undergraduates’ experiences in STEM departments were also related to those students’ decisions to stay in STEM majors (Griffith, 2010). Finally, gender is a significant factor that plays a noticeable role on students’ decisions regarding their college major, and research indicates that it is less likely for American women to continue in STEM majors than men (National Science Board, 2007).

**Academic Performance in High School and the Selection of College Major**

High school students should be aware of and prepared for the academic transition to higher education. They should be ready for higher academic requirements as well as advanced courses. Otherwise, they may find it too difficult to deal with college and may not be able to reach their educational dreams. According to Dickson
“Students may differ in their preparation for college work, and this may affect their initial major choice. For example, students may only choose to pursue a major in engineering if they have strong math skills” (p. 109). Performance and preparation are two different words, but they are similar in meaning. Usually, solid preparation leads to solid performance and poor preparation leads to poor performance, so there is a positive relationship between these two terms.

Even though high school is a critical stage in the educational journey, college preparation starts long before this stage, especially when it comes to math and science. Preparing students for STEM programs needs to start as early as middle school (Melguizo & Wolniak, 2012). Otherwise, students may struggle during their college journey, possibly leading them to give up on their educational dreams. For example, students who aspire to be engineers are expected to come to college with a strong performance in science and math, and “students may only choose to pursue a major in engineering if they have strong math skills” (Dickson, 2010, p. 109).

High school GPA is commonly used to measure students’ academic performance in high school, but some countries have admission exams in addition to high school GPA. For instance, in the United States, students take admission exams such as The American College Test (ACT) and the Scholastic Aptitude Test (SAT). Universities in the United States use ACT and SAT scores to determine which students will be granted admission (Cimetta, D'Agostino & Levin, 2010, p. 3).

Similarly in the KSA, there are two required admission exams for postsecondary schools, and these exams are conducted by the National Center of Assessment in Higher Education (NCAHE). The first one, the “Standard Achievement Admission Test
(SAAT),” measures students’ scientific achievements in chemistry, physics, biology, and mathematics and focuses on the official high school material of these scientific areas (NCAHE, 2011). SAAT is only required for students who graduate from scientific schools. On the other hand, the “General Aptitude Test (GAT),” is required of all high school students who want to apply to any higher education institution (NCAHE, 2011). GAT measures “reading comprehension, logical relations, problem-solving behavior, informational abilities, and inducational abilities” (NCAHE, 2011, p. 2).

In the KSA, college admission is based on standardized exam scores and high school GPA, but standardized exams play a bigger role in the admission decision than GPA. SAAT and GAT weigh 70% on the admission scale, whereas GPA weighs only 30% (Siddiek, 2011). The computation among applicants is based on their weighted square measured by their SAAT and GAT scores and their high school GPA, and this weighted square determines student admission across universities and colleges in the KSA.

Thus, poor performance in high school may block students from being admitted into a favorable college major because it will make them less competitive, especially when it comes to demanding majors such as medicine and engineering. In addition, student admission in the KSA is a computation game, so it varies from year to year depending on the number of students who apply to a particular college or major. If there is a small number of applicants, then each student is more likely to be admitted.

Instead of helping students reach their career goals and select the college major they want, this admission policy unfortunately has prevented some students from doing so. There is no doubt about the importance of high school performance, but it should
not completely control students’ college major decisions. Students should always be given the opportunity to correct their mistakes and make up what they have missed.

In short, high school performance plays a significant role in college major choices and there is a relationship between high school preparation and the initial college major selection (Dickson, 2010). Due to the admission policy in countries such as the KSA, high school performance could also control the selection of college major because college admission is a computation game. In the KSA, admission is based on the high school GPA and the two standardized exam scores. Thus, admission in challenging majors such as medicine and engineering requires optimal high school performance. Although high school performance is an important foundation for college education, poor high school performance should never be the end of a student’s dreams.

Summary

In regard to the KSA, there are unfortunately a limited number of studies discussing the relationship between social factors and college major selection. Additionally, there are no studies that explore the relationship between gender and college major selection. Thus, this study inquires into the selection of college majors among male and female students in the KSA. It pursues, however, a different approach in discussing the issue. Unfortunately, the few researchers who have discussed or mentioned the issue of gender and college major choices among Saudi students usually spend their efforts criticizing the way Saudi women live, study, and work. According to Walker (2004), “Saudi is many times presented as ‘the land of the veil’ … [with] slave women whose sole purpose in life is to serve men,” and that there is a “lack of literature illustrating and exploring life for women in Saudi” (p.27).
This is actually what motivated me to conduct this study. I hope it is a source of knowledge for any researcher who wants to learn about higher education, particularly college major selection among female and male students in the KSA. Moreover, the reason why this study focused on the selection of sciences majors is because these fields represent most of the available opportunities in the job market not only in the KSA, but also in most of the countries across the world. More specifically, this study aimed to examine the relationship between student gender and the choice of college major among college students in the KSA. The study also looked at the relationship between high school performance and college major based on students’ gender.
CHAPTER III

METHODOLOGY

Introduction

In this chapter, the research questions, hypotheses, and research design are explained. This chapter also includes information about the participants, sampling, and data collection of the study. Finally, the method of data analyses of the study is explained. The study aimed to describe the relationship between student gender and the choice of college major among college students in the KSA. In addition, this study looked at the relationship between high school performance and college major based on student gender.

Research Questions and Hypotheses

The study inquired into the following research questions:

First Research Question

1. Is there a relationship between gender and college major selection among college students in the KSA?

Second Research Question

2. Are there significant differences in high school performance (measured by SAAT, GAT, and high school GPA) among college students in the KSA with different college majors while taking students’ gender into consideration?
Based on these two research questions, the following four hypotheses were formulated:

\( H_{01} \): There is no relationship between the selection of college major and gender among students in the KSA.

\( H_{02} \): There are no significant differences in the average SAAT score among college students in the KSA with different college majors while taking students’ gender into consideration.

\( H_{03} \): There are no significant differences in the average GAT score among college students in the KSA with different college majors while taking students’ gender into consideration.

\( H_{04} \): There are no significant differences in the average high school GPA among college students in the KSA with different college majors while taking students’ gender into consideration.

The first hypothesis addressed the first research question and the remaining three hypotheses addressed the second research question. The last three hypotheses were tested three times, once for each measure of high school performance (SAAT, GAT and high school GPA).

**Research Design**

This study compared female and male students in the KSA by their selection of college majors. It also compared students from different college majors by their high school academic performance. In the KSA, there are three measures for students’ academic performance in high school: SAAT, GAT, and high school GPA. These three measures were the dependent variables in this study. Meanwhile, students’ genders and
college majors were the independent variables. These five variables were used in the analysis.

The relationship between students’ gender and their college major selection was established by the cross-classification of students using these two variables (gender and college major). Relationship between students’ college majors, gender, and academic performance was analyzed using a two-by-four factors analysis of variance (ANOVA), where the two factors are students’ gender and students’ college major. The two factors ANOVA allowed for the determination of whether there were any significant differences among students from different college majors in each one of the three high school academic performance measures and whether those differences were dependent on students’ gender.

Comparing the students from different college majors in the KSA by different outcomes clearly fit the definition of a comparative study. Thus, group comparison research was the appropriate design to be used in this study. This design is defined by Gall, Gall and Borg (2010) as being inclusive of:

Empirical, quantitative studies that either (1) compare groups that differ on the independent variable to determine whether they also differ on the dependent variable or (2) compare groups that differ on the dependent variable to determine whether they also differ on the independent variable. (p. 243)

Group comparison research design attempts to determine the consequences of the differences that already exist among groups of people. So the key point is that the differences among groups have already occurred or existed. This research design is used “when the independent variable involves a personal or group characteristic that cannot be manipulated. Some researchers refer to these variables as fixed variables, because
they cannot be changed by the researchers or other groups” (Gall et al., 2010, p. 246).

Data for this study came from the university database in which differences among students had already occurred, and over which the current researcher had no control. Both of the two independent variables of this study, students’ gender and college major, were considered “fixed variables.”

Some clarification is useful to distinguish the process and effects of experimental design and survey research from group comparison research design as used here. Experimental research examines cause and effect relationships between one or more manipulated independent variables and a dependent variable. In experimental research, the researcher usually decides the nature of the independent variables (treatments), participant to whom variables will be applied, and to what extent. Unlike group comparison research, experimental researchers have the ability to manipulate one variable to examine its effect on another variable. Although group comparison research is often used to explore a possible cause-and-effect relationship, it does not confirm results to the same degree as experimental research (Gall et al., 2010).

There is also a major difference between group comparison research and survey research, and this difference appears in the collection of data. Survey research involves collecting information from a group of people in order to describe some aspects or characteristics (i.e., opinion, attitude and/or beliefs) of the population of which that group is a part. The main way in which the information is collected is by asking questions. The answers to these questions, by members of the group, constitute the data of the study. This study was not a survey, as data for this study did not come from
surveying the students about their opinion, attitude, believes or any similar type of information (Fraenkel, Wallen, & Hyun, 2009).

Participants in the Study

Target Population

This study was conducted at a public university in the KSA. The university is located in the geographic center of the KSA. The name “public university” is used for the purpose of anonymity. This public university is one of the largest universities in the KSA with over 500,000 students. It offers degrees in most of the scientific and theoretical fields at both the undergraduate and graduate levels.

Accessible Population

The accessible population included all college students who met the criteria to be included in the study (Gall et al., 2010). Thus, the accessible population of this study constituted all students who had started their undergraduate programs in either the fall of 2010 or the spring of 2011 in the college of science at the public university.

Sample

According to Wiersma and Jurs (2009), “A sample is a subset of the population to which the research intends to generalize the results.” Thus, the sampling technique has a clear effect on both the quality and the inferences of the study (Mertens, 1998). There were more than 2,800 male and female students in the selected public university’s college of science. A total of 568 students, 287 female and 281 male, made up the sample for the study. Students were majored in mathematics, chemistry, physics, or natural sciences. They had all started their undergraduate programs either in the fall of
2010 or the spring of 2011. Thus, by the time the data was received, all participants of this study had finished three or four academic semesters.

The freshman year for science students at this public university is called the “preparatory year of natural science.” Students are not allowed to select a specific science major until they successfully finish this year. Students who had not successfully finished the “preparatory year of natural science” were identified as having a “natural sciences” major. There were a total of 217 students, 90 female and 127 male, whose majors were labeled as “natural sciences.” Data preparation and cleaning were minimal due to well-kept student records at the university. Only three female students and one male student were deleted from the original data as they had missing values on their high school performance measures.

Data Collection

Records needed for this study were kept in a database at the selected public university. The database provided the study with a relatively large sample and very accurate data. A letter emphasizing the importance and usefulness of this study for both the university and the educational sector in the KSA was sent to the “Vice President for Planning and Development and Quality” of the KSA University who, in turn, granted the permission to access the database for this study.

The data were received in two Excel files. The first file included the data for female students, and the second file included the data for male students. Each of the files had the information of all science majors who attended science majors at the public university in the spring of 2012. The first three numbers of the student IDs at the university were used to identify the year and semester in which the student was
registered at the university (using the Islamic calendar, the official calendar in the KSA). The first two numbers of students IDs referred to the Islamic calendar year and the third number referred to the semester in which a student was registered at the university. For instance, an ID number that started with 3-1-1 referred to a student who registered for the fall semester of the year 1431 in the Islamic calendar. That is equivalent to the fall of 2010. Thus, any student with a student ID that started with 3-1-1 indicated that he or she entered the university in the fall of 2010. This structure of the student ID was used in order to draw the sample of this study from the larger population. The sample of this study included all of the students who started the “preparatory year of natural science” in the fall of 2010 and the spring of 2011.

**Limitations**

This investigation used data from a public university that is located in the geographic center of the KSA. Aside from the many advantages, there were several limitations in this study. First was the limitation of time, as the sample of this study only included students who had started their undergraduate programs in either the fall of 2010 or the spring of 2011 in the public university’s college of science. Second was the limitation of place, as the sample of this study only represented students from one university located in the geographic center of the KSA. Finally, the limitation of college major, as the study only represented the four science majors that are available in the college of science at the selected public university (mathematics, chemistry, physics, and natural sciences).
Method of Data Analysis

All of the statistical tests in this study were carried with a probability of committing type one error alpha level of $\alpha = 0.05$. A student’s version 18 of SPSS software was used to analyze the data for this study. To address the first research question of the study, which asks, “Is there a relationship between gender and the selection of college major among college students in the KSA?” there was an analysis of cross-tabulation with a chi-square test for the null hypothesis:

$H_{01}$: There is no relationship between the selection of college major and gender among students in the KSA.

According to Privitera (2012), a chi-square test is a statistical tool that can be used to determine the relationship between two categorical variables. If no relationship exists between students’ gender and their college major selections, one would expect the proportions of female and male students within each college major to be about the same and any differences in these proportions to be an artifact of the selected sample and thus insignificant. If, however, students’ gender does relate to students’ college major selections, then, based on the specific college major, one would expect to see a different percentage of female students than male students. This suggests that female students prefer certain college majors as compared to male students and vice versa. Thus, given the gender of a student, one can predict the likelihood of the college major the student might select.

To address the second research question of the study, which asks, “Are there significant differences in high school performance (measured by SAAT, GAT, and high school GPA) among college students in the KSA with different college majors while
taking students’ gender into consideration?” a two-by-four two factorial analysis of variance (ANOVA) procedure was used three times, once for each one of the three high school academic performance measures (SAAT, GAT, and high school GPA). In addition, summary statistics (means, standard deviations and sample sizes) were used to provide a general description of the data. According to Privitera (2012), the two-factorial analysis of variance is a tool that could be used to investigate the main effect of two independent variables and their interaction with a dependent variable (student performance in high school). In this study, SAAT, GAT, and high school GPA were the three dependent variables (DVs) that were used in the ANOVA. For each of the high school academic performance measures, the ANOVA procedure tested the following hypothesis:

\[ H_{02} \]: There are no significant differences in the average SAAT score among college students in the KSA with different college majors while taking students’ gender into consideration.

An F-test for the above hypothesis addressed the marginal differences among college students from the four different college majors in the public university. A significant F-test with a probability of 0.05 or less of committing type one error indicated that, on average, students from different college majors were significantly different in the population in terms of their specific high school academic performance measure.

\[ H_{03} \]: There are no significant differences in the average GAT score among college students in the KSA with different college majors while taking students’ gender into consideration.
A second F-test for testing hypothesis $H_{03}$ addressed the marginal differences between female and male college students in the public university. A significant F-test with a probability of 0.05 or less of committing type one error indicated that, on average, female students were significantly different from male students in the population in their specific high school academic performance measure.

$H_{04}$: There are no significant differences in the average high school GPA among college students in the KSA with different college majors while taking students’ gender into consideration.

A third and final F-test for testing hypothesis $H_{04}$ addressed the differences among college students from the four different college majors within each of the female and male groups of students at the KSA University. A significant F-test with a probability of 0.05 or less of committing type one error indicated that, on average, significant differences in specific high school academic performance measures depended on student gender among the students of different college majors. Table 1 summarizes the type of analysis and tests procedures that were used to address the two research questions of this study.
Table 1. Analysis Procedures

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>DVs</th>
<th>IVs</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_{01}$</td>
<td>Major</td>
<td>Gender</td>
<td>Chi-square test of independence</td>
</tr>
<tr>
<td>$H_{02}$</td>
<td>SAAT</td>
<td>College major</td>
<td>Two-way ANOVA/ F-test</td>
</tr>
<tr>
<td>$H_{03}$</td>
<td>GAT</td>
<td>Students’ Gender</td>
<td>Two-way ANOVA/ F-test</td>
</tr>
<tr>
<td>$H_{04}$</td>
<td>GPA</td>
<td>Major by Gender</td>
<td>Two-way ANOVA/ F-test</td>
</tr>
</tbody>
</table>

The F-test in analysis of variance is simply a ratio of an estimated variability among groups’ means to the estimated variability of the scores within the groups. For example, an F-test for testing the differences among students from different college majors on their SAAT scores is the ratio of the estimated variance among the means of the SAAT scores from the different college majors to the estimated variance in SAAT scores of all students across all majors. Typically, the larger the F-ratio, for given degrees of freedom, the more likely it is that one would find significant differences among groups.

Answering the second research question of this study required running a two factors ANOVA three times, one for each of the three measures (SAAT, GAT and GPA) of students’ academic achievement. The interaction between students’ college major and their gender provided key information to the answer of the second research question. When the interaction between college major and students’ gender was statistically significant, a post-hoc analysis for the college major effect students’
academic achievement, measured by any of the three measures SAAT, GAT, and GPA, was presented in combination with students’ gender. A post-hoc analysis with the calculation of the effect sizes pinpointed how students from different college majors differed in academic achievement based on their gender. When the interaction between college major and students’ gender were found not to be statistically significant, it signified that differences in academic achievement, measured by any of the three measures (SAAT, GAT, and GPA), across college majors were similar for male and female students. With absence of a significant interaction, the results for the college major’s main effect was reported with a post-hoc analysis and effect sizes to further explain these differences.
CHAPTER IV

RESULTS

Introduction

The main aim of this chapter is to present the results of this study. It includes a general description of the three measures of students’ academic performance in high school (SAAT, GAT, and high school GPA), and an analysis of the first research question, which is about the relationship between students’ gender and their college major selection. To address this question, the analysis of cross-tabulation with a chi-square test was used to test the following null hypothesis:

\[ H_{01} : \text{There is no relationship between the selection of college major and gender among students in the KSA.} \]

The second research question examined whether students from different college majors differed in their academic performance in high school and whether these differences were associated with students’ gender. To address this question, a two-by-four two factorial analysis of variance (ANOVA) procedure was used three times, once for each of the three high school academic performance measures (SAAT, GAT, and high school GPA). The ANOVA procedures were used to test the following three hypotheses:
\( H_{02} \): There are no significant differences in the average SAAT score among college students in the KSA with different college majors while taking students’ gender into consideration.

\( H_{03} \): There are no significant differences in the average GAT score among college students in the KSA with different college majors while taking students’ gender into consideration.

\( H_{04} \): There are no significant differences in the average high school GPA among college students in the KSA with different college majors while taking students’ gender into consideration.

The interaction between students’ college major and their gender provided key information to the answer of the second research question. When the interaction between college major and students’ gender was statistically significant, a post-hoc analysis for the college major effect students’ academic achievement, measured by any of the three measures (SAAT, GAT, and GPA), was presented in combination with students’ gender. A post-hoc analysis with the calculation of the effect sizes pinpointed how students from different college majors differed in academic achievement based on their gender. Table 2 presents the distributions of the SAAT scores within each major for male and female students.
Table 2. General Description for SAAT Scores

<table>
<thead>
<tr>
<th>Sex</th>
<th>Major</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Chemistry</td>
<td>64.66</td>
<td>67</td>
<td>6.839</td>
<td>.950</td>
<td>1.924</td>
</tr>
<tr>
<td></td>
<td>Mathematics</td>
<td>68.64</td>
<td>75</td>
<td>6.655</td>
<td>.122</td>
<td>.537</td>
</tr>
<tr>
<td></td>
<td>Natural Sciences</td>
<td>60.84</td>
<td>89</td>
<td>4.605</td>
<td>.115</td>
<td>-.560</td>
</tr>
<tr>
<td></td>
<td>Physics</td>
<td>64.32</td>
<td>56</td>
<td>6.968</td>
<td>.762</td>
<td>.393</td>
</tr>
<tr>
<td>Male</td>
<td>Chemistry</td>
<td>65.37</td>
<td>70</td>
<td>4.450</td>
<td>.247</td>
<td>.008</td>
</tr>
<tr>
<td></td>
<td>Mathematics</td>
<td>63.61</td>
<td>79</td>
<td>4.637</td>
<td>.878</td>
<td>2.631</td>
</tr>
<tr>
<td></td>
<td>Natural Sciences</td>
<td>62.01</td>
<td>127</td>
<td>4.688</td>
<td>.191</td>
<td>.073</td>
</tr>
<tr>
<td></td>
<td>Physics</td>
<td>64.60</td>
<td>5</td>
<td>2.191</td>
<td>.846</td>
<td>1.745</td>
</tr>
</tbody>
</table>

The male-natural sciences group had the largest (N = 127) number of students and the male-physics group had the smallest (N = 5) number of students. The number of students in the remaining groups ranged from 56 to 89. Standard deviations tended to vary from 2.191 for the male-physics group to 6.968 for female-physics group with most hovering around the 4.5 standard deviation value. The distributions tended to meet the level of skewness and kurtosis to declare them as normal except for male-mathematics, where its kurtosis was 2.631, which is greater than the tolerant level of 2.0. Table 3 presents the distributions of the GAT scores within each major for male and female students.
Table 3. General Description for GAT Scores

<table>
<thead>
<tr>
<th>Sex</th>
<th>Major</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Chemistry</td>
<td>66.57</td>
<td>67</td>
<td>6.900</td>
<td>.560</td>
<td>-.237</td>
</tr>
<tr>
<td></td>
<td>Mathematics</td>
<td>69.51</td>
<td>75</td>
<td>7.133</td>
<td>-.101</td>
<td>.639</td>
</tr>
<tr>
<td></td>
<td>Natural Sciences</td>
<td>65.73</td>
<td>89</td>
<td>4.938</td>
<td>.192</td>
<td>-.170</td>
</tr>
<tr>
<td></td>
<td>Physics</td>
<td>67.45</td>
<td>56</td>
<td>6.744</td>
<td>.239</td>
<td>-.396</td>
</tr>
<tr>
<td>Male</td>
<td>Chemistry</td>
<td>69.64</td>
<td>70</td>
<td>6.290</td>
<td>-.008</td>
<td>-.326</td>
</tr>
<tr>
<td></td>
<td>Mathematics</td>
<td>68.96</td>
<td>79</td>
<td>6.307</td>
<td>.943</td>
<td>1.020</td>
</tr>
<tr>
<td></td>
<td>Natural Sciences</td>
<td>67.28</td>
<td>127</td>
<td>6.333</td>
<td>.706</td>
<td>.314</td>
</tr>
<tr>
<td></td>
<td>Physics</td>
<td>68.40</td>
<td>5</td>
<td>4.722</td>
<td>.105</td>
<td>1.013</td>
</tr>
</tbody>
</table>

Table 3 presents distributions of the GAT scores within each major for male and female students. Standard deviations tended to vary from 4.722 for the male-physics group and 4.938 for the female-natural sciences group, to 7.133 for female-mathematics group, and around a 6.00 standard deviation value for the remaining groups. The distributions tended to meet the level of skewness and kurtosis to declare them as normal; none of these values was greater than 2 or less than -2.

Table 4 presents distributions of the high school GPA within each major for male and female students. Standard deviations tended to vary from 2.581 for the male-physics group to 6.468 for the male-natural sciences group and 6.247 for the female-natural sciences group. On the other hand, the standard deviation for the remaining groups was around a 4.00 standard deviation value.
Table 4. General Description for High School GPA

<table>
<thead>
<tr>
<th>Sex</th>
<th>Major</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Chemistry</td>
<td>95.64</td>
<td>67</td>
<td>3.631</td>
<td>-1.097</td>
<td>.552</td>
</tr>
<tr>
<td></td>
<td>Mathematics</td>
<td>96.68</td>
<td>75</td>
<td>4.052</td>
<td>-2.094</td>
<td>5.381</td>
</tr>
<tr>
<td></td>
<td>Natural Sciences</td>
<td>91.65</td>
<td>89</td>
<td>6.247</td>
<td>-.903</td>
<td>.160</td>
</tr>
<tr>
<td></td>
<td>Physics</td>
<td>95.05</td>
<td>56</td>
<td>4.222</td>
<td>-1.382</td>
<td>3.038</td>
</tr>
<tr>
<td>Male</td>
<td>Chemistry</td>
<td>94.62</td>
<td>70</td>
<td>3.869</td>
<td>-.577</td>
<td>-.498</td>
</tr>
<tr>
<td></td>
<td>Mathematics</td>
<td>92.55</td>
<td>79</td>
<td>4.727</td>
<td>-.456</td>
<td>-.806</td>
</tr>
<tr>
<td></td>
<td>Natural Sciences</td>
<td>89.47</td>
<td>127</td>
<td>6.468</td>
<td>-.452</td>
<td>-.403</td>
</tr>
<tr>
<td></td>
<td>Physics</td>
<td>94.99</td>
<td>5</td>
<td>2.581</td>
<td>-1.698</td>
<td>3.064</td>
</tr>
</tbody>
</table>

The distributions tended to meet the level of skewness and kurtosis to declare them as normal except for: (a) female-mathematics, where its skewness was 2.094 and its kurtosis was 5.381, (b) female-physics, where its kurtosis was 3.038, and (c) male-physics, where its kurtosis was 3.064. Table 5 presents the distributions of female and male students among the four science majors.

Table 5. Distribution of Female and Male Students Among the Four Science Majors

<table>
<thead>
<tr>
<th>Gender</th>
<th>Physics</th>
<th>Mathematics</th>
<th>Chemistry</th>
<th>Natural Sciences</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Male</td>
<td>5</td>
<td>1.8</td>
<td>79</td>
<td>28.1</td>
<td>70</td>
</tr>
<tr>
<td>Female</td>
<td>56</td>
<td>19.5</td>
<td>75</td>
<td>26.1</td>
<td>67</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>10.7</td>
<td>154</td>
<td>27.1</td>
<td>137</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>281</td>
<td>50.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>287</td>
<td>49.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>568</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hypothesis Testing Results

Table 6 presents the result of the cross tabulation analysis between students’
gender and their choice of college major.

Table 6. Result of the Cross-Tabulation Analysis between Students’ Gender and their
Choice of College Major

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person Chi-Square</td>
<td>49.436</td>
<td>3</td>
<td>.000</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>56.797</td>
<td>3</td>
<td>.000</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>568</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The first research question in this study explored the relationship between
students’ gender and their choice of college major. The result of the cross tabulation
analysis between students’ gender and their college major choice suggested that there
was a significant relationship between these two variables with ($\chi^2 = 49.44$) and $p < 0.000$ (see Table 6 above). The chi-square test indicated that there was a statistical
difference in the proportion of college major selection between female and male
students.

The second research question investigated the relationship between students’
college major choice, gender, and academic performance in high school as measured by
the SAAT, GAT, and high school GPA. More specifically, the question examined
whether students from different college majors differ in high school academic
performance and whether these differences were associated with students’ gender. This
question was addressed by the following three hypotheses.
$H_{02}$: There are no significant differences in the average SAAT score among college students in the KSA with different college majors while taking students’ gender into consideration.

$H_{03}$: There are no significant differences in the average GAT score among college students in the KSA with different college majors while taking students’ gender into consideration.

$H_{04}$: There are no significant differences in the average high school GPA among college students in the KSA with different college majors while taking students’ gender into consideration.

These three hypotheses were tested three times, once for each of the three measures of high school academic performance: SAAT, GAT, and high school GPA.

**Descriptive Statistics and Data Distribution**

*Analysis for SAAT*

Table 2, shown earlier, provided descriptive statistics (means, standard deviations, skewness, and kurtosis) for SAAT as one of the measures of high school academic performance across college majors broken down by students’ gender. Table 7 presents the analysis of variance for the SAAT score.

SAAT was used as one of the three measures of students’ performance in high school, and the result of analyzing this measure was used to answer the second research question. Particularly, the second hypothesis addressed the differences among students with different college majors in their SAAT scores (there are no significant differences on the average SAAT score among college students in the KSA with different college majors while taking students’ gender into consideration).
### Table 7. Analysis of Variance for SAAT Score

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>3</td>
<td>24.787</td>
<td>.000</td>
</tr>
<tr>
<td>Gender</td>
<td>1</td>
<td>.942</td>
<td>.332</td>
</tr>
<tr>
<td>Major * Gender</td>
<td>3</td>
<td>10.894</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>560</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>568</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The hypothesis that there is no significant effect between college major and student gender on SAAT scores was rejected because there was an interactive effect on their SAAT scores, F (3.560) = 10.894 with p < 0.000. SAAT scores among students from different majors were different for female and male students. Figure 1 shows that difference in SAAT scores among female students from different college majors were different from those of male students.

Because the interaction is different, cell effect needed to be examined by the combination of students’ gender with the four college majors. This resulted in eight (2X4=8) cells to conduct a cell group comparison. The results of the multiple group comparison of variance (students’ gender by students’ major) showed significant differences in SAAT scores for students from the four different majors depending on their gender. Tukey’s post-hoc analysis helped detect and uncover any patterns of these differences and relationships that the general F-test for the interaction could not.
Figure 1. Interaction Effect Between College Major and Gender on SAAT Scores

Effect sizes are also reported for the significant contrasts to further understand groups’ comparisons (see Table 9 below). Table 8 listed below presents the Tukey post-hoc means comparison with a significant level for SAAT scores across college majors by students’ gender.

Table 9 presents the effect sizes for only the significant post-hoc means comparisons for SAAT scores across college majors by students’ gender. Table 8 presents the 28 [(8X7)/2] pair-wise mean differences and their statistical significance among the eight cell means from the two-way analysis of variance. It also presents effect sizes for the significant contrasts. All significant contrasts had medium to large effect sizes. The smallest effect size for significant contrast was 0.48 for comparing female chemistry majors to male natural sciences majors.
Table 8. Tukey Post-hoc Means Comparison (M.C) with Significant Level (Sig) for SAAT Scores across College Majors by Students’ Gender

<table>
<thead>
<tr>
<th>Posttest</th>
<th>M_Math</th>
<th>F_Ch</th>
<th>M_Ch</th>
<th>F-Ph</th>
<th>M_Ph</th>
<th>F-NS</th>
<th>M_NS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sig</td>
<td>0.000</td>
<td>0.000</td>
<td>0.008</td>
<td>0.000</td>
<td>0.750</td>
<td>0.000</td>
</tr>
<tr>
<td>M_Math</td>
<td>M.C</td>
<td>1.049</td>
<td>1.764</td>
<td>0.714</td>
<td>0.992</td>
<td>2.772</td>
<td>1.600</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.944</td>
<td>0.506</td>
<td>0.995</td>
<td>1.00</td>
<td>0.024</td>
<td>0.454</td>
</tr>
<tr>
<td>F_Ch</td>
<td>M.C</td>
<td>0.715</td>
<td>0.335</td>
<td>0.057</td>
<td>3.821</td>
<td>2.649</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.995</td>
<td>1.00</td>
<td>1.00</td>
<td>0.000</td>
<td>0.030</td>
<td></td>
</tr>
<tr>
<td>M_Ch</td>
<td>M.C</td>
<td>1.050</td>
<td>0.777</td>
<td>4.535</td>
<td>3.364</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.962</td>
<td>1.00</td>
<td>0.000</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F_Ph</td>
<td>M.C</td>
<td>0.279</td>
<td>3.485</td>
<td>2.314</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>1.00</td>
<td>0.005</td>
<td>0.144</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M_ph</td>
<td>M.C</td>
<td>3.764</td>
<td>2.592</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.808</td>
<td>0.968</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F_NS</td>
<td>M.C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.172</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.779</td>
</tr>
</tbody>
</table>

The largest effect size was 1.384 for comparing female math majors to female natural sciences majors. Then 1.206, which was the effect size for comparing female math majors with male natural sciences majors. The effect size for female math majors compared to male math majors was 0.881, and the effect size for comparing male chemistry majors and female natural sciences majors was also considered a large effect size.
Table 9. Effect Sizes for only the Significant Post-hoc Means Comparisons for SAAT Scores across College Majors by Students’ Gender

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
<th>Mean1</th>
<th>SD1</th>
<th>Mean2</th>
<th>SD2</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-Math</td>
<td>M-Math</td>
<td>68.64</td>
<td>6.655</td>
<td>63.61</td>
<td>4.637</td>
<td>0.881</td>
</tr>
<tr>
<td>F-Math</td>
<td>F-Ch</td>
<td>68.64</td>
<td>6.655</td>
<td>64.44</td>
<td>6.839</td>
<td>0.590</td>
</tr>
<tr>
<td>F-Math</td>
<td>M-Ch</td>
<td>68.64</td>
<td>6.655</td>
<td>65.37</td>
<td>4.450</td>
<td>0.574</td>
</tr>
<tr>
<td>F-Math</td>
<td>F-Ph</td>
<td>68.64</td>
<td>6.655</td>
<td>64.32</td>
<td>6.968</td>
<td>0.636</td>
</tr>
<tr>
<td>F-Math</td>
<td>F-NS</td>
<td>68.64</td>
<td>6.655</td>
<td>60.84</td>
<td>4.605</td>
<td>1.384</td>
</tr>
<tr>
<td>F-Math</td>
<td>M-NS</td>
<td>68.64</td>
<td>6.655</td>
<td>62.01</td>
<td>4.688</td>
<td>1.206</td>
</tr>
<tr>
<td>M-Math</td>
<td>F-NS</td>
<td>60.84</td>
<td>4.605</td>
<td>60.84</td>
<td>4.605</td>
<td>0.599</td>
</tr>
<tr>
<td>F-Ch</td>
<td>F-NS</td>
<td>64.44</td>
<td>64.44</td>
<td>60.84</td>
<td>4.605</td>
<td>0.673</td>
</tr>
<tr>
<td>F-Ch</td>
<td>M-NS</td>
<td>64.44</td>
<td>64.44</td>
<td>62.01</td>
<td>4.688</td>
<td>0.480</td>
</tr>
<tr>
<td>M-Ch</td>
<td>F-NS</td>
<td>65.37</td>
<td>4.450</td>
<td>60.84</td>
<td>4.605</td>
<td>0.998</td>
</tr>
<tr>
<td>M-Ch</td>
<td>M-NS</td>
<td>65.37</td>
<td>4.450</td>
<td>62.01</td>
<td>4.688</td>
<td>0.730</td>
</tr>
<tr>
<td>F-Ph</td>
<td>F-NS</td>
<td>64.32</td>
<td>6.968</td>
<td>60.84</td>
<td>4.605</td>
<td>0.618</td>
</tr>
</tbody>
</table>

Note: All effect sizes were calculated by subtracting the group2 means from the group1 means divided by the pooled standard deviations.

**Analysis for GAT**

Table 3, which was presented earlier, provides descriptive statistics (means and standard deviations) for the dependent variable GAT across college majors and student genders. GAT was one of the three measures of students’ performance in high school, and the result of analyzing this measure was used to answer the second research question. Particularly, the third hypothesis addressed the differences in GAT scores among students with different college majors (there are no significant differences in the average GAT score among college students in the KSA with different college majors)
while taking students’ gender into consideration). Table 10 listed below presents the analysis of variance for GAT scores.

Table 10. Analysis of Variance for GAT Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>3</td>
<td>5.623</td>
<td>.001</td>
</tr>
<tr>
<td>Gender</td>
<td>1</td>
<td>2.156</td>
<td>.143</td>
</tr>
<tr>
<td>Major * Gender</td>
<td>3</td>
<td>2.010</td>
<td>.111</td>
</tr>
<tr>
<td>Error</td>
<td>560</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>568</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above hypothesis was accepted. Table 10 shows that there was no significant interaction effect differences among students from different college majors in their GAT scores, F (3,560) = 2.01 and p < 0.111 between students’ college major and their gender on GAT scores. The differences in GAT scores among students from different college majors did not depend on their gender. Therefore, Table 8 shows significant differences in GAT scores among students from different college majors, F (3,560) = 5.623 and p < 0.001. This indicated that, on average, there were significant differences in GAT scores among students from different college majors.

Figure 2 depicts the differences among students with different college majors by their GAT scores. One can see that the largest gap in GAT scores was between mathematics majors and natural science majors. Tukey’s post-hoc means comparison further identified and confirmed the differences in GAT scores among students across college majors. Table 11 listed below presents the Tukey’s post-hoc means comparison with a significant level for GAT scores across college majors.
Figure 2. Interaction Effect Between College Major and Gender on GAT Scores

Table 11. Tukey’s Post-hoc Means Comparison (M.C) with Significant Level (Sig) for GAT Scores across College Majors

<table>
<thead>
<tr>
<th>Posttest</th>
<th>Mathematics</th>
<th>Natural Sciences</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>M.C</td>
<td>1.09</td>
<td>1.49</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.462</td>
<td>0.137</td>
</tr>
<tr>
<td>Mathematics</td>
<td>M.C</td>
<td>2.58</td>
<td>1.70</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.001</td>
<td>0.287</td>
</tr>
<tr>
<td>Natural Sciences</td>
<td>M.C</td>
<td></td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td></td>
<td>0.774</td>
</tr>
</tbody>
</table>

Table 11 shows that the only significant differences on GAT scores was between students majoring in mathematics and those majoring in natural sciences with an effect size of .417.
Analysis for High School GPA

Table 4, above, provides descriptive statistics (means and standard deviations) for the dependent variable high school GPA across college major and students’ gender. The table shows that female mathematics majors had the highest mean (M = 96.679 & SD = 4.052) and male natural sciences majors had the lowest mean (M = 89.468 & SD = 6.468). Table 12 presents the analysis of variance for high school GPA.

Table 12. Analysis of Variance for High School GPA

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>3</td>
<td>29.958</td>
<td>.000</td>
</tr>
<tr>
<td>Gender</td>
<td>1</td>
<td>7.183</td>
<td>.008</td>
</tr>
<tr>
<td>Major * Gender</td>
<td>3</td>
<td>2.660</td>
<td>.047</td>
</tr>
<tr>
<td>Error</td>
<td>560</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>568</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

High school GPA is one of the three measures of students’ performance in high school, and the result of analyzing this measure was used to answer the second research question, particularly the fourth hypothesis that addressed the differences among students with different college majors in their high school GPA (there are no significant differences in the average high school GPA among college students in the KSA with different college majors while taking students’ gender into consideration).

The hypothesis that there is no significant effect between college majors and student gender on high school GPA was rejected because there was an interactive effect on high school GPA, F (3,560) = 2.660 with p < 0.047. High school GPA among students from different majors was different for female and male students. Figure 3
shows that differences in high school GPA among female students from different college majors were different from those for male students.

Figure 3. Differences across Majors within Students Gender for High School GPA

Because the interaction is different, cell effect needed to be examined by the combination of students’ gender with four college majors, resulting in eight (2X4=8) cells to conduct a cell group comparison. The results of the multiple group comparison of variance (students’ gender by students’ major) showed significant differences in high school GPA for students from the four different majors depending on their gender. Tukey’s post-hoc analysis helped detect and uncover any patterns of these differences and relationships that the general F-test for the interaction could not. Effect sizes were reported for the significant contrasts to further understand group comparisons. Table 13 listed below presents the Tukey’s post-hoc means comparison for high school GPA with their significant level across college majors based on students’ gender.
Table 13. Tukey’s Post-Hoc Means Comparison (M.C) for High School GPA with their Significant Level (Sig) across College Majors Based on Students’ Gender

<table>
<thead>
<tr>
<th>Posttest</th>
<th>M_Math</th>
<th>F_Ch</th>
<th>M_Ch</th>
<th>F-Ph</th>
<th>M_Ph</th>
<th>F-NS</th>
<th>M_NS</th>
</tr>
</thead>
<tbody>
<tr>
<td>F_Math</td>
<td>M.C</td>
<td>4.128</td>
<td>1.038</td>
<td>2.056</td>
<td>1.629</td>
<td>1.692</td>
<td>5.032</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.000</td>
<td>0.929</td>
<td>0.231</td>
<td>0.615</td>
<td>0.996</td>
<td>0.000</td>
</tr>
<tr>
<td>M_Math</td>
<td>M.C</td>
<td>3.090</td>
<td>2.072</td>
<td>2.499</td>
<td>2.435</td>
<td>0.904</td>
<td>3.083</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.007</td>
<td>0.209</td>
<td>0.096</td>
<td>0.969</td>
<td>0.946</td>
<td>0.001</td>
</tr>
<tr>
<td>F_Ch</td>
<td>M.C</td>
<td>1.019</td>
<td>0.592</td>
<td>0.655</td>
<td>3.994</td>
<td>6.174</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.941</td>
<td>0.998</td>
<td>1.000</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>M_Ch</td>
<td>M.C</td>
<td>0.427</td>
<td>0.363</td>
<td>2.975</td>
<td>5.155</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>1.000</td>
<td>1.000</td>
<td>0.007</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F_Pha</td>
<td>M.C</td>
<td>0.064</td>
<td>3.403</td>
<td>5.581</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>1.000</td>
<td>0.846</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M_ph</td>
<td>M.C</td>
<td>3.339</td>
<td>5.518</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>0.846</td>
<td>0.257</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F_NS</td>
<td>M.C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.179</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.043</td>
</tr>
</tbody>
</table>

Table 14 presents the effect sizes for the significant post-hoc means comparisons for high school GPA across college majors by students’ gender.
Table 14. Effect Sizes for the Significant Post-hoc Means Comparisons for High School GPA across College Majors by Students’ Gender

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group2</th>
<th>Mean1</th>
<th>SD1</th>
<th>Mean2</th>
<th>SD2</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-Math</td>
<td>M-Math</td>
<td>96.68</td>
<td>4.052</td>
<td>92.55</td>
<td>4.727</td>
<td>0.936</td>
</tr>
<tr>
<td>F-Math</td>
<td>F-NS</td>
<td>96.68</td>
<td>4.052</td>
<td>91.65</td>
<td>6.247</td>
<td>0.939</td>
</tr>
<tr>
<td>F-Math</td>
<td>M-NS</td>
<td>96.68</td>
<td>4.052</td>
<td>89.47</td>
<td>6.468</td>
<td>1.266</td>
</tr>
<tr>
<td>M-Math</td>
<td>F-Ch</td>
<td>92.55</td>
<td>4.727</td>
<td>95.64</td>
<td>3.631</td>
<td>-0.725</td>
</tr>
<tr>
<td>M-Math</td>
<td>M-NS</td>
<td>92.55</td>
<td>4.727</td>
<td>89.47</td>
<td>6.468</td>
<td>0.526</td>
</tr>
<tr>
<td>F-Ch</td>
<td>F-NS</td>
<td>95.64</td>
<td>3.631</td>
<td>91.65</td>
<td>6.247</td>
<td>0.756</td>
</tr>
<tr>
<td>F-Ch</td>
<td>M-NS</td>
<td>95.64</td>
<td>3.631</td>
<td>89.47</td>
<td>6.468</td>
<td>1.092</td>
</tr>
<tr>
<td>M-Ch</td>
<td>F-NS</td>
<td>94.62</td>
<td>3.869</td>
<td>91.65</td>
<td>6.247</td>
<td>0.756</td>
</tr>
<tr>
<td>M-Ch</td>
<td>M-NS</td>
<td>94.62</td>
<td>3.869</td>
<td>89.47</td>
<td>6.468</td>
<td>0.907</td>
</tr>
<tr>
<td>F-Ph</td>
<td>M-NS</td>
<td>95.05</td>
<td>4.222</td>
<td>89.47</td>
<td>6.468</td>
<td>0.613</td>
</tr>
<tr>
<td>F-NS</td>
<td>M-NS</td>
<td>91.65</td>
<td>6.247</td>
<td>89.47</td>
<td>6.468</td>
<td>0.341</td>
</tr>
</tbody>
</table>

Note: All effect sizes were calculated by subtracting the group2 means from the group1 means divided by the pooled standard deviations.

Table 14 presents the mean differences and the effect sizes for the significant contrasts. The smallest effect size for significant contrast was 0.341 for comparing female natural sciences majors to male natural sciences majors. The largest effect size was 1.266 for comparing female math majors to male natural sciences majors. In addition, the effect size for comparing female chemistry majors to male natural sciences majors was 1.092, and for comparing male chemistry majors to male natural sciences majors was 0.907, which are considered high effect sizes. Finally, the effect sizes for
comparing female math majors to female natural sciences majors, 0.939, and to male math majors, 0.936, are also considered high effect sizes.

Tukey’s post-hoc analysis helped detect and uncover any patterns of these differences and relationships that could not be verified by the general F-test for the interaction. Eleven of the pair-wise Tukey’s contrasts were found to be statistically significant with small to large effect sizes. The smallest effect size (.341) reflected the difference, in GPA, between male and female natural sciences majors, in favor of the female students. The largest effect size (1.266) reflected the difference between male natural sciences majors and female mathematics majors, in favor of the latter group.

**Summary**

The first research question in this study was about the relationship between students’ gender and their choice of college major. The second research question of this study investigated the relationship between students’ college major choices, gender, and their academic performance in high school as measured by SAAT, GAT, and high school GPA. More specifically, the question examined whether students from different college majors differed in their high school academic performance and whether these differences were associated with students’ gender.

In regard to the first research question, the result of the cross-tabulation analysis between students’ gender and their choice of college major suggests that there is a significant relationship between students’ gender and their choice of college major. The second research question, however, was addressed by testing three separate hypotheses. Each hypothesis was related to one of the three measures of students’ academic performance in high school (SAAT, GAT, and high school GPA). Results from the
analysis of variance intended to answer the second research question of the study. The findings showed that students’ differences in their high school academic performance among the four college majors depended on gender.

These findings were true for only two of the three measures of high school academic performance: SAAT and GPA. Whether using students’ SAAT score or their GPA to measure their academic performance, the pattern of the differences among male students from different college majors was different from the pattern for female students. Thus, hypotheses two and four for the second research question were rejected.

For instance, results showed that male mathematics majors and female natural sciences majors were significantly lower than other groups in their average SAAT scores. On the other hand, female mathematics majors were significantly higher than other groups in their average SAAT scores. In regard to high school GPA, female mathematics majors also had the highest average high school GPA, unlike male natural science majors, who had the lowest average high school GPA.

Findings from the analysis of variance for the GAT measure, however, did not support the dependency, on students’ gender, of the difference in GAT scores among students across the four college majors. The pattern of the differences in GAT scores for male students was similar to the pattern for female students. Therefore, findings from the analysis of variance using GAT scores supported hypothesis three for the second research question. Implications of the results are discussed in the next chapter.
CHAPTER V
DISCUSSION AND CONCLUSION

Investment in higher education, especially the STEM fields, is one of the most valuable investments a nation can make because it allows for the shaping of the future. The products of STEM fields are highly important in today’s world. According to Rask (2010), “Graduates in these fields are seen as the basic driving force behind international competitiveness, innovation, and productivity growth economy-wide” (p. 1). The great power of higher education has mobilized countless youth toward the pursuit of a college degree to fulfill their career aspirations. In the KSA, for example, few Saudi high school students continued to higher education in the past. Currently, however, the number of students who attend college has increased dramatically, especially the number of women. In fact, women represent 56.6% of the total number of students in Saudi universities today (Ministry of Higher Education, 2010).

A high school graduate’s selection of a college major is one of the most life-altering decisions of his or her academic career. Porter and Umbach (2006) point out that, “The choice of a college major can be one of the most important decisions a student can make” (p. 429). There are multiple factors associated with that decision. However, gender and academic performance in high school are perceived to be two major factors that affect students’ decisions about their choice of college major. Thus, this study aimed to describe the relationship between students’ gender and the selection
of college major among college students in the KSA. The study also examined the relationship between high school performance and college major based on students’ gender. This study was inspired by other studies conducted about the relationship between gender and the choice of college major among students at universities in the United States. More specifically, the study answered two research questions.

1. Is there a relationship between gender and college major selection among college students in the KSA?

2. Are there significant differences in high school performance (measured by SAAT, GAT, and high school GPA) among college students in the KSA with different college majors while taking students’ gender into consideration?

Three major findings were derived from this study, one of which was that there was a significant relationship between student gender and college major selection. This relationship was underscored by the significant gender gap among natural science majors, in which the ratio (male: female) was 127:89.

This finding is not quite the same finding of Griffith’s 2010 study, in which he conducted a longitudinal survey of freshmen from the National Educational Study of 1988 to examine the persistence of American students in STEM majors. Griffith found that it was less likely for minority and female students to select a STEM major, and even if they did, there was a high probability that they would switch away from these fields.

The difference is that students in KSA University who are in the natural science majors are actually the ones that do not perform well, and indicated that they still cannot decide which STEM field they would like to get into. In reality, they cannot be declared
as natural science majors the same ways as separate categories as described in Griffith's study. This is further demonstrated by their poor high school performance (measured by SAAT, GAT exams, and high school GPA) as compared to the high school performance of students from the other three majors.

Furthermore, findings from this study revealed a significant gender gap among physics majors, 92% of whom are female. Nevertheless, when compared to female students in all other college majors, female physics majors constituted about 20% of all female students in this study. This percentage is comparable to the percentages of female students in the other three college majors—26% were mathematics majors, about 23% were chemistry majors, and about 30% were natural science majors.

Male physics majors, however, constituted less than 2% of all male students, which was much lower than the percentage of male students in the other three college majors. Yet, about 45% of male students were natural sciences majors, which was the highest percentage of male students in all college majors. The public university uses the natural sciences label to identify students who have not successfully finished their freshman year “preparatory requirements.” Only those who pass the preparatory requirements can choose a major in mathematics, physics or chemistry.

Thus, the discrepancy between the numbers of male and female students enrolled in the physics college major seems to be directly related to the discrepancy between the number of male students enrolled in the physics college major and the number of male students enrolled in the other three college majors. Checking with the administrative authorities at the public university who provided the data for this study revealed no clear explanation for this discrepancy.
Even though students have recently become more interested in STEM majors, this trend does not extend to the physics major. In fact, it has been found that “Physics lags behind the overall growth rate of the undergraduate population” in the United States (Hazari, Sonnert, Sadler & Shanahan, 2010). It seems that this is also the case among undergraduate students in the KAS.

The aforementioned findings regarding the number of students enrolled as physics majors lead to another interesting and important discussion that may help to explain this discrepancy. This discussion is about the relationship between students’ high school performance, first-year college performance, and choice of college major. An analysis of the results revealed that first-year college students who did not perform well enough academically in order to pass the college preparatory requirements did not perform well in high school as compared to the students from other college majors. This was true for all the three measures of high school academic performance, which include SAAT and GAT scores, as well as high school GPA. Thus, many male students were likely to stay in the natural science major due to their low academic performance, which may be the reason behind the finding that about 45% of all male students were natural sciences majors and less than 2% were physics majors.

These findings emphasize the relationship between students’ high school performance, their college academic performance and ultimately their choice of college major. The results suggest that strong high school academic performance is associated with strong college academic performance and students’ ability to enroll in science and math majors. Despite the cultural differences between the KAS and the United States, the relationships between students’ high school performance, their college academic
performance and their choice of college major were found to be true in both cultures. Rask (2010) used administrative data from the graduating classes of 2001-2009 of an American liberal arts college to examine students’ progression through STEM majors and he found a positive relationship between high school preparation and the selection of STEM majors.

Unfortunately, the imbalanced gender distribution on supply and demand of the workforce might cause some economical and social challenges. According to Rask (2010), “In an increasingly technical society, any gaps in the supply of and demand for technically trained workers and the continuing imbalances in the gender and race composition of these work forces present significant social and economic problems” (p. 1).

The second finding relates to the gap in the measurement of students’ high school performance by the two standardized measures, SAAT and GAT scores, and the non-standardized measure, high school GPA. The scores for students’ high school GPA on average were higher than the two standardized exams across all four-college majors. For instance, the average SAAT and GAT scores for female natural science majors were 60.84 and 65.73, respectively; yet the average high school GPA was 91.65. This gap in the average scores across the three measures was the result of the measurement scale for each of these tests. More specifically, both the SAAT and GAT tests are standardized tests with a known unified unit of measurement. High school GPA, however, is non-standardized measure that has a completely different unit of measurement.

The third finding of this study is related to both students’ high school academic performance and college major selection. The results showed that differences in
students’ high school academic performance, among the four college majors, were significantly related to their gender. This finding was true only for two of the three measures of high school academic performance: high school GPA and SAAT.

The average SAAT scores differed significantly across the four college majors. Moreover, the nature of these differences varied depending on whether the students were male or female. For example, female chemistry majors achieved lower SAAT exam scores than female mathematics students. The opposite was true for males, as male chemistry majors performed better than male mathematics majors on their SAAT scores. Results were found to be similarly significant with regards to high school GPA. The analysis of variance for the GAT, however, did not support the idea that the difference in GAT scores among students across the four college majors depends on students’ gender.

**Implications**

The first finding of this study indicates that there is a significant relationship between students’ gender and college major selection. The imbalanced gender distribution on the supply and demand of the workforce can lead to some social difficulties (Rask, 2010). Thus:

Engaging more students in learning science, particularly under-represented females and minorities, could not only increase the talent pool but also lead to more equitable economic opportunities, wider utilization of science understandings in people’s lives, and new viewpoints in the practice and teaching of science (Aschbacher, Li & Roth, 2009, p. 564).

Students’ college admission in the KSA is mainly based on students’ high school achievement. Generally, high-achieving high school graduates compete for enrollment in high-demand college majors. In other words, high school academic
performance plays a substantial role in college admission, which is why it is so important in the KSA. This overemphasis on high school performance can have a negative impact on the educational quality in the KSA, where scores becomes the major concern of students competing for selective college admission.

As a consequence, students tend to memorize rather than understand and comprehend the knowledge and the information presented to them in school. It seems to them that the process of memorization is more powerful and effective in helping them reach higher scores. Instead of focusing their energy on understanding the information and improving their critical thinking skills, Saudi students tend to waste a great deal of their time and effort preparing for teacher-made exams that mostly measure memorization skills. On the other hand, standardized exams like the GAT and SAAT focus on critical thinking skills. The GAT, for instance, measures students’ reading comprehension, logical relations, problem-solving behavior, informational abilities and induction abilities (NCAHE, 2011). Focusing on memorizing the information is a method that helps students achieve a strong high school GPA, which is based on teacher-made exams and homework, but this compromises their standardized exam scores, which depend on critical thinking skills.

As a result, students tend to do poorly on standardized exams. This is especially true because the use of these standardized exams for college admission is part of a relatively new policy in the KSA. Thus, high school students should be given the opportunity to learn and prepare themselves for these exams. They should be afforded classes specifically designed to enhance their knowledge and skills in taking exams that emphasize critical thinking skills rather than mere memorization.
The finding related to the high achievement of female mathematics majors was a result of the three measurements of high school performance: high school GPA, GAT, and SAAT. This finding is another clear sign of the positive relationship between high school performance and enrollment in science college majors, especially for female students. This finding shows the importance of high school performance in predicting students’ college enrollment in science majors, as high-achieving high school students were more likely to enroll in science college majors.

High school education is the real foundation for the advancement in college education. Strong academic performance in high school tends to encourage students, especially female students, to select their college major in scientific fields. Dickson (2010) affirmed the relationship between high school preparation and the initial choice of college major. Thus, helping Saudi female students do well in high school will encourage them to go beyond the traditional female majors, like arts and humanities, and enroll in science majors instead. Such a change can reduce the high unemployment rate among Saudi women. A recent statistic in the KSA shows that 363,619 women are unemployed versus 265,425 men (Central Department of Statistics & Information, 2013), even though women represent the majority of college attendees in the country (AlMunajjed, 2010).

Assembling all the findings from this study uncovers the importance of a high school education that can encourage students, especially female students, to be more open to selecting STEM majors. Quality high school education is an essential part of the solution in addressing the low numbers of Saudi women in the KSA’s workforce. Offering an improved high school education with more STEM fields is likely to
encourage Saudi female students to go beyond the traditional choices of college majors and enroll in majors that make them more competitive.

**Suggested Further Research**

First of all, researchers in the KSA should investigate the low enrollment rates of male physics majors and seek answers as to why male students are less motivated toward physics than other science majors. “Physics lags behind the overall growth rate of the undergraduate population,” according to Hazari, Sonnert, Sadler and Shanahan (2010), and it is likely that similar conclusions can be drawn from an analysis of undergraduate students in the KSA (p. 979).

Secondly, future studies should investigate the existing achievement gap among high school students between the standardized measures (GAT and SAAT) and the non-standardized measure (high school GPA). An in-depth study is necessary to evaluate the psychometric properties of high school GPA, GAT, and SAAT that are being used to measure high school achievement among high school students in the KSA.

Thirdly, positive high school achievement among female math students raises a question regarding the relationship between high school performance and self-confidence: does strong academic performance in this group contribute to higher levels of self-confidence, which in turn pushes this group to select majors in mathematics? Students’ beliefs about themselves were found to be strongly related to their participation and persistence in the sciences (Hazari et al., 2010). Thus, discussing the relationship between these two variables is a worthwhile topic for future investigations.
Conclusion

Students face many critical, lifelong decisions during their academic careers, and perhaps the most life altering of all is their college major selection. What’s more is that this important decision must be made in the first stage of their college journey. It is not only an educational decision, but also a major life decision that affects students for the rest of their lives.

Therefore, a good educational plan can help students target an appropriate college major and become more competitive. Otherwise, students may target majors that are not in demand and could potentially end up unemployed. At the university level, faculty and administrators need the information derived from this study to help them in the assessment of students’ needs, management and planning for the improvement of the higher education system in the KSA. Further, this study can help the faculty and university administrators with student advising, the allocation of the university resources for the betterment of students education, and responding to the national job market.

I have a personal interest in the findings and applications of this study. When I graduated from high school, I had a tough time selecting a college major. I graduated with a good GPA, yet I still found myself struggling to pick a major. Teaching has been my personal dream since I was a child, and I have kept this dream with me day and night. My father was one of the first people in my city to obtain a college degree, and with it he became an educator. As a boy, I witnessed how my father’s education allowed him to make positive contributions to our community, and I wanted to follow in his footsteps as a teacher.
However, under the pressure of friends and family members who did not want me to be a teacher, I ignored my dream and chose to major in computer science, subsequently switching to a medical microbiology major. My anxiety increased with every passing semester. I started losing motivation. I eventually realized that I needed to pursue not what social pressures told me to pursue, but rather what I had a passion for: teaching. Ultimately, I found myself majoring in Arabic to become an Arabic teacher. Although I have a positive ending to my story, this is not always the case for all college students. I hope the findings of this study can contribute to helping other high school students who are struggling to pick the right major as they begin their college careers, as I did years ago.

High school students should enter college with a clear vision and a solid plan to help them save time, money and effort. Today, more than ever before, the selection of a college major is a critical life decision because of the dynamic changes in the world and the newly created demands of jobs in the workplace. Thus, students should think about majors that give them the right skills and prepare them for the job market.

In the KSA, for instance, the selection of a college major is considered a major factor behind the low representation of women in the national workforce. Saudi women represent only 14.4% of the national workforce, even though they represent the majority of college attendees (AlMunajjed, 2010). Saudi women, however, still limit their choice of college majors to fields such as humanities and social science fields (Onsman, 2011). The fact that the majority of young women are graduating in the field of education and social services has created a gender imbalance in the Saudi labor market and contributed to high unemployment rates of female university graduates. (AlMunajjed, 2010, p. 18)
Moreover, according to Joy (2006), “Gender differences in college major account for much of the gender gap in teaching, health care, teaching, engineering/computer, and service occupations” (p. 239). Therefore, investigating the relationship between gender and college major selection is the initial step toward reversing the low representation of women in the workforce.

Thus, I decided to contribute to the movement of Saudi women toward higher education by investigating the relationship between gender and college major selection among students in the KSA. This study was not meant to be a magic bullet that would solve the high unemployment rate among women in the KSA. Instead, this study was designed to inquire into the contributing factors of college major selection among students in the KSA.

This study showed several interesting results; however, I personally see the relationship between high school performance and college major selection among female mathematics students as having particularly important implications for the way in which education for women in the KSA should be planned in order to increase female participation in the workforce. Specifically, high school students, especially those that are female, should have more opportunity to learn and prepare for the two GAT and SAAT standardized exams. This is highly suggested for the following reasons.

First, students’ performance on the two standardized exams plays a major role in college major selection. Results of this study showed a positive relationship between high school performance and enrollment in science-related college majors, especially for female students. In fact, female students achieved well in both their high school
GPA, GAT, and SAAT. Second, students’ scores on the two standardized exams are major aspects that influence college admission. In the KSA, the SAAT and GAT weigh 70% on the weighted scale of the admission, as compared to the high school GPA, which weighs only 30% on that scale (Siddiek, 2011). Thus, poor high school achievement, especially on the two standardized exams, may block students from being admitted into a favorable college major because it will make them less academically attractive to universities.

Based on the existing relationship between high school performance and female students’ selection of science college majors in the KSA, this study offers the following suggestions for policy makers in the KSA. First, high school students, particularly female students, should be offered free educational courses and seminars specifically designed to enhance their knowledge and train them to do well on the two standardized exams (GAT and SAAT). These free courses can help prepare students for these exams and ultimately encourage female students to go beyond the majors that Saudi females tend to select, like arts and humanities. Second, high school students should be informed of the value of strong high school academic performance and how it can impact them in the future. They should know that high school performance is strongly tied to both their college major selection and their college performance.

In short, although results of the study show several interesting findings, the following three findings were the most telling. First is that there was a significant relationship between students’ gender and their college major choice. Second is that there was a wide achievement gap in the measurement of students’ high school academic performance. This existed specifically between the non-standardized high
school GPA score and the standardized SAAT and GAT scores. Third and finally is that differences in high school academic performance were significantly related to gender among the four college majors, and this finding was true only for two measures of high school academic performance: GPA and SAAT.
REFERENCES


APPENDIX

Office of Research Administration
Akron, OH 44325-2102

NOTICE OF APPROVAL

June 4, 2013

Hujaylan Alhujaylan
2471 Waterford Pointe DR
Kent, OH 44240

From: Sharon McWhorter, IRB Administrator

Re: IRB Number 20130517 "Education of Women in the Kingdom of Saudi Arabia: Relationships of Gender and Academic Performance to Secondary Education to the Selection of College Major among Undergraduate Students"

Thank you for submitting your Exemption Request for the referenced study. Your request was approved on June 3, 2013. The protocol represents minimal risk to subjects and matches the following federal category for exemption:

☐ Exemption 1 – Research conducted in established or commonly accepted educational settings, involving normal educational practices.

☐ Exemption 2 – Research involving the use of educational tests, survey procedures, or observation of public behavior.

☐ Exemption 3 - Research involving the use of educational tests, survey procedures, interview procedures, or observation of public behavior not exempt under category 2, but subjects are elected or appointed public officials or candidates for public office.

☐ Exemption 4 – Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens.

☐ Exemption 5 – Research and demonstration projects conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine public programs or benefits.

☐ Exemption 6 – Taste and food quality evaluation and consumer acceptance studies.

Annual continuation applications are not required for exempt projects. If you make changes to the study's design or procedures that increase the risk to subjects or include activities that do not fall within the approved exemption category, please contact me to discuss whether or not a new application must be submitted. Any such changes or modifications must be reviewed and approved by the IRB prior to implementation.

Please retain this letter for your files. This office will hold your exemption application for a period of three years from the approval date. If you wish to continue this protocol beyond this period, you will need to submit another Exemption Request. If the research is being conducted for a master's thesis or doctoral dissertation, the student must file a copy of this letter with the thesis or dissertation.

Cc: Suzanne MacDonald - Advisor
Cc: Valerie Callanan – IRB Chair

☐ Approved consent form/s enclosed

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