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UNDERGRADUATE MATHEMATICS STUDENTS' ATTITUDES TOWARD USING E-LEARNING IN SAUDI ARABIA

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ABSTRACT

The main objective of this study was to investigate the attitudes of undergraduate mathematics students in Saudi Arabia towards online mathematics education. Comparisons were made among male, female, underclassmen, and upperclassmen undergraduate mathematics students at the University of Tabuk (UT). Of 161 students enrolled in the mathematics program, 118 mathematics students responded to the survey. The sample consisted of 57 male and 61 female students. A 2 x 2 ANOVA test was used to reveal any statistically significant differences between the various groups based on gender and educational level. The findings showed that underclassmen did not differ significantly from upperclassmen in their attitudes toward online mathematics, male students did not differ significantly from female students in their attitudes toward online mathematics, and there was no significant interaction between educational level and gender in terms of the students' attitudes toward online mathematics education.

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CHAPTER 1

INTRODUCTION

E-learning has gained importance over the last few years. The spread of Internet service providers, lower costs, and a growing number of Internet users have persuaded many educators that e-learning is one way to overcome some of the difficulties in traditional education environments. E-learning holds many advantages, such as providing high-quality learning at low cost to both on- and off-campus students. E-learning has also made it possible for off-campus learners to combine education and work. E-learning also has added an international dimension to the educational system (Moore & Kearsley, 2005).

Educators in the United States were among the first to implement and make use of e-learning technology in the field of education. In the United States, enrollment in online courses has grown dramatically in recent years. According to E. Allen and Seaman (2010), online courses in the United States had an enrollment of 1.6 million students in 2002. By 2009, the number of students enrolled in online courses had reached 5.6 million. E. Allen and Seaman added that more than 60% of educational leaders in the United States believe that online learning will increase over the next few years as additional students are attracted toward this type of learning.

In Saudi Arabia, though, e-learning is in its beginning stages. Many educators in Saudi Arabia believe that e-learning can help them overcome some of the difficulties and deficiencies in the current educational system. According to Al-Khalifa (2010), the increasing use of e-learning in other countries has persuaded the Ministry of Higher Education (MHE) in Saudi Arabia to invest in e-learning. The Deanship of Distance Learning at King Abdul Aziz University was established in 2004, and the university started offering online courses to undergraduate students in Saudi Arabia. In 2005, the Saudi MHE established the National Center for E-learning and Distance Learning (NCEL; Al-Jabri, 2012). The center organized two international conferences—one in 2009 and one in 2011. King Saud University also established a Deanship of e-Learning and Distance Learning in 2007. There is increasing competition among many educational institutions in Saudi Arabia to offer online courses as more and more Saudi students use e-learning.

Presently, there is a lack of scientific research in the field of e-learning to better understand how it affects the quantity and quality of learning provided to Saudi students. Learners seem to have varying attitudes about online education depending on the subject of the course. For example, they might feel differently about an online psychology course compared to an online mathematics or science course. Educators in Saudi Arabia are especially concerned about how to provide high-quality learning to mathematics students enrolled at Saudi universities.

Saudi students have low-ranking scores in international mathematics competitions, which is a significant issue for educators. In 2007 for example, Saudi students' performance in mathematics at the high school International Mathematical Olympiad (IMO) was ranked 91st out of the 93 participating countries, and in 2008, Saudi participants were ranked 94th out of 97 (IMO, 2007, 2008). In another international mathematics competition, based on the Trends in International Mathematics and Science Study (TIMSS) test and administered every four years to fourth- and eighth-grade students around the world, Saudi students were ranked 46th out of the 48 participating countries in math (Martin, Mullis, Foy, & Olson, 2008).

House and Telese (2012) observed that students' use of computers was the most important indicator of excellence among the participants in the 2007 TIMSS competition. These findings are consistent with one of the main principles of the National Council of Teachers of Mathematics (NCTM), which stresses the importance of technology in both teaching and learning mathematics (Lin, 2008). The NCTM suggested incorporating technology into the traditional classroom setting for the teaching of mathematics. However, if technology in the classroom is successful, it might be possible to expand the NCTM's ideas into the creation of online mathematics courses that almost exclusively use technology as the teaching tool. Because e-learning is a new field in higher education in Saudi Arabia, few studies have addressed any issues related to online mathematics courses or their potential effects on the teaching or learning of mathematics.

Statement of the Problem

According to the Saudi Arabian General Investment Authority (SAGIA), 70% of Saudis are less than 30-years old, and 46% of that group is under the age of 20. The SAGIA's report stated, "Saudi Arabia's population is extremely young and growing rapidly, with millions of school-age children" (SAGIA, 2012, para. 4). The needs for postsecondary education of this large, young population exceed the available resources for providing it. Ali, Sait, and Al-Tawil (2003) observed that the number of available university enrollment positions in Saudi Arabia does not match the numbers of high school graduates, which is one of the main causes of university over-enrollment. In 1993, 2.8% of high school graduates were unable to progress to a higher education, although in 2003, more than 6% of students could not progress (Aljabre, 2012).

This number more than doubled by 2009; 14% of graduating students were unable to enroll in higher education because there was insufficient space in the universities to accommodate them (Al-Khalifa, 2010).

Many universities in Saudi Arabia are unable to provide learners with high-quality learning because of this problem of over-enrollment (Ali et al., 2003; Asiri, Mahmud, Kamariah Abu Bakar, & Ayub, 2012). Large class sizes are hard for the instructors to manage. The instructors have difficulty focusing on the individual students' needs and performances, which means that most instructors lecture with very little student interaction. This lack of interaction can decrease the quality of education that students in the class receive. E-learning can solve problems related to the shortage in learning facilities and teaching staff. If small classrooms limit the number of students who can enroll in a specific course, an online course with a larger enrollment could accommodate all of the students who want to take the course. Enrollment would no longer be limited by available classroom space. Additionally, instructors could teach a single online session with many students enrolled, instead of multiple small sections of the same course. The teachers would still have the same amount of students enrolled in the course, but they would only teach a single session online.

Religious and cultural factors in Saudi Arabia have led to segregation between male and female students at all educational institutions in Saudi Arabia, which also contributes to the shortage of instructors and enrollment space. This has meant that the MHE has needed to spend more money to establish separate learning institutions for male and female students. In addition, female students have fewer opportunities to enroll in certain majors that have a shortage of female staff, such as science and technology. In the 2011-2012 academic year, the number of students in Saudi universities was 1,206,007—611,861 male students and 594,146 female students. Of the 23,211 faculty who had earned a doctoral degree, 16,668 were male faculty and 6,543 were female faculty. The male student-to-faculty ratio is 37 to 1, and the female student-to-faculty ratio is 91 to 1 (MHE, 2012). Rugh (2002) indicated that the most common field of study for women in Saudi Arabia is education, with 66% of female students majoring in education. He added that female students can only pursue certain majors, which are available at one-third of the colleges in Saudi Arabia where women can attend.

Over two-thirds of students enrolled in Saudi Arabian universities are women. According to statistics provided by the Saudi MHE for the academic year of 2008-2009, students who graduated from a Saudi university with a bachelor's degree were 31.83% (n = 28,838) men and 68.36% (n = 62,306) women. Of the students who graduated with a bachelor's degree during the 2011-2012 academic year, 34.76% (n = 31,478) of students were men and 62.24% (n = 59,048) of students were women. In human studies majors, 19.65% (n = 4,003) of enrolled students were men and 80.35% (n = 16,368) of enrolled students were women. Similarly, in social and behavioral sciences, 21.06% (n = 1,946) of students were men and 78.94% (n = 7,293) of students were women. In contrast, in the engineering and engineering industries major, 99.36% (n = 8,914) of enrolled students were men and 0.64% (n = 57) of enrolled students were women. These differences in enrollment could be attributed to the lack of female instructors available for engineering and mathematics courses, because only female instructors can teach female students. Online courses would offer a solution to this problem because female students can take online courses from a male instructor, but they cannot take face-to-face classes with a male instructor. Online mathematics courses would allow female students the opportunity to study regardless of whether they had a female instructor.

Another problem in Saudi Arabia's education is the role that distance plays for students who want to attend universities. In traditional learning settings, learners need to live close to universities. This is problematic for out-of-state students who wish to pursue higher education because they must move to major cities and find housing accommodations where most of the educational institutions are located. According to statistics provided by the Saudi MHE for the academic year 2010-2011, 66% of students were enrolled in only three states, which include Al-Riyadh, Makkah, and the Eastern province, and 34% of students were distributed over the other ten states (MHE, 2012). The three states with the majority of students have large cities and large universities, but the remaining 10 states have much smaller cities and smaller universities. Concentrating educational institutions in major cities limits students' choices regarding when and how they can learn, and it also hinders the ministry's plans for providing high-quality learning to students in all 13 states.

Purpose of the Study

The main objective of this study was to investigate the attitudes of undergraduate mathematics students in Saudi Arabia towards online mathematics education. The findings of this study will add to the current literature in this field. I hope that the outcomes of this study will aid educators and other researchers who share similar interests in this field.

Significance of the Study

Few studies have addressed how technology impacts the attitudes of undergraduate mathematics students in Saudi Arabia towards online mathematics education. The outcomes of this study will add to the existing information on this topic. It will help educators and curriculum designers in Saudi Arabia construct better instructional strategies for Saudi students. It will also address the shortages in learning facilities and teaching staff, unequal learning opportunities between genders, and increase the ways to offer high-quality learning to Saudi students.

Research Questions

The main purpose of this study was to investigate the attitudes of Saudi undergraduate mathematics students toward online mathematics education. This study addressed the following question: Do Saudi undergraduate mathematics students' gender and educational level impact their attitudes towards online mathematics education?

In order to address potential differences across gender and grade-level groups, the following inferential questions were addressed:

1. Is there a statistically significant difference between educational-level groups (underclassmen and upperclassmen) of Saudi undergraduate mathematics students in their attitudes toward online mathematics education?
2. Is there a statistically significant difference between the Saudi undergraduate mathematics students' gender groups (male and female) and their attitudes toward online mathematics education?
3. Is there a significant interaction between the educational levels of Saudi undergraduate mathematics students and their gender in their attitudes toward online mathematics education?

Null Hypotheses

H_0 1: There is no statistically significant difference between educational-level groups of Saudi undergraduate mathematics students in their attitudes toward online mathematics education.

H_0 2: There is no statistically significant difference between the Saudi undergraduate mathematics students' gender groups in their attitudes toward online mathematics education.

H_0 3: There is no significant interaction between the educational levels of Saudi undergraduate mathematics students and their genders in their attitudes towards online mathematics instruction.

Study Setting

This study was conducted at the University of Tabuk (UT), a university established in 2006. UT is located in the city of Tabuk, which is in the northwestern part of Saudi Arabia. The university consists of 17 colleges. There are approximately 20,000 students enrolled at UT, with 11,000 undergraduate male students and 7,400 undergraduate female students. The university consists of several colleges—the College of Education, College of Science and Art, College of Computer and Information Science, College of Engineering, College of Applied Medical Sciences, College of Medicine, and College of Science. The College of Science consists of the mathematics department, physics department, environment department, and chemistry department. The mathematics department offers a bachelor's degree in mathematics, and students enrolled in the program need to finish at least 134 credit hours over a period of four years. Students need to successfully complete at least 73 credit hours in their area of specialization.

Population and Sample

The population for this study consisted of all undergraduate mathematics majors who were enrolled at UT, and only those participants who met these standards were allowed to take part in this study. At the time of the study, there were 72 male students and 89 female students majoring in mathematics at UT. According to the number of credit hours the participants had successfully completed, the participants were divided into underclassmen and upperclassmen. Underclassmen included students who had earned fewer than 68 credit hours, and upperclassmen included students who had earned 68 credit hours or more.

Definitions of Terms

Distance education is a method of instruction in which students are physically separated from their instructors in place or time (Wu, 2006). According to Moore and Kearsley (2012), distance education is "teaching and planned learning in which teaching normally occurs in a different place from teaching, requiring communication through technologies as well as special institutional organization" (p. 2).

E-learning is "an environment in which learning is facilitated and supported through the use of information and communication technology" (Sistelos, 2008, p. 8).

Attitude can be defined as "learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object" (Fishbein & Ajzen, 1975, p. 6).

Online courses are "courses that use the Internet as the means to deliver instruction to students who may or may not be on campus" (Rice, 2007, p. 18).

Online learning is "an approach to teaching that relies on the Internet instead of a physical classroom to deliver educational information. Online learning has historically gone by various names such as e-learning and distance learning" (Rayle, 2011, p. 12). In this study, the terms *distance learning* and *online learning* are used synonymously.

Underclassmen are limited to all undergraduate mathematics majors enrolled at UT and who had earned fewer than 68 credit hours.

Upperclassmen are limited to all undergraduate mathematics majors enrolled at UT and who had earned 68 or more credit hours.

Limitations

There were some limitations that could have affected the outcome of this study, including the following: (a) the sample in this study was limited to UT, and (b) the sample size was limited to the undergraduate mathematics students enrolled at UT.

Delimitations

The study was restricted to attitudes of Saudi undergraduate mathematics students toward online mathematics education at UT.

Assumptions

I assumed that the participant responses were based on their true attitudes toward e-learning and that the collected data was truly representative of their thoughts and attitudes.

CHAPTER 2

LITERATURE REVIEW

Distance Education

The roots of distance education go back at least 160 years. In 1833, an advertisement in a newspaper in Sweden offered the chance to study “Composition through the Medium of the Post” (Ayers & Simonson, 2010, p. 7). The earliest form of distance education was called correspondence education. According to Matthews (1999), Sir Isaac Pitman offered the first distance education courses in Great Britain when he mailed learning materials to his students. This type of correspondence education first appeared in the United States in 1873 when Anna Ticknor created a home study school, the Society to Encourage Studies at Home. Its goal was to provide women who were unable to attend formal school with opportunities to complete their studies from their homes (Moore & Kearsley, 2012).

In 1892, the University of Chicago offered the first university distance education program in the world. William Rainey Harper established this program after he became president of the University of Chicago (Moore & Kearsley, 2005). As distance education developed, the National University Extension Association began addressing issues specific to correspondence education, including “the necessity of new pedagogical models and new national level guidelines, such as university policies regarding acceptance of credit from correspondence courses, credit transfer, and standard quality for correspondence educators in 1915” (Nasseh, 1997, para. 4).

Instruction via radio and television was introduced between World Wars I and II. A total of 202 universities and school boards were given licenses by the federal government to use radio for instruction. After World War II, televised instruction became a new mode for educational correspondence. In the late 1960s, more instructional tools, such as interactive telephone conferencing, and new multimedia learning and instruction techniques were introduced to facilitate distance education (AlTameemy, 2010).

It was an important step in distance education when Open University was established in the United Kingdom in 1971. At the time, the university was one of the major innovative educational institutions in the world. It played a significant role in the development of distance education. According to Nasseh (1997),

> Britain's Open University brought a new vision of independence for distance education as distinct from traditional education and played a major role in the development of much of the important research in distance learning. It brought the needed respect and confidence to the correspondence program around the world. (para. 5)

The success of Open University in the United Kingdom led to the development of open universities in other countries, such as the United States and Japan.

Another significant step in distance education was the establishment of New York State's Empire State College (NYSES) in 1971. It was the first open university in the United States. The NYSES sought to provide higher education opportunities to learners who were unable to attend courses on campus. The NYSES modified the concept of academic credits by providing more flexibility for learners regarding degree requirements and time limitations than was typical of traditional degree programs (Nasseh, 1997).

The end of the 20th century saw additional improvements to distance education through advances in technology. During the late 1970s and early 1980s, cable and satellite television became an additional delivery medium for distance education and increased the number of quality courses available to the public (Nasseh, 1997). The 1990s witnessed the birth of computer-based distance education. As evidenced, the integration of computers was the most important shift in the history of distance education.

History of E-Learning in Saudi Arabia

The MHE recently began using online education as part of its plan to improve the quality of education in Saudi Arabia. The Saudi MHE believes that online education can help them overcome some of the challenges the country's educational system currently faces. As mentioned in Chapter 1, these challenges include student over-enrollment, shortages in teaching staff, concentration in urban areas, and growing demands for an educated workforce.

In 2005, the Saudi MHE established the National Center for E-Learning and Distance Learning (NCEL; Al-Jabri, 2012). The center was intended to aid all higher-education institutions in the country in the adoption of high-quality e-learning. This center would facilitate research in e-learning, evaluate e-learning projects, set principles for e-learning, organize workshops and conferences related to e-learning, and create strong connections with other international pioneers in the field of e-learning (NCEL, 2012).

In 2004, the Deanship of Distance Learning at King Abdul Aziz University was established to offer online courses to the university's undergraduate students. In 2007, King Saud University established a Deanship of E-Learning and Distance Learning. Following these examples, more and more educational institutions in Saudi Arabia have begun to offer online education options to their students.

Employing Technology in Teaching Mathematics

Online education opened a new door for mathematics teachers in Saudi Arabia because it provided opportunities to overcome many hindrances of educating the increasing numbers of learners enrolled in Saudi universities. Educators in Saudi Arabia need to find new ways to provide high-quality mathematics instruction to students enrolled at Saudi universities and schools. As noted in Chapter 1, the numerous reports have observed that Saudi students performed below average in mathematics (IMO, 2007, 2008; TIMSS, 2007).

The use of computers was the most important indicator of excellence among mathematics students (TIMSS, 2007). Other studies have demonstrated the critical role technology plays in educating students in mathematics. As early as 2000, the NCTM noted the importance of technology in teaching and mastering mathematics. The NCTM (2000) reported, "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (p. 24).

Technology influences how mathematics is taught and what aspects of mathematics are taught. Boggan, Harper, and Bifuh-Ambe (2009) indicated that using technology in the mathematics classroom eliminated needless computations and manipulations for students. Thus, incorporating technology narrowed students' focus to understanding and applying concepts. Also, technology allows students to learn concepts by discovery and helps them retain mathematics rules. By using technology, learners would no longer have to memorize rules and procedures of samples to complete their homework problems. Elementary students would now be able to solve problem with large numbers and analyze large sets of data (NCTM, 2000).

Li (2007) showed that the appropriate inclusion of technology in mathematics is effective but noted that the number of teachers who integrate technology remains low. This evidence suggested that students who are learning how to become mathematics educators need to be taught how to integrate technology into their teaching of mathematics. Boggan et al. (2009) argued that the educators of mathematics teachers must instruct future teachers how to use appropriate technological tools, claiming that using technology in the teaching of mathematics is necessary, not optional. Boggan et al. also emphasized that mathematics faculty need to introduce technology earlier in preservice teachers' programs to help those preservice teachers integrate and implement technology into their own educational practices. Exposing preservice teachers to technology early in their programs gives them more opportunities to integrate technology into their educational practices.

The Need for E-Learning in Saudi Arabia

The Saudi MHE is promoting e-learning as a way to provide high-quality learning for Saudi students, to keep up with the increasing number of students, to overcome teaching staff shortages, and to fulfill the needs of the Saudi job market (Al-Khalifa, 2010). As Al-Shehri (2010) explained, "Saudi Arabia has a huge expansion in higher education and e-learning. In the last five years, one university and five colleges have been commissioned every month; 800 scholarships have been awarded every month for overseas study" (p. 147). However, the growth in the number of higher education institutions is still below the country's actual needs.

Many studies support using technology in teaching mathematics via distance education (Boggan et al., 2009; Lin, 2008). As mentioned earlier, studies have shown that the integration of computers and technology are a critical factor in the teaching of mathematics. For example, Lin (2008) noted that the utilization of technology in mathematics classrooms is one of the main components of the principles and standards published by the NCTM. The NCTM standard asserted that it is important to use technology in the teaching and learning of mathematics in the traditional classroom, and one possible extension of this idea would be the use of online courses to teach mathematics.

E-learning could solve problems related to the shortage in learning facilities and teaching staff. Both male instructors and female instructors can provide learning opportunities for both male students and female students at the same time. Thus, e-learning will provide female learners with opportunities to enroll in certain majors that were unavailable in the past due to a lack of qualified female instructors. For example, e-learning can give female students opportunities to enroll in mathematics education. In earlier forms of distance learning, female students often chose majors such as Islamic studies or Arabic language, but e-learning provides them with a wider selection of majors, such as mathematics and science.

E-learning can also aid learners in overcoming problems related to time and geographic location. Students no longer need to live in large or well-populated areas in order to receive an education. They also do not need to move to areas nearer to the university that they wish to attend. According to Aljabre (2012), e-learning provides students with more choices regarding when, where, and how they want to learn. It will also help the Saudi MHE achieve its goal of providing high-quality learning opportunities to all students, no matter where they are located.

E-learning can provide better learning and high-quality learning opportunities for Saudi students than the Entsab program, a type of correspondence course offered by several universities. The Entsab program is "a method that allows students to seek their education while they are off-campus with only a final exam, which includes a midterm exam. In this approach, there is no communication between students and instructors at all" (Alaugab, 2007, p. 16). Although they are enrolled at a university, the students work almost entirely at home. The numbers of both male and female Entsab students enrolled at universities in Saudi Arabia has grown dramatically over the recent years. According to a Saudi higher-education statistics report, in the 2004-2005 academic year, 17,876 male students and 41,011 female students were enrolled in the Entsab program; by the 2010-2011 academic year, the number of students in the Entsab program reached 82,368 male students and 67,390 female students (MHE, 2012). Moreover, the percentages of Entsab students enrolled at universities in Saudi Arabia has gradually increased over the last few years. The percentages of Saudi university students enrolled in the Entsab program reached new heights during the academic year of 2009-2010, where 25% (n = 74,512) of male university students and 17% (n = 69,616) of female university students were enrolled in Entsab (MHE, 2012). These numbers show that more than 20% of all students enrolled at Saudi universities (n = 709,036) were enrolled in the Entsab program (MHE, 2012). The number of students interested in Entsab suggests that students are looking for an alternative to the traditional classroom format. E-learning could offer an alternative to the classroom format and an educational opportunity that is higher in quality than the existing Entsab program.

As has been outlined, Saudi Arabia has a number of problems with its mathematics education that could potentially be solved using e-learning. The integration of technology can assist with learning mathematics. Overcrowded classrooms can be solved by teaching students online. E-learning allows students to attend classes during times that meet their needs. Instructor shortages are alleviated when professors teach online courses. Students do not have to move or travel long distances to take online courses. Female students could have access to many different courses online that might not be available in a traditional classroom setting. E-learning provides possible solutions to many problems in Saudi Arabia's education, especially in the approach to mathematics education.

Saudi Students' Attitudes Toward E-Learning

Previous studies have shown that Saudi students generally have a positive attitude toward employing technology in teaching and learning online (Alanazy, 2011; Al-Arfaj, 2001; Alaugab, 2007; Bendania, 2011). Alanazy (2011) examined male and female students' attitudes toward online learning in postsecondary education in Saudi Arabia. The sample consisted of 707 Saudi students studying in American universities between January and June 2010. There were 586 male and 121 female students, and all students in the sample had completed K-12 education in Saudi Arabia. The study concluded that both male and female students showed positive attitudes toward online learning. Many of the students also believed that online learning would make postsecondary learning in Saudi Arabia more effective. Further, the Saudi students in Alanazy's study strongly preferred electronic text mediums such as chat, email, forums, and blogs when studying in a coeducational online cooperative learning environment. However, Alanazy also found that students preferred using voice chat and video-conference only with students of the same sex.

Alaugab (2007) conducted a study entitled "Benefits, Barriers, and Attitudes of Saudi Female Students toward Online Learning in Higher Education" and used mixed-methods research to collect the data. The sample consisted of female faculty and students at the Girls Studying Center at Imam University in Riyadh. The study concluded that female students' attitudes about e-learning were positive. The results also indicated that factors such as the availability of a home computer, home Internet access, and experience using a computer were significantly positively correlated with students' attitudes about e-learning. Similarly, the students' experiences in online courses and threaded discussions were significantly correlated with students' attitudes towards e-learning. The study also discovered that students agreed that e-learning requires many skills and types of support that may not be available to all students, including Internet access, equipment and infrastructure, technical support, technology skills and computer literacy, financial support for online instruction, established pedagogy for online instruction, and training for online instruction.

Bendania (2011) performed a quantitative study about the use of e-learning in teaching and learning at King Fahd University of Petroleum and Minerals. The researcher explored students' and instructors' attitudes toward e-learning. The sample consisted of 40 male students. Although the study concluded that students did hold positive attitudes towards e-learning, the students actually preferred face-to-face learning. Interestingly, the students preferred online tests and assessment to the traditional paper tests and assessment. Bendania indicated that students with more confidence and motivation generally had positive attitudes toward online-learning opportunities. Also, Alenezi, Abdul, Abdul, and Veloo (2010) surveyed 254 male and 154 female students from five universities in Saudi Arabia and found that computer anxiety and self-efficacy with computers influenced the students' intentions to use e-learning. The researchers also found that students' attitudes towards using e-learning were positively correlated with their attitudes toward the usefulness and ease of e-learning.

Al-Arfaj (2001) executed a quantitative study entitled "The Perception of College Students in Saudi Arabia towards Distance Web-Based Instruction" and examined male and female Saudi college undergraduate students' perceptions of distance web-based instruction at King Faisal University. The study concluded that the students positively perceived distance web-based education. It also revealed a statistically significant difference among students' perceptions based on their genders. Female students expressed slightly more positive preferences for online education than male students did. The findings also indicated that most of the students believed distance web-based instruction was efficient, effective, and convenient. On the other hand, some students surveyed believed that distance web-based instruction is not an efficient mode of instruction or a useful means of teaching all courses.

Not all studies have shown positive attitudes toward e-learning in Saudi Arabia. Al-Jarf (2005) performed an experimental study in which the female instructor and her students from one university shared an online course with a male instructor and his students from a different university. The study concluded that the participants had negative attitudes towards e-learning. The researcher reported that female students were shy and hesitant to show their identities to male students and the male instructor, and they did not use their real names. Al-Jarf suggested that cultural factors contributed to the lack of interactions among the participants, because male and female students are segregated at all educational institutions in Saudi Arabia. The researcher also stated that the educational level of the students, all of whom were freshmen, may have affected the level of interaction among the participants because most of students already knew each other and did not want to interact with unfamiliar students from a different university. The researcher reported that the e-learning course in this experiment was unsuccessful and ineffective.

Ali et al. (2003) also found that students had negative attitudes toward e-learning. Their result can be attributed to the fact that the online course they studied was not accredited by the Saudi MHE. In addition to the lack of accreditation, the students in their study were concerned about the lack of interaction among the students and the lack of interaction between the students and instructors.

Previous studies have shown that factors such as gender, educational level, interaction with other students and instructors, course accreditation, and the perceived usefulness of online education impacted attitudes of Saudi students about online education, but in general, they have positive attitudes toward e-learning.

Teaching Mathematics via Distance Education in Saudi Arabia

Educators in Saudi Arabia face many challenges, such as finding practical solutions to accommodate the increasing numbers of enrolled students, especially in schools where there is a shortage of female faculty members. Distance learning provides a solution to the problems of segregation between male and female students in Saudi Arabia because the students would not need to be separated in an online course setting.

Distance education has many advantages for college students in Saudi Arabia, such as providing high-quality learning at a low cost while offering a variety of educational opportunities. Distance education also provides learners with more scheduling flexibility and course accessibility. Summers, Waigandt, and Whittaker (2005) reported that distance education provided learning opportunities for students who were unable to attend face-to-face classes, such as employees whose work schedules conflicted with class meeting times. According to Rey (2010), online classes actually provide more opportunities for meaningful interaction among students, between students and instructors, and between students and content when compared to traditional face-to-face classrooms.

Other studies have shown that technology can specifically benefit the teaching of mathematics. Lin's (2008) participants agreed that computers and Internet resources are very useful. Computers and web-based resources helped the participants in this study learn mathematics. Most participants agreed that computers provided a visual multidimensional representation, which helped them grasp concepts. In addition, the participants believed a visual representation was engaging for learners, and they also believed that computers might make learners more interested in mathematics. Furthermore, Lin argued that using technology in teaching mathematics is important because computers provide an efficient method for learning as society moves into a digital age.

Challenges for Mathematics Learners in Online Settings

Although they have many advantages, online mathematics courses present special challenges compared to face-to-face mathematics courses. Educators emphasize that teaching and learning mathematics online can be difficult because mathematics is communicated with symbols (Engelbrecht & Harding, 2005a; Hodges & Hunger, 2011; Mayes, Luebeck, Mays, & Niemiec, 2006). This symbolic language can complicate mathematics courses. Engelbrecht and Harding (2005a) stated that online mathematics courses are less available than courses in other content areas because communicating mathematics online is much more difficult. According to Hodges and Hunger (2011), “Communicating with mathematical expressions on the Internet is not as easy as communicating with regular text” (p. 43). Mayes et al. (2006) also noted that teaching mathematics online has many challenges due to the abstract nature of mathematics. It is difficult to communicate mathematical concepts electronically, such as expressing and exchanging mathematical symbols and representing iconic or pictorial representations. Engelbrecht and Harding argued that teaching and assessing mathematics in an online setting is difficult because mathematics is symbolic, iconic, and conceptual. They noted, “Mathematics is a conceptual subject and a common opinion is that face-to-face contact is necessary for conveying these concepts” (Engelbrecht & Harding, 2005a, p. 254). Mayes et al. (2006) stated, “Communicating mathematical ideas over the Internet is posited by some as being impossible” (para. 1).

Learners also need to spend more time reading and preparing for online mathematics courses than they do for other types of courses that are taught online. According to Rey (2010), ”The argument is that online communication, which is generally text-based, requires thinking through the material and questions more thoroughly than verbal face-to-face communication, forcing online students to clearly articulate their thoughts and meaning in writing in plain text” (p. 13). The text-based communication in online courses is not always the most effective means for communicating mathematics concepts.

Distance education is learner-centered, and students are responsible for constructing their own knowledge. Evidence suggests that e-learning requires a model shift from a teacher-centered approach to learner-centeredness (Macon, 2011). Mathematics requires learners to be more active than when they study other subjects. In mathematics, reading an assignment or listening to a teacher is often not enough to learn how to solve mathematics problems; rather, learners learn best by solving problems themselves. Macon (2011) also pointed out that learners have to work by themselves to find the solutions to the problems.

For a variety reasons, distance education in mathematics is not as effective as using it in teaching other classes. As Macon (2011) stated, “Some types of classes are more easily constructed for the online format than other types of classes” (p. 3). These classes are different in many aspects, such as curriculum, strategies, and testing.

The language of mathematics is symbolic. In online settings, the students take a long time to type in numbers and symbols. G. D. Allen (2003) asserted that mathematical typography is the greatest obstacle of communicating mathematics online. Smith, Torres-Ayala, and Heindel (2008) found that teaching mathematics through e-learning presented problems with communicating diagrams and mathematics notation. It took an overwhelming amount of time and effort to translate mathematics symbols to text. Smith and Ferguson (2005) noted that the current models of e-learning environments, totally asynchronous courses and threaded discussions, do not work well in online mathematics courses. These models have no support for mathematics notation and diagrammatic communication. Rey (2010) stressed that communicating mathematical concepts and symbols using current technology presents an additional challenge for teaching and learning mathematics online, arguing that translating symbols into text can lead to a change of meaning or misunderstanding. It is very hard for instructors and students to communicate with mathematics notation in an online setting.

Further, the types of feedback required in a mathematics course are not easy to provide in an online setting. Smith et al. (2008) noted that online courses typically lack dynamism, which is problematic for online mathematics instructors who need to model the problem-solving process for their students. In addition, it is difficult for instructors to provide feedback to students working through the problems in an online setting. The hints or immediate feedback learners would receive from the instructor or classmates in face-to-face class sessions are not available in online courses. The mechanisms for feedback within common course management systems, most of them asynchronous, emphasize text and not mathematics notations or diagrams. Therefore, it is a challenge to provide feedback in real time, and online-course management systems do not always provide the means for offering efficient and effective feedback.

Online courses prevent certain types of interactions in the learning environment. Students are no longer limited to the walls of the classroom, and they can interact with their instructors or their peers at any time. Rabe-Hemp, Woollen, and Humiston (2009) argued,

> Most criticisms voiced about online courses are due to the concern that the interaction between students and faculty is inferior to the traditional classroom setting, making

> student engagement difficult. Student interactions with faculty and peers are critical to learning and are at the core of any educational situation (p. 208).

They added that students who perceive high levels of interaction in a course also express higher satisfaction with the quality of their course and learning.

Finally, traditional courses and course models do not always adapt well to an online setting. According to Leh and Jobin (2002), many of the challenges in distance learning result from the reduced face-to-face interaction, a lack of nonverbal communication, and the inability of teachers to adapt media materials. Instructors who develop and teach online courses are not given any special preparation or training for developing and teaching online courses. Thus, they generally use what they know about effective face-to-face instruction in their online courses. Engelbrecht and Harding (2005b) stated that some online mathematics instructors simply convert their lectures from a face-to-face setting to an online presentation. However, those skills and practices often do not effectively translate to the online learning environment (Rey, 2010). Leh and Jobin (2002) pointed out that distance-learning administrators must offer additional training for instructors in order to address these types of limitations.

Some students feel that online interactions cannot replace face-to-face interactions. A. A. Ibrahim (2011) found that a significant number of students who studied in online classroom settings did not like the classes, and they felt uncomfortable in distance classroom settings. Those learners preferred to interact with their classmates and instructors in the face-to-face classroom setting. Al-Jarf (2005) also observed that some learners had negative attitudes toward instructions in online settings when compared to face-to-face settings. However, Mayes, Luebeck, Akarasriworn, and Korkmaz (2011) noted, “Mathematics education courses also succeed in the online environment and technological tools can be introduced to enhance mathematical communication and to enable a richer and deeper exploration of meaningful mathematics" (p. 160). In conclusion, e-learning can provide learners with many advantages, such as more flexibility and greater resources, but at the same time, e-learning may not provide them with some of the advantages of taking face-to-face classes. In particular, mathematics can be difficult to transform from a face-to-face setting to an online course because it requires different language, feedback, and problem-solving skills than other types of online courses.

Factors Affecting Students' Attitudes Toward Online Mathematics Education

Many factors can impact students' attitudes toward online education, including age, gender, educational level, students' perceptions of the outcomes and benefits of online learning, and subjects being taught. Isman, Dabaj, Altinay, and Altinay (2004) have shown that student perceptions toward e-learning vary based on gender, age, educational level, number of the distance education courses taken, and subject matter. They added that not all content would be appropriate for distance education, so educators should choose appropriate course content when designing distance education programs. In addition, the design of the distance education course should utilize an appropriate format and style based on the age and educational level of the learners. Distance educators need to pay attention to the content taught as well as to the students' ages and educational levels.

Over 10 academic years, S. C. Wagner, Garippo, and Lovaas (2011) analyzed male and female students' performances in a course that was offered both online and in traditional instruction, both of which were taught by the same instructor. The instructor used the same criteria, standards, course syllabi, course assignments, and course exams in both models. The sample consisted of 289 male and 317 female students. The study concluded that there were no significant differences between male and female students' performances in online courses when compared to traditional instruction courses. Wilson and Allen (2011) concluded that there were three key differences among e-learning and face-to-face learners: online students tended to be female, older, and have earned more credit hours compared to face-to-face learners.

D. M. Anderson and Haddad (2005) conducted a quantitative study entitled “Gender, Voice, and Learning in Online Course Environments.” The sample consisted of 109 online students at a Midwestern regional university during the winter 2002 semester. There were 80 female and 29 male students. The study concluded that the female online learners were more successful in online settings compared to face-to-face settings, but male students’ performances in online settings differed little when compared to their performance in face-to-face courses. Female learners seemed to express themselves more freely in online settings compared to face-to-face settings, which may explain their increased learning in online settings. The researchers also found a gender difference in the level of the professor’s support, because female students received more support from their professor online than they did in face-to-face settings. Male learners did not express a significant difference in the amount of support they received from the professor.

In contrast, Liaw and Huang (2011) found that male students had more positive attitudes toward e-learning compared to female students. They used a quantitative study to collect the data. The sample consisted of 424 university students. There were 191 male and 233 female students. The study concluded that there was a statistically significant difference between the two genders toward e-learning, and male students were more positive about e-learning than female students were.

In addition to gender, students’ readiness can also affect their attitude toward online learning. D. Z. Ibrahim, Silong, and Abu Samah (2002) performed a quantitative study that consisted of 139 undergraduate students enrolled at Tun Abdul Razak University in Malaysia. There were 73 male and 66 female students. The study concluded that there was a moderate (neutral) attitude towards online learning, but male students had a significantly more positive attitude towards online learning compared to the female students. They also found that older students showed more willingness than younger students for online learning.

Ashong and Commander (2012) conducted a quantitative study entitled “Ethnicity, Gender, and Perceptions of Online Learning in Higher Education.” The researchers used mixed-methods research to collect the data. The sample consisted of 92 female and 28 male students at a large research institution in the southeastern United States. Courses were taught using the university’s learning-management system, uLearn, during the academic year 2011-2012. The study concluded that gender and ethnicity were key factors in the students’ perceptions of online learning. The results also indicated that female students had more positive perceptions than male students of online learning. There was not a significant interaction between gender and ethnicity on students’ perceptions of online learning. Also, a student’s age, country of birth, year in school, enrollment status, previous online enrollment, and number of online classes did not have a significant effect on his or her perceptions of online learning.

Students’ attitudes of the outcomes and benefits of online learning in mathematics education affect their attitudes toward online mathematics education. Caputo (2010) used a mixed-method research process to collect the data. The survey results revealed varied attitudes of mathematics students towards their online education. Although some of the participants were enthusiastic about the idea of an online mathematics course, the other participants felt it was impossible to conduct a successful mathematics course online. In addition, Summers et al. (2005) conducted a study about comparative analysis of student engagement, learning, and satisfaction in lecture hall and online-learning settings. The researchers examined the differences between online distance education and face-to-face classroom learning for an undergraduate statistics course. The sample consisted of 38 undergraduate nursing students at a large Midwestern university. The study found no significant difference in scores between the online and face-to-face learners; however, learners enrolled in the online course expressed less satisfaction with the course than the face-to-face learners did.

Lin's (2008) study of 47 undergraduate students concluded that the most students expressed positive attitudes toward using computers and web-based learning approaches for studying mathematics. The majority of the students in this study felt confident and comfortable using web-based approaches for learning mathematics.

Many factors can affect a student's attitude toward online mathematics education. Studies have shown that these factors are not always consistent, either. Some studies show no differences between male and female students' perceptions. Other studies suggest male students have more positive attitudes, and some other studies show that female students have more positive attitudes. Other factors such as race, ethnicity, and readiness can also affect a students' perception of online learning. These perceptions regard both online learning in general and the teaching and learning of mathematics online.

Theoretical Framework

Theory of Transactional Distance

Many educators, such as Garrison (2000) and Fladd (2007), consider Moore's transactional distance theory one of the most important theories in distance learning. According to Garrison (2000), Moore's transactional distance theory moves the field of distance learning toward the realization of an educational theory. The theory of transactional distance states that distance is a pedagogical phenomenon, not a geographic measurement (Gunawardena & McIsaac, 2004). According to Moore and Kearsley (2005), transactional distance is "the physical distance that leads to a communications gap, a psychological space of potential misunderstandings between the instructors and the learners that has to be bridged by special teaching techniques" (p. 224). Transactional distance theory consists of three variables: dialogue, structure, and learner autonomy.

First, dialogue refers to positive interactions between learners and instructors in e-learning settings (Fladd, 2007; Moore, 1997; Moore & Kearsley, 2005). The dialogue should be purposeful, constructive, and valid for each member taking part (Moore, 1997). Moore and Kearsley (2005) differentiated dialogues and interactions, noting that interactions can be either positive or negative but dialogue includes only positive interactions (see also Fladd, 2007; Moore, 1997). The size of a learning group, the educational philosophy of designers and instructors, the learners' personalities, the subject matter of the course, and the language and medium of communication can all affect dialogue (Moore & Kearsley, 2005).

Second, structure refers to the flexibility of the courses' elements, including learning objectives, instructions, and methods of evaluation (Moore & Kearsley, 2005; Veale, 2009). According to Moore (1997), structure "expresses the rigidity or flexibility of the course's educational objectives, teaching strategies, and evaluation methods; it describes the extent to which course components can accommodate or be responsive to each learner's individual needs" (p. 227). Factors such as the teachers, level of learners, the educational philosophy of the institutional organization, the level of instruction, the subject, the pedagogical model used in teaching the course, and the medium of communication can all affect structure (Falloon, 2011; Fladd, 2007; Moore, 1997; Moore & Kearsley, 2005). Gunawardena and McIsaac (2004) noted that increased structure and decreased student–teacher dialogue increases the transactional distance of an online classroom to a transactional distance similar to those found some in face-to-face settings. They stated, “Greater transactional distance occurs when an educational program has more structure and less student–teacher dialogue, as might be found in some traditional distance education course” (Gunawardena & McIsaac, 2004, p. 361). That is, an educational program that is more structured and has less dialogue between students and teachers leads to a larger transactional distance. In contrast, a program that is less structured and has large amounts of dialogue leads to a smaller transactional distance between students and the instructors (Fladd, 2007; Moore, 1997).

Finally, according to Moore (1997), learner autonomy is the “extent to which in the teaching/learning relationship it is the learner rather than the teacher who determines the goals, the learning experiences, and the evaluation decisions of the learning program” (p. 31). Moore categorized programs according to the degree of autonomy offered to the learner in the preparation for, carrying out of, and assessment of instruction. The highest degree of autonomy allows the learner to participate in all three aspects of instruction, while programs in which the instruction is prepared, carried out, and assessed only by the teachers, has the lowest degree of autonomy (Gunawardena & McIsaac, 2004).

Moore’s theory emphasizes an inverse relationship among dialogue, structure, and learner autonomy. In other words, an increase in one factor can lead to corresponding decreases in others (Falloon, 2011). Moore and Kearsley’s theory has highlighted the important role that interaction plays in an online learning setting and how positive interaction can build a productive learning environment for learners enrolled in online courses.

E-Learning and Interaction

Moore (1989), Hillman, Willis, and Gunawardena (1994), and Moore and Kearsley (2005) have discussed the importance of successful interaction in creating a productive learning setting. E. D. Wagner (1994) defined interaction as “reciprocal events that require at least two objects and two actions. Interaction occurs when these objects and events mutually influence one another” (p. 8). Interaction between students, teachers, and content are very important elements for the learning process in both distance learning and traditional education (Bernard et al., 2009; Jung, Choi, Lim, & Leem, 2002; Moore, 1989; Moore & Kearsley, 2005).

The four types of interactions—learner–content interaction, learner–instructor interaction, learner–learner and learner–interface interaction—are interrelated, interactive, and interdependent. Moore (1989) defined three types: learner–content interaction, learner–instructor interaction, and learner–learner interaction. Hillman et al. (1994) added a fourth type of interaction, which is called learner–interface. They claimed that these categories of Moore’s did not take into account the learner–technology interaction, which occurs between the learner and the technology that is used to administer learning experiences. T. D. Anderson and Garrison (1998) expanded Moore’s original types of interaction to six types of interactions, adding teacher–content interaction, teacher–teacher interaction, and content–content interaction. Bouhnik and Marcus (2006) pointed out that no one of the types of interaction function independently and that they are closely interrelated.

Learner–Content Interaction

Learner–content interaction is the interaction between the learner and content. This type of interaction is a characteristic of education because the process of interacting with content leads to changes in the learner’s perceptions, level of understanding, cognitive structures (Moore, 1989). Learner–content interaction develops mental and physical skills. Examples of learner–content interaction include working on a project or assignment, searching for or reading information, using a study guide or cognitive support software, watching a video, and interacting with computer-based multimedia (Bernard et al., 2009). Bouhnik and Marcus (2006) asserted that choosing the appropriate form of interaction between the learner and the content leads to worthwhile and valuable learning experiences for learners. Thurmond and Wambach (2004) listed some factors that affected students' attitudes toward learner–content interaction, such as clarity of course design, continuous interaction with the content, time available to devote to course content, input in online discussions, and a web-based medium of delivering coursework. They found that learner–content interaction in e-learning settings can help students learn the material. Thurmond and Wambach also discovered that students who contributed more during online discussions had higher levels of learning and achievement. They noted that decreased amount of time participating in an online course is one barrier to learner–content interaction. Nonetheless, e-learning settings can provide learners with opportunities for a richer interaction between the student and the content than traditional learning settings.

Learner–Instructor Interaction

Learner–instructor interaction refers to the interaction between the learners and instructors during actual learning settings (Moore, 1989). According to Bernard et al. (2009), the instructor facilitates coursework, and the instructor seeks to stimulate the learner's attention by encouraging the student to learn the material that is being taught. Moore and Kearsley (2005) stated that the role of instructors in e-learning setting are providing advice, support, and encouragement to the learner based on his or her educational level. In e-learning settings, learner–instructor interaction can be synchronous, such as telephone calls and videoconferences, or asynchronous, such as discussion boards and emails.

Learner–instructor interaction can provide motivational and emotional support. Interaction among learners is an important element in the success of a virtual environment. Fredericksen, Pickett, Shea, Pelz, and Swan (2000) found that learner–instructor interaction was the most significant contributing factor to the students' perceived learning in online courses. Conversely, learners who interact less with their instructors tend to learn less and are less satisfied with their online courses. Thurmond and Wambach (2004) listed some factors in e-learning situations that affect students' attitudes toward learner–instructor interaction, such as the absence of face-to-face interaction, the quality of feedback, and the student's performance in the course. Bouhnik and Marcus (2006) pointed out that the lack of interaction between the learner and instructor created a communicational and psychological gap between learners and their instructors, which, in turn, led to decreased learning outcomes. They added that instructors and learners need to find ways to create a virtual environment to replace the physical classroom setting. In contrast, some studies found that the quality of interaction between learners and instructors in online settings were equal to or better than interactions between learners and instructors in traditional settings (Thurmond & Wambach, 2004).

Learner–Learner Interaction

Learner–learner interaction is defined as the interaction among individual learners or of learners in group settings, with or without the presence of an instructor (Moore, 1989). The aim of learner–learner interaction is to increase knowledge and motivational support (Bernard et al., 2009). According to Bernard et al. (2009), this type of interaction is one of the most important resources for learning because peer discussions improve communication skills, and communication skills are essential for functioning in modern society.

Bouhnik and Marcus (2006) stated that emails, online conferences, and chat rooms were good tools for promoting interaction among learners in e-learning settings, and they argued that course subjects that contained discussion, brainstorming, and reflection were the most appropriate for e-learning settings. They also noted that discussion group interactions allowed learners to overcome their isolation and strengthened their relationships in asynchronous distance-learning settings. Fredericksen et al. (2000) also suggested that learner–learner interaction is a significant contributor to perceived learning in online courses, noting that learners who reported the highest levels of interaction with their peers also had the highest levels of perceived learning in the course.

Learner–Interface Interaction

Hillman et al. (1994) defined learner–interface interaction as “a process of manipulating tools to accomplish a task” (p. 34). They added that the previous three interactions described above “overlooked the effect of high-technology devices on interaction” (Hillman et al., 1994, p. 32). Learner–interface interaction emphasizes skill, access, and attitudes necessary for a successful interaction (T. Anderson, 2003). According to Thurmond and Wambach (2004), factors such as computer experience, perceptions of technology and access to technology can impact learner–interface interaction. Bouhnik and Marcus (2006) suggested that computers offer new types of interaction that are not available in face-to-face settings. The availability of online data and multimedia, the ability to review past discussions, and the accessibility of self and group data all play positive roles for learners to experience being part of a group. Bouhnik and Marcus (2006) added that permitting each individual to assess his or her achievements in comparison to his or her peers' achievements can encourage healthy competition among the learners.

Summary

This chapter presented a brief history of distance education in general and distance education specifically in the Saudi Arabia. The chapter also discussed the need for e-learning in Saudi Arabia, Saudi students' attitudes toward e-learning, challenges for mathematics learners in online settings, and the factors affecting students' attitudes toward online mathematics education. Previous studies show mixed results regarding students' attitudes toward e-learning, and this study addressed Saudi students' attitudes toward e-learning in order to fill this particular gap in the existing literature.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter discusses the methods used to investigate undergraduate mathematics students' attitudes toward online mathematics education in Saudi Arabia. Online education in Saudi Arabia is still in its infancy; therefore, only a few studies have been conducted in this new field of education in that country. Online education holds many advantages for both learners and instructors, as shown in the previous chapters. The information in this study will help educators in Saudi Arabia build better online learning environments for Saudi learners.

Research Design

Online education has become a very important part of the educational system in many developed countries such as the United States and the United Kingdom because it holds many academic benefits for both teachers and students. Educators in Saudi Arabia have realized the value of online learning and how it can help educators overcome some of the obstacles currently preventing them from providing all learners with equal learning opportunities, such as over-enrollment and a shortage of teaching staff.

This study is descriptive in nature, utilizing survey methodology, and it is inferential through comparison of gender and grade-level groups on their attitudes toward online mathematics education. The sample of this study included all undergraduate mathematics majors enrolled at UT. A research survey was conducted to investigate the attitudes of Saudi undergraduate mathematics students toward online mathematics education. Some previous studies have shown that gender does impact students' attitudes toward online education (Isman et al., 2004). Earlier studies have also suggested that students' educational levels affect their attitudes toward online education (Wilson & Allen, 2011). Students in advanced educational levels (upperclassmen) tend to have more experience with online education and can have different attitudes than their peers who are in lower educational levels (underclassmen).

In this study, gender and grade level represent the independent variables, and students' attitudes represent the dependent variable. Descriptive statistics and analysis of variance (ANOVA) were used to analyze the collected data. I hope the findings of this study will be a significant addition to the existing literature in this field and will help other researchers who are interested in pursuing this topic.

Research Questions

The central purpose of this study was to investigate the attitudes of Saudi undergraduate mathematics students toward online mathematics education. Specifically, do Saudi undergraduate mathematics students' genders and educational levels impact their attitudes towards online mathematics education?

In order to address potential differences across gender and grade level groups, these inferential questions needed to be answered:

1. Is there a statistically significant difference between educational-level groups (underclassmen and upperclassmen) of Saudi undergraduate mathematics students in their attitudes toward online mathematics education?

2. Is there a statistically significant difference between the Saudi undergraduate mathematics students' genders and their attitudes toward online mathematics education?
3. Is there a significant interaction between the educational levels of Saudi undergraduate mathematics students and their genders on their attitudes toward online mathematics education?

Null Hypotheses

H_0 1: There is no statistically significant difference between education level groups of Saudi undergraduate mathematics students in their attitudes toward online mathematics education.

H_0 2: There is no statistically significant difference between the Saudi undergraduate mathematics students' gender groups in their attitudes toward online mathematics education.

H_0 3: There is no significant interaction between the educational levels of Saudi undergraduate mathematics students and their gender on their attitudes towards online mathematics instruction.

Study Setting

This study was conducted at UT, which was established in 2005. UT is located in the city of Tabuk, which is in the northwestern part of Saudi Arabia. Students surveyed had not taken any completely online course, but they were aware of hybrid courses through JUSUR, which is a learning-management system e-learning process in Saudi Arabian universities. All students enrolled in the College of Science must complete at least 134 credit hours over a period of four years, and the majority of those credit hours must include their area of specialization. To earn a bachelor's degree in mathematics, a student must successfully complete at least 73 of their credit hours in the area of mathematics. The mathematics department was once part of Tabuk Teachers' Colleges, which prepared elementary mathematics teachers educationally and academically. In 2006, the mathematics department became a part of the College of Science at UT, but the department is still responsible for preparing middle and high school teachers.

Population and Sample

The population and sample of this study included all undergraduate mathematics majors who were enrolled at UT during fall semester 2012. At that time, 72 male students and 89 female students were majoring in mathematics at UT. The students in the study were divided into underclassmen and upperclassmen. Underclassmen students had earned fewer than 68 total credit hours, and upperclassmen students had earned more than 68 total credit hours.

Instrumentation

This study adapted a survey that was developed in 2010 by Caputo in his study, "Undergraduate Mathematics Students' Attitudes towards Online Mathematics Education and Achievement in a Hybrid Calculus Course." The survey was utilized to analyze undergraduate mathematics students' attitudes towards online mathematics education and their subsequent achievement in a hybrid calculus course. Caputo adapted his survey from a study conducted by Lim, Kim, Chen, and Ryder in 2008. Caputo's survey included 20 items and employed a 5-point Likert scale, agree/disagree options, and open-ended comments. The results of this study revealed mathematics students' attitudes towards online education were varied: students were optimistic about the idea of an online mathematics course, but other students felt that it would be impossible to conduct a successful mathematics course online.

The current study used a modified version of Caputo's (2010) survey, after I received permission from Caputo to use and modify his survey. This study only included minor modifications to the original survey format. These modifications were the addition of the independent variables of gender and education level to the demographic section of the survey. In addition, the last part of the survey, which was used to check whether the student agreed or disagreed with specific statements regarding participation in an online mathematics course, employed a 5-point Likert scale instead of the 2-point Likert scale that Caputo used. This approach made the findings consistent with the other parts of Caputo's survey, which used a 5-point Likert scale. The modified version of Caputo's survey included only 23 items.

The survey consisted of five main parts. A copy of the survey is reproduced in Appendix A. The first part of the survey included two items used for demographic purposes. The items in this part inquired about the participants' gender and educational levels. The second part included six items, and those items were used to rate the students' reasons for taking online courses. The items in this part identified some of the reasons students would prefer to take online courses, such as low cost and flexibility regarding time and place. The third part consisted of five items and rated the students' reasons for not taking online courses. This part listed some of the reasons that might prevent learners from enrolling in online courses, such as the lack of immediate feedback and the feeling of isolation during online settings. The fourth part included five items, which evaluated how much or how little the student agreed with specific statements regarding online education issues, such as the reliability of online examinations and the frequency of academic dishonesty in online course settings. The fifth part included five items and asked if the student agreed or disagreed with specific statements regarding participation in an online mathematics course. The survey was translated into the Arabic language, and a pilot study was performed to check the readability and understandability of the survey. The aim behind the field study was to make it easier for the participants to comprehend the full meaning of the statements and items provided in the survey.

Dependent and Independent Variables

Students' attitudes toward online mathematics education, which represented the dependent variable, were measured by the participants' total responses to all items presented in Parts 2 through 5 of the survey. The dependent variable was calculated based on the overall mean scores on Parts 2 through 5. Part 1 of the survey was only used for demographic purposes: grade level (underclassmen/upperclassmen) and gender (male/female) represented the independent variables.

Reliability of the Instrument

As Fraenkel, Wallen, and Hyun noted, "Reliability refers to consistency of the scores obtained" (2012, p. 154). According to Gravetter and Wallnau (2007), "A reliable measurement procedure produces the same or nearly the same scores when the same individuals are measured under the same conditions" (p. 510). The current study employed the same instrument Caputo (2010) used in his study. The test-retest reliability of the original instrument was $r = 0.93$ and the Cronbach's alpha coefficient value was 0.91. Because Caputo adopted his survey from an earlier survey, it was assumed that the reliability would remain constant. The current study employed the same instrument that Caputo utilized, and a Cronbach's alpha was conducted on the data and compared with Caputo's Cronbach's alpha test to ensure that the reliability was constant.

To determine the reliability of the survey, I conducted a Cronbach's alpha coefficient on a sample of Saudi undergraduate students at Indiana State University in Terre Haute, Indiana. There were four female students and seven male students in this sample. The results showed that the Cronbach's alpha coefficient for the survey was 0.81 for 21 items. All items deserve to be in the survey because the greatest increase in Cronbach's alpha coefficient came from deleting item 12, and removing this item only increased Cronbach's alpha coefficient by 0.004.

Validity of the Instrument

Validity is a key consideration when it comes to selecting or designing the instrument for a scientific study (Fraenkel et al., 2012). According to Fraenkel et al. (2012), "validity refers to the appropriateness, meaningfulness, correctness, and usefulness of the inferences a researcher makes" (p. 147). Caputo (2010) established validity for the instrument employed in his study by having the instrument reviewed by several experienced colleagues who had conducted similar studies. As the current study employed an instrument similar to Caputo's instrument, with only minor modifications to the demographic section and no deletion or addition to Caputo's original work, it was assumed that the reliability and validity of the instrument would remain constant.

Procedures and Data Collection

After obtaining approval from the Institutional Review Board, arrangements were made with the General Director of Distance Education Unit (GDDE) at UT to participate in the survey. The GDDE was an assistant professor in the educational technology department at the College of Education and had completed the IRB training. The GDDE agreed to send a letter of invitation to undergraduate mathematics majors enrolled at UT. The distance education unit at UT made arrangements with the Office of Registration and Records to collect the contact information of the undergraduate mathematics students through email. In the letter of invitation, students were informed that their participation was voluntary, that there was no penalty if they did not participate, and that no one would know whether they had participated in this study or not. Participants were informed that the survey would be anonymous and that the participants would not be identified by name or by any other means. The participants were assured about the confidentiality of the information and told that it would only be used for answering the research questions in this study. The participants were also informed that nothing they said on the questionnaire would in any way influence their present or future grades. The participants were also informed that at any time, they could discontinue participation and destroy their copy of the questionnaire.

The letter of invitation provided a date, time, and location for data collection for those who chose to participate. At this meeting, the GDDE provided the participants with a brief description of the study, and he ensured that the participants read and understood the elements of informed consent in the survey cover letter and the letter of invitation. Next, the GDDE distributed a hard copy of the survey to each of the participants in a blank envelope. Participants who completed the survey were then instructed to seal their survey inside the blank envelope and place it in a larger envelope at the front desk. They were informed that their contribution to the research was appreciated and highly valued, but they were not offered any financial or monetary form of compensation for their participation. Then the GDDE left the meeting room. The participants had approximately 10 minutes to complete the survey. After 15 minutes, the GDDE took the envelope and sealed it for delivery to me. Finally, after I collected all of the data from the participants, I stored the hard copy surveys in a secure file cabinet in my office that only I could access. Then I entered the data from the hard-copy questionnaires into a secure SPSS database. The faculty sponsor and I were the only people with access to the database records. The collected data were only used for the purpose of answering the questions in this study. The hard copies of the survey were destroyed once the data from the questionnaires were entered into a secure SPSS database.

Data Analysis

Descriptive statistics and ANOVA were used to analyze the data. As the study's independent variables included grade level (underclassmen/upperclassmen) and gender (male/female), a 2 x 2 ANOVA test was utilized to analyze the data. The results of the ANOVA test revealed if there were any statistically significant differences between the various groups on the basis of gender and educational level, as well as if there was a significant interaction between gender and education level.

Higher mean scores on the survey reflected a positive attitude toward enrolling in online mathematics courses, and lower mean scores reflected a negative attitude toward enrolling in online mathematics courses. Reverse scores were employed for items 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, and 21 (see Appendix A for the specific questions asked in these items). Descriptive statistical scores (such as mean, median, and mode) were utilized to describe the sample and to highlight the differences between the various groups. A mean score between 2.5 and 3.5 was considered a neutral response.

Measurement

For Part 1 of the survey, each item was rated according to the participants' replies. For Parts 2 and 3 of the survey, items were measured on a 5-point Likert scale. In these parts, the participants identified how they felt about each statement on a scale from 1 to 5. For Parts 4 and 5 of the survey, items were measured on a 5-point Likert scale. In these parts, the participants identified their levels of agreement or disagreement for each statement on a scale from 1 to 5. To test the null hypotheses, 2 x 2 ANOVA tests were utilized.

Summary

This chapter addressed the research methodology that was employed in this study. The target sample and population of the study was identified. In addition, the methodology described included the research design and statistical tests used to analyze the data. A detailed description of the study instrument, procedures, data collection, and analysis was provided. The findings and discussion are presented in Chapters 4 and 5.

CHAPTER 4

RESULTS

The goal of this study was to investigate the attitudes of Saudi undergraduate mathematics students toward online mathematics education. A survey was administered to all undergraduate mathematics students at the University of Tabuk (UT), the details of which were described in Chapter 3. Of the 161 students enrolled in the mathematics major at UT, 118 students responded to the survey. Both male and female mathematics students at UT participated in the fall 2012 semester study. A 5-point Likert scale was used to measure an overall score of students' attitudes toward enrolling in online mathematics courses. Descriptive statistics and ANOVA were used to analyze the data.

Descriptive Statistics for the Sample

Of the 118 students who responded to the survey, male students made up approximately 48% (n = 57) of the sample, and female students made up the other 52% (n = 61) of the sample. The students' educational levels were categorized as underclassmen or upperclassmen. Underclassmen made up approximately 49% (n = 58) of the sample, and upperclassmen made up the other 51% (n = 60).

The descriptive statistics for the students surveyed revealed that male students' attitudes toward online mathematics education had a mean of 61.19 and a standard deviation of 12.55. Skewness (0.34) and kurtosis (-0.47) fell within the acceptable limits of normality. Female students' attitudes toward online mathematics education had a mean of 62.42 and a standard deviation of 14.70. Skewness (0.07) and kurtosis (-0.97) fell within the acceptable limits of normality.

The underclassmen's attitudes toward online mathematics education had a mean of 60.21 and a standard deviation of 13.49. Skewness (0.30) and kurtosis (-0.77) fell within the acceptable limits of normality. Furthermore, upperclassmen's attitudes toward online mathematics education had a mean of 63.40 and a standard deviation of 13.75. Skewness (0.10) and kurtosis (-0.70) fell within the acceptable limits of normality.

Descriptive Statistics for the Items

The highest mean score was on item 5 (*M* = 3.86, *SD* = .12), which addressed the advantage of time flexibility for online classes. Furthermore, students had high mean scores on item 6 (*M* = 3.71, *SD* = 1.27), which regarded the student not having to volunteer answers in front of his or her peers, and item 3 (*M* = 3.70, *SD* = 1.33), which concerned the convenient times and locations for online courses. Students had lower mean scores on item 11 (*M* = 2.29, *SD* = 1.29), which was related to the student's perception that an online mathematics course is more difficult than a class offered in a traditional classroom setting, and item 13 (*M* = 2.38, *SD* = 1.06), which represented the students' perception of the reliability of examinations in an online course. The lowest mean score was on item 15 (*M* = 2.27, *SD* = 1.22), which mentioned not seeing or knowing the person grading their work.

Tables 1 and 2 list the means and standard deviations of every group in each question on the survey. These tables reveal how students from each of the four different groups answered each question. Table 1 includes the data for the mean and standard deviation for male students, female students, and both genders. Table 2 provides the data for the mean and standard deviation for underclassmen, upperclassmen, and both educational levels.

Table 1

Descriptive Statistics for Gender Attitudes Toward Online Mathematics Education

	Male		Female		Total	
Items	Mean	*SD*	Mean	*SD*	Mean	*SD*
An online course is easier to schedule.	3.23	1.34	3.33	1.23	3.28	1.28
It allows me to move at my own pace.	3.17	1.25	3.23	1.28	3.20	1.26
Decreases the time of commuting.	3.68	1.36	3.72	1.31	3.70	1.33
Decreases the cost of commuting.	3.56	1.50	3.52	1.32	3.54	1.40
Can study at my own convenience.	3.81	1.20	3.92	1.05	3.86	1.12
Do not have to volunteer answers publicly.	3.74	1.30	3.69	1.24	3.71	1.27
Lack of immediate feedback.	2.42	1.22	2.59	1.28	2.51	1.25
Uneasy attending office hours with unknown teacher.	2.63	1.20	2.70	1.36	2.67	1.28
No interaction with classmates.	2.56	1.27	2.28	1.28	2.41	1.28
Rank compared with the rest of the class.	2.52	1.35	2.74	1.36	2.64	1.36
It more difficult than a traditional class.	2.14	1.29	2.43	1.30	2.29	1.29
More likely to cheat on an assignment.	2.63	1.42	2.91	1.44	2.78	1.43
The reliability of examinations in doubt.	2.40	0.98	2.36	1.14	2.38	1.06
Should have graded projects rather than exams.	2.47	1.07	2.43	1.16	2.45	1.11

Table 1 (continued)

Items	Male Mean	Male *SD*	Female Mean	Female *SD*	Total Mean	Total *SD*
Desire to know the person grading my work	2.35	1.20	2.20	1.23	2.27	1.22
Assignments are the same as traditional classroom assignments.	3.58	1.18	3.51	1.06	3.54	1.11
Online courses are favorable in any subject.	2.89	1.37	3.26	1.26	3.08	1.32
Online courses are not favorable in mathematics.	2.56	1.27	2.85	1.31	2.71	1.29
Would sign up for online mathematics course.	2.91	1.40	3.06	1.34	2.99	1.37
An online course is as a good as a traditional course.	3.31	1.27	3.13	1.28	3.22	1.27
An online grade is inferior to a traditional grade.	2.60	1.39	2.55	1.24	2.58	1.31

Table 2

Descriptive Statistics for Educational Level Attitudes Toward Online Mathematics Education

Items	Male Mean	Male *SD*	Female Mean	Female *SD*	Total Mean	Total *SD*
An online course is easier to schedule.	3.29	1.32	3.27	1.25	3.28	1.28
It allows me to move at my own pace.	3.17	1.33	3.23	1.21	3.20	1.26
Decreases the time of commuting.	3.69	1.37	3.71	1.32	3.70	1.33
Decreases the cost of commuting.	3.57	1.51	3.52	1.31	3.54	1.40

Table 2 (continued)

Items	Male Mean	Male *SD*	Female Mean	Female *SD*	Total Mean	Total *SD*
Can study at my own convenience.	3.81	1.13	3.91	1.12	3.86	1.12
Do not have to volunteer answers publicly.	3.66	1.27	3.77	1.27	3.71	1.27
Lack of immediate feedback.	2.28	1.22	2.73	1.25	2.51	1.25
Uneasy attending office hours with unknown teacher.	2.46	1.26	2.87	1.28	2.67	1.28
No interaction with classmates.	2.34	1.30	2.48	1.25	2.41	1.28
Rank compared with the rest of the class.	2.50	1.40	2.77	1.31	2.64	1.36
It more difficult than a traditional class.	2.07	1.23	2.50	1.33	2.29	1.29
More likely to cheat on an assignment.	2.60	1.39	2.95	1.47	2.78	1.43
The reliability of examinations in doubt.	2.26	1.07	2.50	1.05	2.38	1.06
Should have graded projects rather than exams.	2.41	1.14	2.48	1.10	2.45	1.11
Desire to know the person grading my work.	1.98	1.18	2.55	1.20	2.27	1.22
Assignments are the same as traditional classroom assignments.	3.52	1.23	3.57	1.00	3.54	1.11
Online courses are favorable in any subject.	2.98	1.37	3.18	1.28	3.08	1.32
Online courses are not favorable in mathematics.	2.67	1.38	2.75	1.21	2.71	1.29

Table 2 (continued)

	Male		Female		Total	
Items	Mean	*SD*	Mean	*SD*	Mean	*SD*
Would sign up for online mathematics course.	3.07	1.42	2.92	1.31	2.99	1.37
An online course is as good as a traditional course.	3.41	1.30	3.03	1.23	3.22	1.27
An online grade is inferior to a traditional grade.	2.45	1.39	2.70	1.22	2.58	1.31

In terms of gender variables, female students had higher means in all items except 6, 9, 13, 14, 15, 16, 20, and 21. The highest mean score for female students was on item 5 (M = 3.92, SD = 1.20), which addressed the advantage of time flexibility for online classes, and the lowest mean score for female students was on item 15 (M = 2.20, SD = 1. 23), which concerned not seeing or knowing the person giving them a grade. The highest mean score for male students was on item 5 (M = 3.81, SD = 1.20), which regarded the advantage of time flexibility for online classes, and the lowest mean score was on item 11 (M = 2.14, SD = 1.29), which stated the perception that an online mathematics course is more difficult than a traditional classroom setting. The greatest mean difference was on item 17, which spoke to the students' perceptions that online courses are favorable in any subject area, in which females students reported (M = 3.26, SD = 1.26) compared with (M = 2.89, SD = 1.37) for male students. The least mean difference was on item 3, which concerned students preferring the convenient time and place of online courses.

In terms of educational level, upperclassmen had higher means in all items except in items 1, 19, and 20. The highest mean score of upperclassmen was on item 5 (M = 3.91, SD = 1.24), which regarded the advantage of time flexibility for online classes. The lowest mean scores of upperclassmen were on item 9 (M = 2.48, SD = 1.24), which described the feeling of isolation in online settings, and on item 14 (M = 2.48, SD = 1.10), which expressed the feeling that an online course should have graded projects or assignments rather than exams. The highest mean score of underclassmen was on item 5 (M = 3.81, SD = 1.31), which regarded the advantage of time flexibility for online classes, and the lowest mean score was on item 15 (M = 1.98, SD = 1.18), which mentioned not seeing or knowing the person grading their work. The greatest mean difference between upperclassmen and underclassmen was on item 7, which was related to the student not receiving immediate feedback during an online mathematics course, in which upperclassmen reported (M = 2.73, SD = 1.25) compared with (M = 2.27, SD = 1.22) for underclassmen. The least mean difference was on item 1, which concerned the advantage of scheduling flexibility for online classes.

Reliability

A reliability test was conducted on the data to examine its consistency. Results showed that Cronbach's alpha coefficient for the survey was 0.86 for 21 items. All items deserved to be in the survey because the greatest increase in Cronbach's alpha coefficient came from deleting item 16, and removing this item only increased Cronbach's alpha coefficient by 0.005.

Testing of Research Questions

Testing the Assumption of Normality

In order to use appropriate statistics to analyze the sample data, I checked the homogeneity and normality assumptions, verifying that the ANOVA test could be applied to compare the attitudes across gender and educational levels as well as the interaction between gender and education levels. The Shapiro-Wilk test was used to verify the assumption of normality. The null hypothesis for the Shapiro-Wilk test was that the attitudes variable was normally distributed in each of the four groups. As shown in Table 3, the result of the Shapiro-Wilk test was not significant in any of the four groups. Thus, the assumption of normality was not violated. As mentioned earlier, skewness and kurtosis fell within the acceptable limits of normality in each of the four groups.

Table 3

Test of Normality

	Shapiro-Wilk		
Attitudes	Statistics	*df*	Sig.
Male students	.98	57	.316
Female students	.97	61	.135
Underclassmen	.97	58	.113
Upperclassmen	.97	60	.228

Testing the Assumption of Homogeneity

Levene's test was used to verify the assumption of homogeneity, and the results are shown in Table 4. The null hypothesis of Levene's test was that the error variance for the dependent variable was equal across all groups. The Levene's test for equality of variances in this study was not significant. Thus, the assumption of homogeneity of variance was not violated, and each category of independent variables had similar variance. Because the assumptions of homogeneity and normality were met, the ANOVA test was applied to the data.

Table 4

Levene's Test of Equality of Error Variances

F	*df1*	*df2*	Sig
1.10	3	114	.351

The first question this study asked was whether there was a statistically significant difference between educational-level groups (underclassmen and upperclassmen) of Saudi undergraduate mathematics students regarding their attitudes toward online mathematics education. The result showed that underclassmen did not differ significantly from upperclassmen regarding their attitudes toward online mathematics education, $F(1, 114) = 1.42$, $p = .236$. The 95% confidence interval for the mean difference (3.1) was 2.0 - 8.1. Therefore, I was unable to reject the null hypothesis and concluded that there was not a statistically significant difference between educational-level groups (underclassmen and upperclassmen) of Saudi undergraduate mathematics students in their attitudes toward online mathematics education.

The second question asked whether there was a statistically significant difference between male and female Saudi undergraduate mathematics students (both underclassmen and upperclassmen) regarding their attitudes toward online mathematics education. The result showed that male students did not differ significantly from female students in their attitudes toward online mathematics across educational levels, $F(1, 114) = 0.08$, $p = 0.782$. The 95% confidence interval for the mean difference (0.71) was 4.4 - 5.8. Therefore, I was unable to reject the null hypothesis and concluded that there was no statistically significant difference between male and female students' attitudes toward online mathematics education.

The third question asked if there was a significant interaction between educational level and gender in terms of students' attitudes toward online mathematics education. The result showed no significant interaction between educational level and gender on attitude, $F(1, 114) = .03$, $p = 0.864$. Therefore, I was unable to reject the null hypothesis and concluded that there was no significant interaction between the educational level and gender.

Summary

This chapter presented the result of analyzing the data to answer the study questions. The total number of respondents was 118. Approximately 48% ($n = 57$) of the sample were male students, and 52% ($n = 61$) of the sample were female students. A 2 x 2 ANOVA test was used to reveal any statistically significant differences between the various groups based on gender and educational level. The findings showed that underclassmen did not differ significantly from upperclassmen in their attitudes toward online mathematics, male students did not differ significantly from female students in their attitudes toward online mathematics, and there was no significant interaction between educational level and gender in terms of students' attitudes toward online mathematics education.

CHAPTER 5

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

This chapter discusses the findings of the study, examines implications, and makes recommendations for further research. The main objective of this study was to investigate the attitudes of undergraduate mathematics students in Saudi Arabia toward online mathematics education. Comparisons were made among male and female students and underclassmen and upperclassmen undergraduate mathematics students at the University of Tabuk. Of 161 students enrolled in the mathematics program, 118 mathematics students responded to the survey. The sample consisted of 57 male students and 61 female students. In terms of educational levels, there were 58 underclassmen and 60 upperclassmen in the survey. In order to address potential differences across gender and grade-level groups in terms of their attitudes toward online mathematics, the study investigated the following inferential questions:

1. Is there a statistically significant difference between educational-level groups (underclassmen and upperclassmen) of Saudi undergraduate mathematics students in their attitudes toward online mathematics education?
2. Is there a statistically significant difference between the Saudi undergraduate mathematics students’ gender (male or female) and their attitudes toward online mathematics education?

3. Is there a significant interaction between the educational levels of Saudi undergraduate mathematics students and their gender on their attitudes toward online mathematics education?

The first question was whether there was a statistically significant difference between educational-level groups (underclassmen and upperclassmen) of Saudi undergraduate mathematics students regarding their attitudes toward online mathematics. The result of the ANOVA test showed that underclassmen did not differ significantly from upperclassmen regarding their attitudes toward online mathematics, F (1, 114) = 1.42, p = 0.236.

This finding was similar to the results of a study conducted by Seyal, Ali, Mohamad, and Rahman (2010), which also found no significant difference in undergraduate students' attitudes toward online courses based on their educational level. Al-Khashab (2007), however, had a different result compared to this study and Seyal et al.'s study. Al-Khashab found significant differences in student attitudes toward online courses based on their educational level. The difference in findings between these studies might be attributed to the composition of the sample. Al-Khashab's sample included students from K-12 institutions as well as university students. Al-Kahashab's sample, therefore, significantly increased the range of students' ages in the study. Age is a key factor regarding attitude toward e-learning (D. Z. Ibrahim et al., 2002). In comparison, the range of ages in Seyal et al.'s (2010) sample fell between 20 and 25 years of age. In the current study, the range of the students' ages was also narrow. The narrow range of Saudi universities' students' ages in these two studies is due to the fact that Saudi universities only admit students who have graduated from high school in the last five years, and top priority is given to the most recent high school graduates. Therefore, although this study did not ask students their ages, it was assumed that no students participating in this study were over the age of 25. Thus, the small range of ages within the sample may explain why underclassmen did not differ significantly from upperclassmen regarding their attitudes toward online mathematics.

The second question asked if there was a statistically significant difference between male and female Saudi undergraduate mathematics students in terms of their attitudes toward online mathematics courses. The result of the ANOVA test showed that male students did not differ significantly from female students in their attitudes towards online mathematics across educational levels, F (1, 114) = .08, p = 0.782.

Previous studies investigated the effects of gender on undergraduate students' attitudes toward online courses, and these studies had conflicting results. Some studies indicated that gender is a key factor affecting a student's attitude toward e-learning and that there is a statistically significant difference between the two genders regarding their attitudes toward e-learning (Ashong & Commander, 2012; D. Z. Ibrahim et al., 2002; Liaw & Huang, 2011). Other studies found that there was not a statistically significant difference between genders of undergraduate students regarding their attitudes toward e-learning (Ali et al., 2003; Egbo, Okoyeauzu, Ifeanacho, & Onwumere, 2011; Seyal et al., 2010). For example, Egbo et al. (2011) found that female students did not differ significantly from male students regarding their attitudes toward e-learning, but they also found that female students did have a higher mean than male students in terms of their attitudes toward e-learning. This finding was similar to that of this study.

The studies mentioned previously also had conflicting results when there was a statistical difference between the two genders' attitudes toward online education. Some of these studies found that male students had more positive attitudes toward e-learning than female students (Al-Doub, Goodwin, & Al-Hunaiyyan, 2008; D. Z. Ibrahim et al., 2002; Liaw & Huang, 2011). For example, Liaw and Huang (2011) concluded that there was a statistically significant difference between genders toward e-learning, and male students had more positive attitudes toward e-learning than female students. On the other hand, others studies found that female students had more positive attitudes toward e- learning than male students (Al-Arfaj, 2001).

This current study's findings were supported by those of Ali et al. (2003), Egbo et al. (2011), and Seyal et al. (2010). In this study, as in theirs, there was no statistically significant difference between male and female Saudi undergraduate mathematics students in terms of their attitudes toward online mathematics courses. The difference in findings between this study and the other studies might be attributed to many factors, such as course subject matter, culture, and when the study was conducted. For example, as Macon (2011) noted, "some types of classes are more easily constructed for the online format than other types of classes" (p. 3). Leh and Jobin (2002) added that online education is more effective for certain subjects than others because it is easier to assess the success of instruction in those subjects. This particular study investigated undergraduate student attitudes toward mathematics online courses, while the previous studies did not specify the course subject.

In addition, the students' experiences with prior online courses also impacted their attitudes toward online education (Seyal et al., 2010). The previous studies investigated students who were already taking online courses, but this study investigated students who had not yet taken any online courses. A student's attitude toward online courses might also be affected by how much experience they had with online courses. For example, Dobbs, Waid, and del Carmen (2009) found that a significant number of university students who had taken an online course would like to take another online course in the future.

The third question asked if there was a significant interaction between educational level and gender in terms of attitudes toward online mathematics education. The result showed that there was no significant interaction between educational level and gender on attitude, F (1, 114) = .03, p = .864.

I was unable to reject the null hypothesis and concluded that there was no significant interaction between the educational level and gender. These findings agreed with those of Ashong and Commander (2012), who found that age, country of birth, year in school, enrollment status, previous online course enrollment, and the numbers of online classes previously taken did not have a significant effect on students' perceptions of online learning. This study also showed that there was not a significant interaction between gender and educational level on students' perceptions of online learning.

The interaction between gender and educational level was absent in these findings due to the fact that both male and female students' attitudes changed in a similar pattern for both underclassmen and upperclassmen. An interaction between two variables occurred when the mean difference of one variable depended on the different level of a second variable (Gravetter & Wallnau, 2007). Therefore, the mean difference of gender attitude did not depend on different educational levels and vice versa. The change in gender attitudes increased similarly across educational levels. In terms of upperclassmen-level students, gender difference in the mean students' attitudes toward e-learning was 0.27, compared with 1.15 in the upperclassmen level. The students' attitudes increased similarly across gender from underclassmen to upperclassmen levels. In the male group, underclassmen-upperclassmen difference in the mean students' attitudes toward e-learning was 2.62, compared with 3.5 for the female group.

Looking at the details, male underclassmen's attitudes toward online mathematics education had a mean of 60.09 and a standard deviation of 11.73, compared with a mean of 62.71 and a standard deviation of 13.70 for male upperclassmen's attitudes. Female underclassmen's attitudes toward online mathematics education had a mean of 60.36 and a standard deviation of 15.77 compared with a mean of 63.86 and a standard deviation of 12.55 for female upperclassmen's attitudes. The difference in the mean had a similar pattern for gender and educational-level variables. Although the interaction between gender and educational level was nonsignificant, the mean difference between gender groups and educational groups could not be explained by the interaction between gender and educational level.

Discussion of Survey Items

Even though there were no statistically significant differences between the groups surveyed, the descriptive statistics highlighted important points. Some research has indicated that students have a positive attitude toward online courses, and other research has found that students have negative attitudes toward online courses. On average, the students in this survey had differing attitudes toward online mathematics education, and their attitudes were, on average, neutral. These findings are consistent with Caputo's (2010) findings, as he concluded, "based on the findings of the study, undergraduate mathematics students had varied attitudes about online mathematics" (p. 16). In a study conducted at Tun Abdul Razak University in Malaysia, D. Z. Ibrahim et al. (2002) also found that students had a moderately positive attitude towards online learning.

One explanation for this differing finding in the present study is that students have positive attitudes in terms of the advantages of an online setting, such as flexibility of scheduling and convenient times and locations for online courses. For example, the majority of students indicated that they either agreed (42.1%) or strongly agreed (31.4%) with the advantages of the flexibility of online classes. This result indicated that students felt the deciding factor for preferring to take online mathematics courses was flexibility of time. Kirby, Barbour, and Sharpe (2012) and Dobbs et al. (2009) also found that the greatest reason for students to take online courses is the flexibility.

As mentioned in Chapter 1, most of Saudi Arabia's educational institutions are located in major cities. In the 2010-2011 academic year, for example, 66% of students were enrolled in three states, and the remaining 34% of students were enrolled in the other 10 states (MHE, 2012). Concentrating the educational institutions in major cities limits the students' choices regarding where they could learn. Out-of-state students who wish to pursue higher education must find housing accommodations in major cities, which can be a major deterrent. Dobbs et al. (2009) found that living far from the university was the third most important reason students gave for taking an online course. Similarly, Ali et al. (2003) found that students who lived in villages and small cities were more willing to enroll in e-learning than students who lived in large cities in Saudi Arabia. According to Aljabre (2012), e-learning provides learners with more flexible choices for their learning schedule and location.

Another interesting finding in this study was students' preference for online mathematics courses because they did not have to volunteer answers in front of their peers. This was the second most important reason students listed for taking online mathematics courses. Approximately two-thirds of students surveyed (64.4%) agreed or strongly agreed with the reason for taking online mathematics courses was that they do not have to volunteer answers in front of their peers. In contrast, Caputo (2010) found that the least important reason for students taking online mathematics courses was that they did not have to volunteer answers in front of their peers. The difference in findings between this study and Caputo's study might be attributed to cultural and educational factors among the students surveyed. As Alebaikan and Troudi (2010) noted, "education in Saudi public universities is based on the traditional didactic, lecture-based classroom" (p. 508). In his study at Qassim University, Saudi Arabia, Hamouda (2012) found that "64.2% of students are afraid of speaking in front of others in class" (p. 22).

Although many students preferred not having to volunteer answers in front of their peers, the students in this study also showed a negative attitude toward issues related to the e-learning setting, such as a lack of interaction with classmates and the instructor. Al-Jarf (2005) found that the participants had negative attitudes towards e-learning because the interactions among participants was lacking. Ali et al. (2003) found that many students did not enroll in e-learning because there was a lack of interaction among students and a lack of interaction with instructors.

The descriptive statistics revealed that female students had slightly higher mean attitudes compared to male students, although the difference was not great enough to be statistically significant. These findings agreed with those of Al-Arfaj (2001), who also observed that female students expressed slightly more positive preferences for online education than male students did. In addition, D. M. Anderson and Haddad (2005) noted that the online experience for female learners was more successful in e-learning settings than in face-to-face settings. One explanation for this difference is that female students in Saudi Arabia need e-learning more than male students because religious and cultural factors prevent female students from driving to classes or interacting with male instructors physically. Also, female students have more quality and quantity distance programs (such as Entsab) available than male students in Saudi Arabia. Distance education programs such as Entsab facilitate education for women without the need for them to physically meet with male instructors. Saudi women are more likely to be comfortable with e-learning because the concept is a continuation of a tradition.

Limitations and Further Studies

This study investigated the attitudes of undergraduate mathematics students in Saudi Arabia towards online mathematics education. However, some limitations may have affected the outcomes of this study.

First, the sample in this study was limited to UT, and the sample size was limited to the undergraduate mathematics students enrolled at UT. This study was conducted in a modern university, but an older university with a larger number of students might have a different outcome. Also, this university is located in a small city compared with other cities in Saudi Arabia, which might also have affected the outcome. Further studies that include more than one university, a university in a large city, a larger university, or other variables might increase the reliability of the findings. Although this study had a sample-size limitation, this study was generalizable to universities that are similar in size, age, and location.

Another limitation was the exclusion of some demographic information, such as age, prior experience with computers, level of computer skills, preferred tools of communication, and prior experience with online courses. These factors may also have an affect on the students' attitudes towards online courses, as some studies have already indicated (Ashong & Commander, 2012; Dobbs et al., 2009; Kirby & Sharpe, 2011). Further studies may include these additional factors in order to provide more information about the students' attitudes toward online mathematics education.

This study used a quantitative method with multiple-choice questions. This multiple-choice survey did not allow students to provide reasons or explanations for their answers.

Subsequent studies could use a qualitative research method or mixed method research, adding open-ended questions so that students would be able to provide information that was not specifically asked in the survey questions or to explain the answers that they provided. These types of studies can provide information that could better explain students' attitudes towards online mathematics education.

Implications

Despite the lack of a statistically significant differences between the groups surveyed, the descriptive statistics of this study highlighted important points that educators in Saudi Arabia could take into account in order to understand students' attitudes toward online mathematics education and, therefore, provide efficient and effective online mathematics courses.

A student's attitude toward online education can affect his or her performance in an online course. The descriptive statistics revealed that students had a neutral attitude toward online education both in individual categories and overall. Studies showed that students with positive attitudes perform more successfully than students with neutral or negative attitudes (Berg, 2005). Therefore, educators should understand the reasons behind students' positive or negative attitudes. If the MHE in Saudi Arabia encouraged the development of positive attitudes toward online mathematics courses, they might potentially increase the students' successes in those courses. More positive attitudes toward online courses could lead to increased enrollment in online courses in the future (Kirby et al., 2012).

Students' perceptions of exam security matched the educators' perceptions of exam reliability. Moore (2012) stated that administering a secure exam was a challenging issue in distance education. Conole and Oliver (2006) noted that the biggest barriers in distance education are obtaining enough evidence to identify individual learners and to know whether their work is their own. Although advanced technology and online testing tools are available, the dilemma of ensuring test security still exists. The integrity of tests is impossible to achieve if learners take their exam in non-proctored settings in schools or learning centers (Moore, 2012). This survey also indicated that students worried about the likelihood of administering a reliable exam in an online environment. There are some options for increasing the security of exams. For example, Web-Cams could monitor learners who take online tests, but this technology does not necessarily provide enough evidence to confirm a student's identity. In the future, technology devices such eye printing, finger scanning, and voice identification may be used to identify learners and preserve integrity (Moore, 2012). This result suggests that the university providing the course should allow students to take their exams in proctored settings at nearby schools or libraries, which are usually available even in very small villages in Saudi Arabia. Additionally, a university can develop or provide technology devices that could verify learners' identities.

Nearly two-thirds of the students surveyed agreed that online course grades are inferior to traditional course grades. A full 29.7% of students agreed and 26.3% of students strongly agreed that a grade in an online course was less significant than a grade in a traditional course. Interestingly, the same percentages of students agreed that the quality of an online course is as a good as a traditional course. This means that students did not find the course itself inferior, only the grade in the course. These findings indicated that students overemphasized grades instead of learning and knowledge.

This particular attitude about grades is also reflected by the MHE. Ali et al. (2003) found that many students did not enroll in e-learning because online courses are not accredited by the MHE. In the MHE, completely online degree programs are strictly forbidden, and degree programs that include some online courses lack certificate equivalency. Students are not allowed to take online courses except with strict conditions and a maximum of six credits in the whole program. It would be interesting to conduct a study of MHE attitudes to learn the basis for these beliefs. To increase positive attitudes and perceptions of the grades of online courses, educators of the MHE could work to change their own views about online courses. Mirza (2007) also suggested that the MHE should change its regulations about rejecting university degrees earned through distance learning, noting that distance learning has gained prestige in respected universities such as MIT, Harvard, and Stanford. Degree rejection by the MHE means students cannot acquire governmental jobs or pursue graduate education with their online degree. Ali et al. (2003) suggested that changing MHE regulations about accreditation of online courses could encourage universities to offer online courses. This attitude about grades may also affect students' positive, neutral, or negative attitudes toward an online course.

Another point for educators to consider is the lack of immediate feedback and of interaction with the classmates and teacher in an online course setting. Students in this survey gave low scores to items such as immediate feedback, teacher interaction, and classmate interaction. More than half of students indicated that they either agreed (28.8%) or strongly agreed (26.3%) that immediate feedback was not available in online courses. These numbers indicated that students were concerned about a lack of interaction with their instructors and about receiving immediate feedback for their questions. This result suggested that online instructors should manage their time appropriately to meet the needs of their students, such as setting virtual office hours or offering web chat options.

In addition, the descriptive statistics showed agreement about the lack of interaction with classmates and the teacher in an online course. This finding agreed with that of O'Dwyer, Carey, & Kleiman (2007), who found that the majority of students in the algebra I online course felt that the amount of interaction with their instructors was not adequate for their learning needs. The findings suggested that instructors and system designers needed to establish cooperative e-learning environments, especially for mathematics courses. Students' interactions with their instructors and classmates are critical to learning and are at the core of any educational situation. According to Moore (1989) and Hillman et al. (1994), students who had high levels of interaction also had high levels of learning. Fredericksen et al. (2000) found that learner–instructor interaction was the most significant contributor to perceived learning in online courses. Conversely, learners who had less interaction with their instructors tended to learn less and were less satisfied with their online courses.

The descriptive statistics also revealed that online learning is not viewed as a favorable option for teaching mathematics courses. More than half the students surveyed indicated that they either agreed (33.1%) or strongly agreed (18.6%) that an online course was not a favorable approach for mathematics. Less than 30% of students surveyed agreed or strongly agreed with the statement that online mathematics courses are effective. Students thought that an online course format was favorable for some subjects, but not for mathematics. This attitude is likely due to the symbolic language of math, and translating mathematics symbols into text potentially requires an overwhelming amount of time and effort for the students. To combat this attitude, instructors and course designers need take advantage of many types of technology that could help students translate mathematics symbols into text and make those technologies available through the course website.

Further, the descriptive statistics revealed that students in advanced grade levels had more positive attitudes toward online mathematics courses than students in lower grade levels.

Al-Jabri (2012) also found that Saudi students who were enrolled in advanced grade levels showed greater preference for web-based courses than those who were enrolled in lower grade levels. This finding indicated that awareness of e-learning started at the college level, so students need to start practicing e-learning skills earlier, during grades K-12. A good way to introduce e-learning to younger students is to have students complete an online assignment in a traditional course format. These suggestions agreed with Kirby et al. (2012), whose findings indicated that students' prior experience in high school also led to more positive attitudes toward online courses. Kirby et al. agreed that more positive attitudes toward online courses led to increased enrollment in online courses in the future. Dobbs et al. (2009) found that the majority of university students who had taken an online course in high school wanted to take another online course in the future. Kirby et al. stated that studies found that university students who took an online course in high school tended to be more motivated and self-disciplined. These students also had more academic ability and enrolled in universities immediately after they graduated. Kirby et al. added that university students believed that their high school online learning experiences helped them succeed by developing their learning skills for higher education.

As mentioned earlier, the descriptive statistics revealed that students appreciate the time flexibility offered by online courses. The majority agreed that the advantage of scheduling flexibility of online classes was a deciding factor for preferring to take online mathematics courses. Kirby et al. (2012) and Dobbs et al. (2009) found that the greatest reason for taking online courses was their flexibility. This finding indicated that students are willing to take online education but need more support from educators about the quality of higher education. The

MHE could offer this support by increasing the number of online courses available and making courses available at many different times during the day.

Additionally, the MHE needs to pay attention to the reasons behind students' negative attitudes toward e-learning, such as the lack of interaction and the types of feedback offered. The MHE could offer workshops and training to motivate students toward e-learning and increase the students' awareness about e-learning. The designers and facilitators of online courses should be familiar with programs and tools, which helps them to communicate mathematics in distance learning.

Summary

This chapter discussed the findings of the study, examined the implications, and made recommendations for further research. During this study, I investigated the attitudes of undergraduate mathematics students in Saudi Arabia towards online mathematics education, making comparisons among male, female, underclassmen, and upperclassmen undergraduate mathematics students at the University of Tabuk. The findings showed that underclassmen did not differ significantly from upperclassmen in their attitudes toward online mathematics, male students did not differ significantly from female students in their attitudes toward online mathematics, and there was no significant interaction between educational level and gender in terms of students' attitudes toward online mathematics education. Other studies have shown that students with positive attitudes perform more successfully in courses than students with neutral or negative attitudes. Understanding students' attitudes toward online mathematics education can help educators in Saudi Arabia provide efficient and effective online mathematics courses.

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APPENDIX A: TEACHING MATHEMATICS ONLINE SURVEY

This survey is completely anonymous, so please answer honestly.

Part I: Demographics:

How many credit hours have you successfully completed?

○ Less than 68	○ 68 or more

Please indicate your gender.

○ Male	○ Female

Part II: Please circle the choice after each statement that indicates your opinion.

I would consider taking an online mathematics course because:

No.	Items	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1	It is easier to schedule.	5	4	3	2	1
2	It allows me to move at my own pace.	5	4	3	2	1
3	It saves me the time of commuting.	5	4	3	2	1
4	It save me the money of commuting	5	4	3	2	1
5	I can work during a time of day I feel best suits me.	5	4	3	2	1
6	I don’t have to volunteer answers in front of my peers.	5	4	3	2	1

Part III: Please circle the choice after each statement that indicates your opinion.

I would not consider taking an online mathematics course because:

No.	Items	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
7	I would not be able to ask questions and get immediate feedback.	5	4	3	2	1
8	I would feel uneasy attending office hours for a teacher I don't see in class.	5	4	3	2	1
9	I would not be able to interact with classmates.	5	4	3	2	1
10	I would not be sure how I rank with the rest of the class. ("Am I the only one that doesn't understand?")	5	4	3	2	1
11	I think it would be more difficult than a traditional classroom setting.	5	4	3	2	1

Part IV: Tell how you agree with the following statements:

No.	Items	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
12	I feel I would be more likely to cheat on an assignment in an online course rather than a classroom course.	5	4	3	2	1
13	I don't believe a reliable exam is possible to administer online.	5	4	3	2	1
14	I feel that an online course should have graded projects/assignments rather than exams.	5	4	3	2	1
15	I would like to have seen/known the person giving me my grade.	5	4	3	2	1
16	I don't think assignments would be treated differently in an online course versus a traditional classroom course.	5	4	3	2	1

Part V: Tell how you agree with the following statements.

No.	Items	Strongly Agree	Agree	Neither Agree nor disagree	Disagree	Strongly Disagree
17	I think online courses are favorable in any subject area.	5	4	3	2	1
18	I think online course are favorable in certain subjects, but not mathematics.	5	4	3	2	1
19	If an online mathematics course was offered, I would sign up.	5	4	3	2	1
20	An online course would present the same level of difficulty as a traditional course.	5	4	3	2	1
21	I would feel that my grade in an online course would be less significant to me than my grade in a traditional course.	5	4	3	2	1

APPENDIX B: PERMISSION TO USE AND MODIFY ORIGINAL SURVEY

From: MATTHEW CAPUTO [MATTHEW_CAPUTO@exchange.fitnyc.edu]
Sent: Tuesday, November 15, 2011 5:24 PM
To: balrehaili@indstate.edu
Subject: Dissertation Permission

Bakheet,
I am officially giving you permission to use and modify the survey you found in my dissertation research "*Undergraduate mathematics students' attitudes towards online mathematics education and achievement in a hybrid calculus course*". . If you could return the favor by providing my [*sic*] a copy of completed research for my own perusal [*sic*], I would very much appreciate it. Feel free to send to this email or mgmc62480@aol.com, which is my personal email address.
If I can be of any additional assistance, please do not hesitate to ask.
--Matt Caputo

APPENDIX C: INSTITUTIONAL REVIEW BOARD APPROVAL

Indiana State University
More. From day one.

Institutional Review Board

Terre Haute, Indiana 47809
812-237-3092
Fax 812-237-3092

DATE:	October 1, 2012
TO:	Bakheet Alrehaili
FROM:	Indiana State University Institutional Review Board
STUDY TITLE:	[378037-1] Undergraduate Mathematics Students' Attitudes toward using E-learning in Saudi Arabia
IRB REFERENCE #:	
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF EXEMPT STATUS
DECISION DATE:	October 1, 2012
REVIEW CATEGORY:	Exemption category # 2

Thank you for your submission of New Project materials for this research study. The Indiana State University Institutional Review Board has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations (45 CFR 46). You do not need to submit continuation requests or a completion report. Should you need to make modifications to your protocol or informed consent forms that do not fall within the exempt categories, you will have to reapply to the IRB for review of your modified study.

Informed Consent: All ISU faculty, staff, and students conducting human subjects research within the "exempt" category are still ethically bound to follow the basic ethical principles of the Belmont Report: a) respect for persons; 2) beneficence; and 3) justice. These three principles are best reflected in the practice of obtaining informed consent.

If you have any questions, please contact Dr. Vicki Hammen within IRBNet by clicking on the study title on the "My Projects" screen and the "Send Project Mail" button on the left side of the "New Project Message" screen. I wish you well in completing your study.