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Mathematical Teachers' Perception: Mobile Learning and Constructing 21st Century Collaborative Cloud-Computing Environments in Elementary Public Schools in the State of Kuwait

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MATHEMATICAL TEACHERS' PERCEPTION: MOBILE LEARNING AND CONSTRUCTING 21ST CENTURY COLLABORATIVE CLOUD-COMPUTING ENVIRONMENTS IN ELEMENTARY PUBLIC SCHOOLS IN THE STATE OF KUWAIT

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ABSTRACT

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The purpose of this study was to examine Kuwaiti mathematical elementary teachers' perceptions about their ability to integrate M-learning (mobile learning) into their current teaching practices and the major barriers hindering teachers' ability to create an M-learning environment. Furthermore, this study sought to understand teachers' perceptions about their ability to create a collaborative cloud-computing learning environment that corresponds with the 21st century skills and possibly explain their readiness for future reformation of education in Kuwait.

Using an Internet-based format to this study quantitative and qualitative data, the Technological Pedagogical Content Knowledge (TPACK) and barriers survey gleaned quantitative information about how mathematics teachers and a head of a mathematics department (n = 562) viewed use of technology as well as the barriers they faced in integrating it into the classroom. Also, qualitative data were collected using a survey of open-ended questions to provide context to survey answers and better understand the barriers and affordance experienced by the participants. Moreover, a 21st century open-ended questionnaire was employed to collect qualitative information from mathematics teachers and head of the departments (n = 21) in regard the their ability to construct a 21st century learning environment based on collaboration and constructivist perspective utilizing a cloud-computing technology.

Quantitative analysis was utilized to examine elementary mathematics teachers' perceptions using the TPACK survey, and the validity and reliability of the TPACK subscales were computed by administering the confirmatory factor analysis. Factors that were elicited were specified as: all seven subscales encompassed in the TPACK survey significantly fit model of factor structures, and the TPACK survey was reliable and valid. In addition, descriptive analysis such as the TPACK subscale means and standard deviations were computed via the SPSS software.

Qualitative content analysis was used to understand teachers' perceptions about their ability to integrate mobile technology, perceptions of the primary barriers and affordance that limited their ability, and their perceptions of their ability to integrate collaborative cloud computing and create a 21st century learning environment based on the constructivist perspective. When analyzed, the self-reported open-ended survey yielded the following specific themes: (a) teachers perceived themselves high in their ability to integrate mobile technology; (b) the primary barriers based on teachers' perceptions were budget constraints, IT limitations, time constraints, and administrative support; and (c) teachers perceived themselves high in their ability to integrate collaborative cloud computing to construct a 21st century learning environment based on the constructivist perspective. This study finding could be implemented to create a new modern mathematics elementary curriculum that resolves the current curriculum issues. Future research is recommended in the direction of creating a new mathematical curriculum based on administrators', parents', and students' perspectives.

DEDICATION

Family is like a tree. All parts of it go through the same process and help each other to grow into a beautiful tree. No matter what part of the tree will eventually become the fruit, the hope is to accomplish the ultimate goal of growing a tasteful fruit. Thank you to my family, thank you for sharing your time, effort, and emotion with me….

Thank you, Abdulaziz, for sharing with me your funny jokes to make me smile when I felt lonely in my long journey.

Thank you, Jawad, for your nice and kind words to help me stay strong when I was breaking under pressure.

Thank you, Zainab, for sharing your precious tears with me and making me feel happy when I was crying from hard moments.

Thank you, Hashim, for sharing your confidence and pride in me to encourage me to believe in myself when I was hesitant to go beyond my ability.

Thank you to my husband for supporting me to fulfill my DREAM.

Finally, I dedicate all this work to the souls of my parents, who I know they will be proud of me. I know both of you will not be beside me in my graduation ceremony but you have and will always live inside my heart.

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During our journey of life we meet many people. However, very few people have tremendous impact on our lives, and we will remember them for the rest of our lives. These people might not be our families or close friends but they combine the feelings of both. We have this sense of confidence and success in their presence. We feel warm feelings and support through their words and smiles.

Thank you to my advisor, Dr. Mia Williams, for your limitless support and endless efforts to guide me in grasping the light of valuable knowledge. You shared inexhaustible hours of hard work with me to lead me through this journey and enable me to excel. I am appreciative of all my committee members for sharing their precious knowledge and expertise with me. Thank you for everyone who shared their time and effort to help me succeed.

You helped me learn that great accomplishments do not come from achieving my dreams alone but that the true achievements are to fulfill my dreams with people who care. I will walk each step in my commencement with great pride and confidence and these steps are definitely comprised of your munificent support and encouragement.

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CHAPTER I

INTRODUCTION

"What will it take to prepare today's students for their future in a world that may look very different from today?" (www.roadmap21.org, p. 4)

The Net Generation and Technology Availability

Today's students are digital natives (Prensky, 2005). The digital generation, youth born between1990 and 2000, are so named because they were born during the digital revolution. Therefore, they embrace the intensive use of the Internet, cell phones, social networking tools, and video games (Sheets, 2001). Small and Vorgan (2008), for example, identified children today as digital natives, individually living in a world constructed around technology. This reality assures current students are more familiar with digital technology than previous generations of learners, and they are accustomed to the rapid technological changes (Levine, 2010; Lusk, 2010; Yakel, Conway, Hedstrom, & Wallace, 2011). Likewise, new emerging technologies surrounding digital learners are changing the content standards for their methods of socializing, communicating, collecting, sharing, reporting, searching, and learning (Prensky, 2005). Therefore, educators should support this digitalized generation's technological needs to promote positive growth and maximize their learning in order to create the leaders of the 21st century.

Mobile Technology and M-learning (Mobile Learning)

In the 21st century, students are expecting their schools to be equipped with connected computers with fast and uninterrupted access to the Internet, but in some cases, learners find that their schools possess outdated or non-functioning computers with teachers who have little experience in functioning with these computers and other advanced technology (Norris, Mason, & Lefrere, 2003). Changing a school's subculture is necessary to achieve functional technology integration; schools should possess adequate and modern equipment that is consistently connected to the Internet if educators are hopping to transform schools and prepare learners to acquire the necessary 21st century skills (Tapscott, 2001). Under those current circumstances, many schools in the United States are using the "one-to-one" laptop programs (i.e., M-learning) to help personalize learning environments and increase technology usage. Such programs assist learners to extensively use technology (i.e., laptops) and the Internet anytime/anywhere (Wilson, 2006). Indeed, tremendous studies found that enabling learners to attain mobile technology and having access to the Internet improved the quality of learning inside and outside the classroom (Grimes & Warschauer, 2008; Inan & Lowther, 2010a). Nowadays, technology is rapidly changing, and the use of new and global technologies (i.e., mobile devices) is spreading. As such, smart phones, portable gaming systems, iPods, and tablets are available to expand Internet accessibility and technology integration in the classroom (Cheung, 2009).

In addition, technological inventions are acknowledged as renovation agents that are shaping students' learning environments and reconstructing their cultural and social practices in schools. This notion corresponds with Kukulska-Hulme's (2009) statement that "widespread ownership of mobile phones and the increasing availability of other portable and wireless devices have been changing the landscape of technology-supported learning" (p. 157). In this regard, mobile learning (i.e., M-learning) is rapidly expanding the learning horizon. Educators have acknowledged the benefits of mobile and handheld technology for years; it is not a relatively new learning concept (Tu, 2005). Nowadays, most learners possess handheld mobile devices (e.g., tablets, smartphones, laptops, and netbooks) with frequent, easy, and available wireless access; this advantage strongly introduced M-learning as a feasible learning opportunity (Norris & Soloway, 2008). M-learning and mobile technology are key tools available to today's learners. Palfrey and Gasser (2008) described learners of the 21st century as collaborative, independent scholars and multitasking individuals.

The 21st Century Skills

"Schools are stuck in the 20th century. Students have rushed into the 21st. How can schools catch up and provide students with a relevant education?" (Prensky, 2005, p. 8). In the same manner, Dilworth et al. (2012) concurred with Prensky's perspective that technology is in constant revitalization and development, which has a significant impact on how educators teach and, in turn, how learners learn. In addition, educators must admit that the traditional schooling system is considered passé in satisfying today's educational goals and challenges (Levine, 2010). It is worth mentioning that Laughlin (2014) stated that all of the 21st century skills proposed by Partnership for 21st Century Skills (P21) are important for learners' future success, but most of these skills are certainly not novel. Identifying these particular skills by the P21 as skills for the 21st

century supported the importance of including these skills within the structure of the modern classroom.

The P21 national organization was developed and funded by the Department of Education in the United States in 2002 to ensure that 21st century education would serve all learners (Dede, 2010; Jennings, 2010). The P21 framework perspective is based on the idea that to prepare today's learners to succeed in the 21st century work and life, they must adequately master contemporary skills, expertise, and knowledge proposed by the P21 (Partnership for 21st Century Skills, 2009, p. 1).

For the purpose of this study, the 21st century skills will be defined based on the P21 framework. To illustrate, the P21 framework categorized the skills of the 21st century into four primary categories:

1. Core Subjects and 21st Century Themes: emphasizes the responsibility of learners to adequately grasp interdisciplinary topics (e.g., recognizing the global challenges and the ability of making sufficient economic choices).

2. Learning and Innovation Skills: focuses on the significance of the four Cs skills; namely, communication, creativity, collaboration, and critical thinking. The four Cs skills are important in assisting learners to be prepared for challenges of the 21st century's complex life and working settings (Partnership for 21st Century Skills, 2009, p. 3).

3. Information, Media, and Technology Skills: emphasizes the significance of learners in the 21st century to adequately interact (i.e., produce and consume) with information in multiple formats.

4. Life and Career Skills: focuses on the learners' need to master skills such as initiative, flexibility, and productivity to enable students to compete globally in exploring the complexity of 21st century life and work settings (Partnership for 21st Century Skills, 2009, p. 6).

In other words, adopting P21's perspective to prepare future learners' foci around their ability to construct concrete core subject knowledge will enable them to think critically in solving future life and work issues and develop their ability to reflect awareness of how to explore and subsidize expanding knowledge in a diverse and global environment.

Although tremendous efforts exist in the United States to improve the performance of learners, teachers, and schools and to encourage learners and teachers to adopt the 21^{st} century skills, expertise, knowledge, and preparation, success is limited. Expanding upon this, Laughlin (2014) stated that no significant improvement could be recognized when he closely observed the pedagogical, content, and technological practices adopted in current classrooms; instead, a notable disconnection between school and the real life and work demands was obvious. This corresponds with the American Management Association's (2010) statistics that 51.4% of executives and 46.9% of participants indicated "average" communications skills, creativity, and innovation among their current employees working in the real world. Unfortunately, 15 years into the 21^{st} century, many educators, districts, and ministries of education around the globe are standing perplexed and uncertain as to how to effectively accommodate the influence of rapid changes in technology on learners' attitudes and how to improve the schooling experience to correspond with the 21^{st} century demands. In other words, according to

Bellanca and Brandt (2010), dramatic changes exist in the current world due to the technological advancements and the global market.

As a result, the rise of global competition and collaboration is obligatory due to the revolution in communication and information. Therefore, this significant and rapid change in the world and people (i.e., learners) encourages a need to cope with and adopt the 21st century skills in order to enhance the chances of success in the new global workplace.

Students' Collaboration

A learning context in a conventional classroom could be categorized into two types of interactions: (a) student-teacher interaction, and (b) student-student interaction (So & Brush, 2008). Furthermore, social collaboration in the classroom could be defined as the setting in which learners accomplish assigned tasks together in small groups (Diemer, Fernandez, & Streepey, 2012). In fact, collaborative learning is considered an instructional method in which a group of students interacts with each other and shares their experience and skills to resolve a task to achieve a desirable learning goal (So & Brush, 2008). According to Vesely, Bloom, and Sherlock (2007), collaboration exists when groups of learners interact and collaborate to explore a specific purpose and task. In the same regard, the complex processes that control the interaction between learners and their surrounding social environment will have tremendous impact on maintaining motivation in the learners' collaboration (Jarvela, Jarvenoja, & Veermans, 2008).

In addition, there is evidence in the literature confirming the existence of the relationship between school climate (i.e., collaboration) and learners' achievement (Kraft & Papay, 2014). However, collaboration is not an easy task to accomplish (Reeves, 2004). The teacher is the primary agent in constructing the classroom environment and teaching practices. Thus, maximizing collaboration in schools needs to start with empowering teachers to possess more control and authority over the curriculum they are delivering to learners (Holmquist, 2010). Furthermore, Stronge (2007) emphasized the importance of the teachers' roles in constructing what, who, and how much learners learn, taking into consideration the influence of the learning environment, curriculum content, and peer interaction on students' engagement. Throughout the last decade, a handful of research has demonstrated the usability and capability of technology to improve the quality of student-student and teacher-student interaction (i.e., social collaboration) in the classroom (Francescato et al., 2006). Indeed, technology is a learning culture; this leads elementary teachers to understand that students' engagement will enhance their students' learning.

Cloud Computing

In the past few years, the notion of online document storing and collaboration was considered a fanciful idea (Mühlmann, 2014). Currently, the Internet connection speed and Internet users' numbers (i.e., 6.3 billion Internet connection speed tests) are expanding worldwide (Ookla Netindex, 2014). As a result, the users around the globe are striving to create a new, advanced system that can compensate between the advantages and needs of users in different disciplines. This notion corresponds with Mühlmann's (2014) perspective about the need for creating a new learning system (e.g., cloud computing) where data could be transferred and stored for feasibly effective individuals' collaboration via the operation of multiple and different devices (e.g., mobile technology) that overcomes the technical obstacles. He also suggested transferring the data storage from the terminal devices and providing a virtual environment embedded in the cloud (e.g., cloud computing).

Storing different types of data on a server is not the main and only function of cloud computing; users' (e.g., teachers and learners) needs are satisfied by cloud computing via the robust connections between multiple and different technologies (e.g., mobile technologies) linked into one learning environment (Mühlmann, 2014). Recently, mobile devices are no longer utilized for voice communication only. Indeed, the advanced and sophisticated built-in features (i.e., Bluetooth, GPS, front and back cameras, data communication, etc.) enable mobile devices to play other significant roles in multiple disciplines (e.g., cloud computing). Simultaneously, the compound multifunction software functions have encouraged the administration of mobile devices such as smartphones and tablets in different tasks and activities (i.e., pedagogy practices in mathematics content) (Vemulapalli, 2014). Nowadays, schools are utilizing a private central computing system that manages and operates synchronous and asynchronous teaching and learning environments, multiple teaching materials formats, collaborative group learning, and interactive curriculum (Vujin, 2011).

In some classrooms across the K-12 schools, learners could use mobile devices they possess and interact with the teacher and learners via audio/visual subsidiary applications (Luckerson, 2014). The cloud computing is the primary source that connects these entire multiple and distinct mobile devices together and ensures effective collaboration practices between all individuals (e.g., learners, teachers, administrators, and parents). A beneficial example of integrating a cloud-computing-based concept in K-12 schools corresponds with Tom's (2014) suggestion to provide computers or tablets to all students, facilitating the use of personal mobile devices in the classroom, which he considers an advantage for using cloud computing in classrooms.

Mathematics

It is evident from the literature that tremendous advantages are associated with the utilization of different mobile technologies in K-12 classrooms in enhancing learners' and teachers' performance. Indeed, technology integration is obtained as a byproduct (Jackson, Helms, Jackson, & Gum, 2011). As relative evidence, Eyyam and Yaratan (2014) conducted a study in a K-12 space in which the mathematics classroom was divided into two groups; one group utilized the conventional mathematical format (i.e., paper test), and the other group utilized an online version of the same test (i.e., computer as a tool). The findings indicated the learners in the online test group performed better than the group using the paper-based test. It is worth mentioning that Eklund (2015) stated that the constructivist collaboration learning approach could be facilitated via cloud technology. Further, Denton (2012) agreed sharing files and employing online collaborative instruments as cloud-computing solutions provided collaborative learning opportunities for learners to work in a group to accomplish a specific task. Also, Denton (2012) emphasized the importance of constructivism as a learning approach to improve learners' performance via the utilization of a cloud-computing-based environment. He suggested that learners are urged to engage with their existence knowledge when encountering constructivist learning opportunities (e.g., mathematics). Additionally, effective teachers who adopt the discourse (i.e., communication and collaboration) concept when structuring their classroom learning environment are able to enhance learners' mathematical understanding (Franke, Kazemi, & Battey, 2007; Franke et al., 2009). Besides, teachers' facilitation of mathematical discussions (i.e., collaboration) might encourage learners to integrate their experiences and knowledge to explore, understand, and solve mathematical problems with the use of mathematical language and improve their learning (Ball, Thames, & Phelps, 2008).

Theoretical Framework

Constructivism Learning Theory

Constructivism originated in the theories of Piaget and posits learning is constructed via social activity (Clinton & Rieber, 2010). The constructivist approach to teaching focuses on learning environments that are technology-based and which enable learners to construct knowledge. Inside the construct of constructivism sit two similar, but meaningfully different, viewpoints. The line of thinking directly from Piaget argues that knowledge is constructed via the cognitive processes of the learner, whereas the form of constructivism from Vygotsky acknowledges that knowledge is constructed, rather than passively received, but that social and cultural interactions are central to an individual's ability to construct meaning (Szili & Sobels, 2011). It is this view of knowledge, constructed from social and cultural interactions and forces, that leads directly to constructivism.

Constructivism is important as a foundation for technology-based instruction because cooperative learning and construction of knowledge are well supported by numerous technologies, including cloud computing (Denton, 2012). For example, learners are likely to use prior knowledge to construct new knowledge. Moreover, cloud-computing processes fit this process well. As learners explore new information, analyze it, and reflect upon it, a platform for easily referencing relevant information that has already been gathered can allow for a more efficient and enjoyable experience. In addition, cloud computing makes this possible, particularly because classmates and teachers can all add relevant information and remove information that is discovered to be irrelevant in a learning task, in real time. Further, the sharing and manipulation of a shared body of information is a cooperative activity based on time and place, as suggested by constructivism (Denton, 2012). Therefore, cloud computing serves as an efficient vehicle for this kind of learning and reinforces the effectiveness of technology-based learning.

Technological Pedagogical Content Knowledge Framework

This research is premised on the Technological Pedagogical Content Knowledge framework (TPACK). This framework provides ways to show the educators' understanding of and skills to (abilities) integrate technology combined with pedagogy and content knowledge in their classroom (Parr, Bellis, & Bulfin, 2013). Therefore, teachers' must recognize representation of using technology in the classroom, pedagogical strategies employ technologies to transfer the content knowledge in a constructive manner, realization of the ways that make learning tasks easy or difficult to understand and diminish issues learners encounter by integrating technology in the classroom (Koehler & Mishra, 2009). For this reason, understanding teachers' perception about their ability to sufficiently integrate new technology (i.e., mobile technology) is significant for their teaching effectiveness. There is a wide spread of integration methods of M-technology (such as smartphones, tablets, and laptops) between students in public schools. Of course, any learning experience has potential benefits and determent that should be clearly examined to successfully implement technology in teaching environments. Therefore, examining the integration of M-technology to facilitate content knowledge transformation might assist teachers to sufficiently integrate it in their classrooms to improve teaching effectiveness.

The State of Kuwait

The State of Kuwait is an Arabic country in the Middle Eastern region. Specifically, Kuwait is located on the Arabian Gulf (Government of Kuwait, 2015a). Although Kuwait is smaller in size than the state of New Jersey in the United States with a land area of 6,880 square miles, Kuwait has succeeded in constructing a substantial educational system (Government of Kuwait, 2015a). Additionally, according to the 2012 census, the Kuwaiti population has increased and is estimated at 1,128,381 citizens, compared to the population of 206,473 citizens in the first official census in 1957 (Government of Kuwait, 2015b). In particular, the population of Kuwait is becoming more dependent on technology and the accessibility of the Internet. As evidence, according to the United Nations Development Programme (2010), the Internet users (Internet users are people with access to the worldwide network) in the State of Kuwait increased from 131,000 in 2000 to 1,050,000 in 2010. This enormous increase in the use of the Internet means almost half of the Kuwaiti population has access and use of the Internet.

It is worth mentioning that Kuwait was, and still is, considered a pioneer country in the Middle East in the educational field. Currently, education in Kuwait is in the reformation era. Kuwait is trying to construct education in schools to correspond with the 21st century learning environment's characteristics. Nonetheless, in the last few years, the Ministry of Education (MOE) has had difficulties in effectively integrating E-learning and M-learning into their school system. Thus, paradoxical feelings exist between educators in the field of education in Kuwait. This overshadowing ambiguity resulted from hesitant attempts taken by the Ministry of Education (MOE) to transform learning experiences across all grades, K-12, from old paper-version textbooks into modern electronic-version textbooks. Yet, this tremendous struggle in changing the textbook format is not the only problem. How to integrate contemporary technology, such as mobile technology in classrooms, is another concern that exhausts all personnel of the MOE. As evidence, in the last five years, the MOE, representing the government of the State of Kuwait, made many attempts to change the infrastructure of education via reforming the curricula for subjects, classroom structures, and pedagogical practices. Also, the MOE encourages K-12 teachers to integrate mobile technology into their classrooms and infuse technology in their pedagogy and content practices. Unfortunately, all previous attempts to digitize education in Kuwait failed to achieve the desired result. Some of these efforts follow:

1. Digitalizing textbooks (2011). An enormous and serious attempt was to digitize all 1st to 12th grade textbooks into electronic textbook versions and installing the electronic version of the textbooks on flash drives; the flash drive was supposed to replace the original physical textbook and was distributed at the beginning of the year to pupils across all grades (The Regional Center of Development of Educational Software, 2011).

2. Distribution of the digital white board for high schools. The MOE (2011) distributed digital white boards to all high schools in all educational districts across Kuwait. Unfortunately, the digital white board did not accomplish the desired tasks, and

it's use ended due to many reasons, including teachers' lack of successfully operating the digital white board.

3. At the beginning of the 2015 academic year, the Ministry of Education bought iPads for 76,045,878 million US dollars. The educational specialists in the MOE were hoping to overcome the challenges that hindered the success of all previous efforts to digitize the education in Kuwait by reforming the infrastructure of learning into e-learning (i.e., M-learning) with the use of iPads and other mobile technologies.

In this regard, all previous attempts failed to accomplish the desired outcomes to digitize education in Kuwait and did not encourage teachers to construct smart classrooms. Nevertheless, the failure to succeed in shifting education toward E-learning and M-learning could be linked to many factors, such as teachers, students, parents, facilities, and curricula as well as school and institution policies. For instance, the curriculum for mathematics at the elementary level has changed twice in less than five years. For the purpose of this study, it is obvious that the MOE is determined to construct a modern E-learning environment, and it is necessary to understand the influence of all factors engaged in this intertwined process. Therefore, examining and understanding the teachers' perceptions about their readiness and proficiency in utilizing and integrating the new mobile technologies the MOE is willing to fund to help create a contemporary learning environment (M-learning) is crucial to overcoming challenges and obstacles that might hinder the success of creating a 21st century learning environment. In conclusion, Kuwait is a wealthy country and providing contemporary technology or providing high technology to schools will not be a huge financial issue.

Because of this, Kuwaiti teachers have numerous responsibilities to secure the success of future attempts to move education into the 21st century mathematical learning environment. Therefore, elementary mathematical teachers' perceptions about their ability to construct cloud computing collaborative learning environments with the use of mobile technology will be the key to future success for educational system in Kuwait. Finally, this study attempted to reduce the gap in the literature in regard to understanding the teachers' perspective of the reasons that could be utilized to enhance their ability to construct cloud computing and the M-learning experience based on mobile technology. Specifically, there is no research that studies M-learning, cloud computing, collaboration, or mathematics with elementary teachers in Kuwait.

Need for this Study

Current research shows learners in schools, across all grades, are progressively detached from learning content in their school and the surrounding environments outside of their school. Researchers proposed the reasons for learners withdrawing from school are related to an educational system (e.g., school) that does not synchronize with the high-technological world surrounding them in their everyday world (Dede, 2005; Geraci, 2005; Strauss, 2005).

Most of the Arabic countries in the Middle East (i.e., including Kuwait) share a general educational system. According to Al-Mughaidi (2009) in the third report of the Arab Human Development, the educational system in most Arabic countries (including Kuwait) lacks quality. The report identified that the curriculum, assessment methods, and methods of teaching were based on direct instruction (e.g., indoctrination and passive learning), limiting opportunities for dialogue types of discussion and critical thinking.

Kuwait is a country striving to develop its educational system to work abreast of all other sectors of the country in order to face the rapid changes taking place in the rest of the world. Also, preparing the students to adopt the 21st century skills is crucial and difficult at the same time. In this regard, the Ministry of Education is offering millions of dollars in an attempt to reform education (i.e., E-learning and M-learning) in Kuwait. Since education is a complex concept that results from the efficiency of the interplay among many factors such as teachers, students, administers, and curriculum, there is a need for examining and understanding what is preventing teachers from accomplishing the MOE's desired goals as well as understanding why they are not able to effectively reform their learning environments into smart and digital classrooms. In this case, there is a need to explore the reasons Kuwait has not achieved the desired improvement in the educational performance in all areas and does not correspond with the educational systems in developed countries, especially when the budget is of no concern. More specifically, research examining and understanding why teachers are unable to successfully integrate technology in learning (i.e., E-learning and M-learning) and what teachers' perceptions are regarding the factors that hinder their ability to integrate technology to create collaboration (i.e., cloud computing) in the 21st century learning environment is significant because the learners of this century need to acquire 21st century skills in order to succeed in the global workplace.

Purpose of this Study

The purpose of the study was to examine Kuwaiti mathematical elementary teachers' perceptions about their ability to integrate M-learning into their current teaching practices and the major barriers hindering teachers' ability to create an M-learning environment. Furthermore, this study sought to understand teachers' perceptions about their ability to create a collaborative cloud-computing learning environment that corresponds with the 21st century skills and might explain their readiness for future reformation of education in Kuwait. Specifically, mathematical teachers at the elementary level (i.e., first to fifth grade) were asked to describe their reasons for and the major barriers that hinder their ability to integrate mobile technology in the elementary classrooms in different educational districts. A mixed research method was utilized to identify reasons (e.g., positive and negative) that have an impact on mathematical teachers' aspirations to create a 21st century learning environment.

Research Questions

In order to explore these topics, the following research questions guided the study:

Q1 What are the Kuwait teachers' current perceptions about their ability to integrate mobile learning technology in their classroom?

Q2 What are the major affordances and constraints impacting Kuwait teachers' ability to prepare future-ready students through an integrated technology environment?

Q3 What are the Kuwait teachers' perceptions about their ability to construct learning experiences promoting 21st century skills in collaborative cloud computing environments that applies constructivist perspective?

Significance of this Study

The 21st century skills are currently viewed as fundamental and universal skills for learners' success in the current world (Levy & Murnane, 2007). This study is significant because it introduced an explanation of elementary teachers' perceptions about their ability to integrate technology into the classroom as well as their ability to create a 21st century learning environment that enables learners to acquire the necessary

21st century skills to lead the future of Kuwait. Furthermore, this study offers a new understanding about how far the elementary school system in Kuwait is from being an ideal 21st century learning environment. In addition, this study attempts to understand teachers' perceptions about the barriers that prevent them from expanding their pedagogical, technological, and content knowledge beyond the traditional learning environment. The study helps educators and administrators in the MOE understand the reasons for modest results from previous technological integration attempts, from teachers' perspectives, that wealthy countries like Kuwait, which have relatively small populations and which spend hundreds of millions of US dollars, are still imprisoned in the last decade's teaching methodologies and learning environments. Additionally, this study explains whether the elementary schools in Kuwait are capable of shifting and aligning with the 21st century skills introduced in the literature as being fundamental skills for superior success in the current century as well as understanding the readiness of elementary schools being transformed into smart classrooms to promote a modern learning environment.

This mixed method study is significant because it helps the Ministry of Education in Kuwait save time, effort, and money by assisting administrators and educational specialists to benefit from the findings of the current study. The findings might contribute to outlining the paramount solutions to reforming the mathematical elementary educational system in Kuwait. This study provides evidence to enrich our understanding about how and what elementary mathematics teachers should teach in their classrooms to improve and prepare independent thinkers and leaders of future generations in the State of Kuwait.

This mixed method study identifies for the leaders in the educational field detailed knowledge about a schools' model to illustrate the degree of benefit, from the teachers' perspectives, for teaching and preparing learners for the 21st century. The study is important for educators (i.e., teachers) since it provides a model of integration and is supported by the teachers' perspectives about its use for effective learning. This research produces information about successes and roadblocks as well as solutions for implementation, rather than detailed abstract evidence. While this mixed method study was principally focused on the elementary school level, the study results could be transferred to cross-populations in Kuwait for all K-12 school levels, all six districts, the Ministry of Education, and the national level in forming priorities and ways to accomplish the general educational goals in Kuwait.

Limitations of this Study

Limitations of this study might include:

1. Utilizing self-reported questionnaires includes possible limitations of this study due to the fact that the participants provide self-perception about participants' own teaching. The research did not include classroom observation to cross-check if participants' self-perceptions aligned with observable classroom behaviors.

2. The study's participants voluntarily participated in this study and might not represent all perspectives.

Delimitations of this Study

Delimitations of this study included:

1. The difficulties in accessing and recruiting participants from private schools was the main reason for choosing the study's participants from public schools only.

Also, the huge difference in the curricula, outcome goals, and teaching practices between private schools (i.e., American, French, British, and Indian school systems) prevented the integration of private schools in the current study.

2. The study's qualitative data were collected via open-ended questions in a survey. Interviewing the teachers could be significant for qualitative studies, but for this study, the reason was to collect different perspectives from as many teachers as possible, rather than interviewing a smaller sample size, to understand the variables being studied.

3. The instrumentation was chosen and created specifically to answer the study's research questions to explore the teachers' perceptions about their pedagogical, content, and technological knowledge (TPACK). Further, open-ended questions were created to explore teachers' perceptions about their ability to create 21st century learning environments including cloud computing and constructivist collaboration practices.

Definition of Terms

For the purposes of this study, the following terms are defined.

Twenty-first Century Skills: The P21 organization describes the 21st Century Skills as the combining of core subject content knowledge and interdisciplinary 21st century themes (i.e., consists of specific skills), proficiency, and literacies essential for forthcoming accomplishment in the global workplace (Partnership for 21st Century Skills, 2011).

Collaboration: The mutual interaction (i.e., collective work) among two or more individuals working together to complete more than working individually (Greenstein, 2012).

Communication: Sufficient mutual exchange of thoughts and ideas via active articulation (Partnership for 21st Century Skills, 2009).

Creativity: The method of constructing original and valuable ideas (Azzam, 2009).

Critical Thinking: Effective and reflective method of thinking based on rational decisions about what to do or think (Ennis, 2002).

Cloud Computing: A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (The National Institute of Standards and Technologies, 2011).

Mobile Learning: The integration of different mobile or handheld devices such as smartphones and tablets while learning in the move (Park, 2011).

Summary

In Chapter I, the main goal was to construct an overview of the background for the current study, and the chapter targeted the importance of further reforming and enhancing the learners' mathematical competency to correspond with the 21st century skills. In addition, the need for reforming mathematics education in classrooms in Kuwait was discussed for immediate and necessary changes in teachers' pedagogical, content, and technological practices to effectively construct attractive 21st century learning environments (i.e., cloud computing and constructivist collaboration) to prepare learners for the 21st century workplace.

CHAPTER II

LITERATURE REVIEW

Twenty-first Century

In the 21st century, the world is rapidly evolving and changing in all fields of life. Considering these consistent changes in the landscape of the global economy, current learners and future leaders should adequately master the 21st century skills to improve their chances of success in a steadfast, rapidly changing workplace. One of the influential reasons directly and indirectly influencing the nature of the global economy and workforce is the revolutionary expansion in communications and information technology. In fact, success in the professional or postsecondary educational worlds depends on knowledge and application of these 21st century skills.

To ensure that students are ready for either, or both, of these worlds, educators themselves must develop a depth of understanding of 21st century skills (Achieve, Inc., 2013). One method of instruction that is effective in building these skills is infusing core subject content with a specific skill, often through project-based learning (Partnership for 21st Century Skills, n.d.). The importance of each of these skills has been identified through findings in a study conducted by the Conference Board, Corporate Voices for Working Families, the Partnership for 21st Century Skills, and the Society for Human Resource Management after working with over 400 employers from all over the United

States on their impressions of new employees with their workforce (Casner-Lotto, Barrington, & Partnership for 21st Century Skills, 2006).

High school graduates, college instructors, and employers were asked to determine what skills were necessary to be successful in the post-secondary and professional world. The Conference Board, Corporate Voices for Working Families, the Partnership for 21st Century Skills, and the Society for Human Resource Management Survey was recognized as a tool for identifying necessary skills (Casner-Lotto et al., 2006). The survey highlighted concerns about the lack of preparation for college and career readiness demonstrated by many high school graduates and those essential skills.

Partnership for 21st Century Skills Framework

Being successful today means having the ability to disperse and access information, responding in dynamic ways to expectations and problems, and utilizing technology to embrace and continuously improve knowledge (Pacific Policy Research Center, 2010). A comprehensive framework for 21st century teaching and learning that has gained popularity and acceptance in 17 state educational systems was created by the Partnership for 21st Learning. This framework has served as a guide for this research (Partnership for 21st Century Skills, 2011). One essential component evidenced in the framework is the combination of core academics with student outcomes demonstrated through direct application of skills (Figure 1).

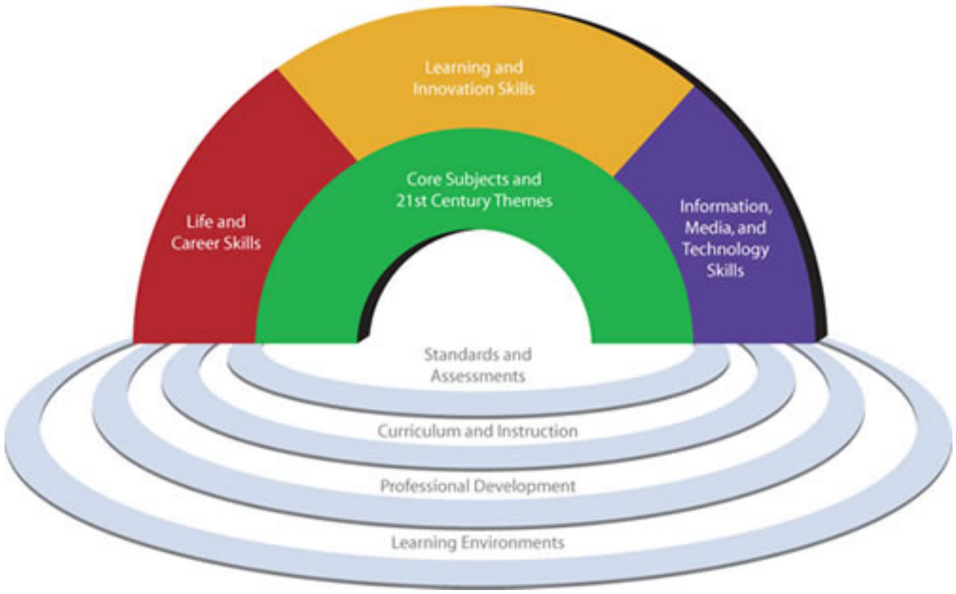

Figure 1. Partnership for 21st century skills framework (Partnership for 21st Century Skills, 2011).

The inner and outer arch of the framework is integrated together to prepare students for success in the 21st century. The inner arch consists of core subjects including English, reading or language arts, economics, math, history, geography, government, civics, world languages, and art. Interdisciplinary themes included within the core subjects are financial, economic, business and entrepreneurial literacy, environmental literacy, civic literacy, health literacy, and global awareness. The outer arch, Life and Career Skills, includes information, media, and technology skills, life and career skills, and learning and innovation skills. Preparation for success in college and careers is dependent on mastery of both the inner and outer arches (Partnership for 21st Century Skills, 2009).

Twenty-first Century Skills

Advances in technology and globalization mean that learners and employees worldwide must master and demonstrate a dynamic skill set. In this review, 21st century skills that were examined are from the national organization Partnership 21st Century Skills that is utilized in both American and Canadian schools. Their framework emphasizes the importance of not only reading, writing, and arithmetic (3Rs), but also the importance of creativity, critical thinking, communication, and collaboration (4Cs) (Kay & Greenhill, 2011). The P21's framework consists of four skill components: (a) core subjects and 21st century themes; (b) learning and innovation skills; (c) information, media, and technology skills; and (d) life and career skills. The P21 Framework emphasizes the importance of acquisition of 21st century skills essential for leadership in our current globalized education and work environments (Kay & Greenhill, 2011).

The concept of 21^{st} century skills is not a novel one in the world of education. Rotherham and Willingham (2009) proposed that 21st century skills are no longer optional. They cannot be reserved for students with certain opportunities or teachers, but must be provided to all students. Explicit teaching of 21st century skills should be commonplace, not an afterthought. New thinking regarding these skills includes the need to teach and assess these skills across content areas. Twenty-first century skills are here to stay, and our educational system should reflect this.

According to Kay and Greenhill (2011), the purpose of 21st century education is to ensure students can succeed throughout their educational path, career, and life utilizing the knowledge, skills, and expertise they have acquired. Currently, over two-thirds of occupations have moved to the service industry from the manufacturing industry. This shift means that workers need a certain skill set. As the result of technological advancements, employees are needed to collaborate with colleagues, synthesize information, and introduce new ideas as opposed to apply procedural skills.

Core Subjects (3Rs) and 21st Century Themes

Core subjects and 21st century themes are essential to a 21st century education (Kay & Greenhill, 2011). Core subjects are classes that may be classified as general education or liberal arts education already offered in educational institutions. Courses included in the core subjects are civics, government, geography, history, English or language arts, arts, world languages, math, economics, and science. Four interdisciplinary themes included with core subjects in P21 are: (a) global awareness; (b) financial, economic, business, and entrepreneurial literacy; (c) civic literacy; and (d) health literacy.

Learners must be able to make connections between the broad, common themes within the content knowledge and the real-life situations in order to be adequately prepared for the future. Making such connections leads to a deeper understanding and ability to apply knowledge (Dewey, 1899). Despite Dewey's thinking being over a century old, his assertion that connections are essential is still evident in the P21's Core Subjects and 21st Century Themes. Learners will acquire and master content knowledge applicable to situations they will encounter later in life, whether it is later in their educational career or eventual profession. Multicultural content should be included, enhancing understanding of multiple cultural backgrounds, abilities, and languages (Garcia, 2002; Gay, 2002). Teachers are able to create genuine lessons in core content areas that allow students to connect to their culture from home and experiences to deepen understanding (Bennett, 2001). Students' cultural awareness and competency can be increased as they are encouraged to interact with and understand content through a multicultural lens.

Learning and Innovation Skills (4Cs)

Core subjects and 21st century themes are foundational to the P21 framework, and learning and innovation skills are central to the spirit of the framework (Kay & Greenhill, 2011). According to Kay and Greenhill, students in postsecondary or career situations are more likely to demonstrate learning and innovation skills, which include four sub-skills that are labeled the 4Cs: (a) critical thinking; (b) creativity; (c) communication; and (d) collaboration. P21 gives further explanation of each skill. Critical thinking, defined as the ability to energetically think and explore, is the first of the skills (Kay & Greenhill, 2011). Continuing in this same direction, two philosophers proposed critical thinking should also embrace creativity (Paul & Elder, 2006). The integration of focus and creativity as part of solution-based thinking means that a methodical thought process can lead to innovation.

Creativity is a second group of skills included within learning and innovation skills. Sir Kenneth Robinson is a well-respected leader and presenter who embodies innovation and dynamic thinking. Robinson (2006) is critical of a system in which children are taught that there is one correct answer to be found, maintaining that they begin as creative thinkers, but this ability is dulled as they move through a standardized educational system. Some may be critical of this view as widespread and severe, but it seems worth at least considering as we discuss the importance of creative thinking. Today’s students are tomorrow’s leaders, and as technological advancements and globalization have become common themes, educational systems must intentionally teach the skills these students will need to be successful.

When considering teaching the content and global themes, communication and collaboration are interwoven as the third and fourth skills of learning and innovation. To prepare students to be successful in a multicultural workplace or postsecondary educational system, they must be taught the skills necessary to communicate and collaborate with colleagues around the world (Kay & Greenhill, 2011). The ability to share ideas and collaborate with peers and colleagues can be taught smoothly as part of core content and other themes. Interpersonal communication skills can be positively impacted by building effective communication and collaborative skills. Gay (2002) expressed how utilizing a multicultural lens means having the ability to effectively express ideas for varied reasons with a diverse population in multiple ways and locations. This is an essential skill that can be introduced through collaborative group work before students begin their postsecondary education or profession.

Information, Media, and Technology Skills

The P21 clearly explains information or digital literacy, which expects learners to locate data and determine its meaningfulness, in a way that allows for easily delivered instruction and assessment (Kay & Greenhill, 2011). Learners must be able to locate the needed data, assess if the data meets the requirements and needs for relevance and accuracy, and apply the data as needed (Kay & Greenhill, 2011). To be clear, as a teacher of 21st century skills, using a lot of technology is not required. Instead, teachers must think through infusing skills like collaboration, teamwork, and self-directed learning into their lessons (Walser, 2008).

Collaboration Based on the Constructivist Approach

According to Happ (2013), collaboration is an effective instructional practice that requires students to manage interpersonal relationships with essential social skills while providing their own ideas and solutions for the current group undertaking. Although students engage with their learning in multiple ways, at a variety of paces, collaboration allows for them to work cooperatively with other students while building confidence and a love of learning. Fisher (2009) explained that students should have the opportunity to think through and problem solve situations together, as opposed to working individually on similar tasks. Learners of the 21st century must be adept with collaborative skills to increase their academic and social skills.

The Partnership for 21st Century Skills (2013) suggested that essential collaborative skills include the ability to respectfully work toward a shared end result with a diverse group of peers, making compromises when necessary, and consistently demonstrating flexibility and helpfulness. All personal contributions are important and valuable, and everyone is responsible for the success of the collaborative team. Technological support of collaborative environments is just beginning as researchers establish which technologies are best for this type of creativity-infused learning. Collaborative opportunities have been enhanced with new technology, and students and teachers are using these tools to increase learning.

Armstrong and Elkind (2006) proposed the importance of collaboration as part of learning communities for promoting the human element. Fisher (2009) encouraged teachers to increase achievement by making a move away from structured learning environments focused on individual output and, instead, creating collaborative learning environments that allow students to be motivated by learning activities that expect them to work together in partners and small groups.

Gasser (2011) expressed that by allowing students to have more control of their learning through collaboration, teachers are actually making students more accountable for their learning. Bhatia and Makela (2010) determined through a study of senior-level students that even test preparation could be enhanced by collaboration. Those who took part in review sessions as a collaborative group had higher levels of achievement on assessments than their peers who did not attend. These findings could be meaningful for classroom teaching and learning because there was no established limitation of benefits based on subject or age of students (Bhatia & Makela, 2010).

According to Eisner (2002), teaching considers science and art, and learning must occur in order to be effective. In addition, tremendous studies by The Teaching Commission 2004 identified teacher effectiveness as the primary agent of student achievement (Aaronson, Barrow, & Sander, 2007; Clotfelter, Ladd, & Vigdor, 2007; Harris & Sass, 2006). Also, teacher quality (teacher effectiveness) was found to be an important foreteller of students' success in school (Akiba, LeTendre, & Scribner, 2007) and a fundamental benchmark in educational systems (U.S. Department of Education, 2010).

According to the philosophical perspective of constructivism, self-regulated learners construct their own learning process via multiple attempts to find solutions to inherent conflicts. This could be salient in learners' attitudes toward discussing and reflecting upon these conflicts to acquire new information and construct meaningful knowledge. Constructing knowledge based on the constructivism perspective means that, regardless of the learner's age or developmental stage, learners need to be actively engaging in building their own learning experiences while in active social learning environments (Gilakjani, Leong, & Ismail, 2013). In other words, it is the combination of exploration, self-directed problem solving, and social interaction that brings learners to the acquisition of new knowledge.

Constructivism is a dynamic and progressive process that requests active involvement on the part of the learner to construct their own knowledge, and as a result, they will be accountable for constructing their own learning. At the same time, teachers will fulfill their roles of providing all the necessary support and tools (e.g., technologies) to facilitate and increase the effectiveness of the learning context (Gilakjani et al., 2013).

There is naturally a strong link between technology and collaboration when considering the opportunities available to learning communities, leading researchers to reconsider how creativity is seen (Happ, 2013). The Web is dynamic and changing constantly, reflecting the work of millions of people and companies who provide content for the more than two billion people who consistently make use of it.

Cooperative learning, like constructivism, is easily associated with cloud technology. It is easy to see why, especially when you think about the tools provided to users of cloud technology like sharing and Internet publishing, which allow for easy collaboration as people work together to problem solve and share ideas (Johnson, Johnson, & Smith, 2007).

Competitive learning is an example of the exact opposite of cooperative learning, as its main attention is on competition, meaning that many must fail so that a select few can find success (Johnson et al., 2007). This idea is counter to the usual goal of equalityfocused educational institutions (Noddings, 2007). This becomes more obvious when one considers that the collaborative nature of cooperative learning means students must work together, help one another, and share resources (Johnson et al., 2007). These same skills and qualities are valued by many professional communities, such as Partnership for 21st Century Skills, which explained that teamwork, flexibility, and collaborative problem solving are needed for success in both educational and professional endeavors (Johnson, 2009).

Despite the fact that cooperative learning has long been proven a useful classroom strategy, utilizing it in combination with cloud computing is much newer (Ertmer et al., 2011; Kear, Woodthorpe, Robertson, & Hutchison, 2010). Regardless, research done so far suggested cloud-based technologies certainly would be an added value to cooperative learning environments. As an example, Nicholas and Ng (2009) discovered pre-service teachers' attitudes and beliefs in regard to online learning was enhanced via the infusion of blogging and wikis.

There remains some belief in the idea that digital technologies distract from learning more than they enhance it (Traxler, 2010). This certainly begs the question as to how constructivism and collaborative learning can be positively impacted by cloud computing. Recently, there has been consideration of the possibilities offered by "Web 2.0" technologies for educational purposes (Hughes, 2009; Mason & Rennie, 2008; Redecker, 2009). These technologies refer to what many people know as "social media," including wikis, blogs, and a variety of social networking sites including Facebook, Flickr, and Delicious. These sites can be used for everything from sharing pictures and bookmarks to building community. Plenty of educators are enthusiastic about the many ways learning can be more collaborative, energetic, and fun for everyone, incorporating tools already known and used by many young individuals (Green & Hannon, 2007).

Cloud Computing (as a Web 2.0 Application)

According to Denton (2012), constructivism is significant as an infrastructure for technology-based instruction because it allows for a collaboration type of learning and provides the opportunity for learners to construct their own knowledge. This is evident in the tremendous advances in technology such as cloud computing. For instance, previous knowledge and experiences are the main resources for learners to construct their new and future knowledge. Cloud computing corresponds to and matches the constructivism process. Through the learners' exploration and journey for seeking to construct new knowledge, learners will explore the world of information and use strategies to communicate with other learners when teachers provide opportunities to use technologies such as cloud computing. The learners find valuable information that is relevant to their tasks and activities and corresponds with their beliefs. When this occurs, an analysis process takes place that connects the new information and makes sense of it. Finally, the learners reflect on and interpret the meaning of these connections in relation to the provided activity. All these steps take place and are facilitated by using a technological means such as cloud computing that enables learners to enjoy learning individually and collaboratively with other learners to resolve the task or activity.

The importance of constructivism is that it facilitates personalized learning and enhances learners' engagement in the creation of the learning experience, relying on technology to construct knowledge and facilitate the effectiveness of the learning experience (Denton, 2012). Furthermore, a huge advantage in adopting technology in teaching methods and constructing the learning environment based on technology is that technology is rapidly changing (Chen et al., 2013). This constantly opens new venues for taking advantage of technology to enhance the teacher-learner interaction and ensure the student-centered concept, which is promoted by constructivist theorists. Simultaneously, changes in technology affect learners' learning and communication preferences, such as those using the existence of new and different technological applications as wikis, being able to share a document online (e.g., Google docs), audio and video applications, online free websites, and blogs.

Cloud-Computing Architecture

As a novel information technology population, cloud computing and all of the benefits offered by this technology are highly regarded by the world's giant enterprises. According to the Chen et al. (2013), cloud computing would be at the forefront of the IT industry and was forecast to reach $95 billion in 2013. It is expected that 400 powerful enterprises will utilize an array of cloud services in the world's 500 largest companies, and the average annual growth rate of services could be up to 26% (Chen et al., 2013).

Cloud computing is the development and combination of a variety of traditional computer and network technologies such as grid computing, distributed computing, virtualization, and load balancing (Chen et al., 2013). Cloud computing is a computing mode grounded on the Internet service (Feng, Bi, Hu, & Cao, 2011). The architecture of cloud computing is comprised of two parts: service and management. Service mainly refers to multiple services provided to users grounded on the cloud and includes three service levels: infrastructure (IaaS), platform (PaaS), and software (SaaS). For users, the three independent and distinct services are intended for different profiles of users.

Management is primarily for both the supervisors of cloud and customers to guarantee that the complete cloud-computing center could operate securely and steadily and could be efficiently operated (Huang, Zuo, & Rong, 2010).

The Advantage of Cloud Computing in Mobile Learning

Cloud computing's obvious and important advantages have quickly led to recognition and acceptance on a large scale, and its services have rapidly covered all aspects of society. Education and learning have been further developed as the result of cloud computing's popularization and promotion. Li (2012) asserted that the fusion of modern technology and learning has created an opportunity for mobile learning to be deeply influenced by cloud computing as evidenced by: (a) offering tremendous and beneficial learning venues; (b) decreasing the needs of mobile technology (i.e., learning devices); (c) facilitating the construction of virtual learning community and contexts; (d) facilitating collaboration between learners in depth; (e) promoting educational equity by increasing the possibility and coverage rate of learning with mobile technology; (f) the cost of the cloud learning technology being low; (g) facilitating learning anywhere and anytime; and (h) increasing motivation and learning efficiency for learners.

Currently, some schools in the United States are using their own central computing systems, as schools and the educational system are very different than they were. Education now differs greatly from that of even 10 years ago when paper assignments, rubrics, and grade books were still the norm. Schools are able to provide distance teaching and learning opportunities, interactive curriculum, different formats of teaching materials, and group-formatted learning (Vujin, 2011). Learning management systems (LMS) are utilized for multiple media plans, grading student performance, cluster learning format, and distance learning. All of these modern and essential technologies are utilized in school systems and can be fruitfully employed utilizing various cloud-computing services. One example of this is Blackboard, a SaaS platform that provides schools with a LMS.

Cloud computing continues to grow in popularity, with no end in sight. In Toppin's and Toppin's (2015) article, the future of virtual K-12 educational reform was discussed, and it was anticipated that revenue in the online learning industry would increase by as much as 43% by 2015. Research continues regarding best practices and solutions for implementing cloud computing in the business sector and for-profit organizations, but is lacking for the educational sector. Examination of their relationship with cloud computation will allow educators to be better prepared for utilization of this technology.

Cloud computing has practical applications in both the classroom and within the administration of the educational sector. Unfortunately, the rapidity of technological advancements makes it difficult for budgets to keep pace as resources continue to require upgrades. Economic issues over the past decade mean that school districts struggle to meet needs with limited funding (Nabil, 2009). The cloud provides an opportunity to reduce costs, an obvious benefit to educational institutions. Administrators responded to a 2011 poll stating that 86% of K-12 institutions lowered costs by moving applications to the cloud, averaging 28% in total cost savings (O'Hanlon & Schaffhauser, 2012). In addition, maintaining the safety and security of data is a top priority in today's age of technology. Schools and universities now have the capability to examine and analyze student data, learning trends, and engagement which can all be stored and accessed through cloud solutions. The ability to store and back up data offsite is an appealing option when considering limited funds and security concerns (Waters, 2010).

Mobile Technology and Mobile Learning in the Classroom

As education has evolved over the last decade, learning institutions are looking to bring more technology into their classrooms (Tom, 2014). The number of schools joining the trend of technology implementation to positively impact student engagement and retention of knowledge continues to grow. A recent survey indicated that as many as 75% of K-12 teachers in the United States use technology as a motivational strategy (Luckerson, 2014). Results drive this movement as instructional technology increases student learning and engagement, making it more fun and encouraging students to learn more (Eyyam & Yaratan, 2014). Technology can also shift instruction away from a lecture format to a more hands-on approach in K-12 schools (Luckerson, 2014).

The use of computers has jumped from 15% of U.S. households owning and using computers in 1990 (Shelton & Saltsman, 2011) to 78.7% in 2008 (United Nations Development Programme, 2010). In 2012, 46% of adult Americans were using smartphones (Pew Research Center, Internet, & American Life Project, 2014). There are now a large variety of mobile devices that are regularly used by and familiar to the general population (Nie, Armellini, Witthaus, & Barklamb, 2011). Using these mobile devices can improve the experience of distance learning by allowing users to access material from anywhere at any time. Having access to a computer is no longer necessary (Yousef, 2007).

In order to understand the educational potential of mobile devices, one must look to see how mobile technologies work within traditional learning theories. The traditional learning theories to be examined are: behaviorist, cognitivist, constructivist, situated learning, problem-based learning, context-based learning sociocultural theory, collaborative learning, and conversational learning (Keskin & Metcalf, 2011). Mobile devices have the capability of catering to each of these theories, whether through games, social networking, email and text messaging, video conferencing, virtual reality, multimedia, or other applications (Keskin & Metcalf, 2011). Yousef's (2007) research showed that mobile technology benefits learning:

> 1. Helps learners to overcome the digital divide.
> 2. Helps to make learning informal.
> 3. Helps learners to be more focused for longer periods.
> 4. The provision of course content to off campus students.
> 5. The provision of feedback to off-campus students.
> 6. The provision of student support services to off-campus students.
> 7. Student-to-student interactivity. . . . Student to tutor and institution interactivity.
> 8. Can be used for independent and collaborative learning experiences.
>
> (pp. 117-118)

Though the portability of mobile devices is the most helpful aspect in facilitating learning, the limitations of the devices can be a hindrance (Park, 2011). Using a student's personal device can aid in alleviating these concerns as they likely already have a good knowledge of their device, rather than learning to use one assigned to them (Elias, 2011).

Mobile technologies allow students to access content when it is best for them, allowing them to learn at their own pace (Yousef, 2007). Mobile learning facilitates effective communication and collaboration in any organization (schools) via utilization of rapid messaging and file sharing (Yousef, 2007). A major driving force of mobile learning is the expectations of the *Net-Generation*, students who have grown up with Internet access and are accustomed to using computers and mobile technology. According to Anderson (2008), "this new generation of learners is smart, but impatient, creative, expecting results immediately, customizing the things they choose, and very focused on themselves" (p. 203).

While there is great potential for mobile technology in the classroom and it has now become a key component to learning experience, the needs, goals, and outcomes of the learner are the priority (Yousef, 2007). Though limitations exist with mobile technology, the advantages appear to outweigh the disadvantages.

Mathematics

The vocabulary of mathematics can make math instruction difficult because it is often specific, theoretical, and academic in nature. This is caused by linguistic features such as vocabulary, syntax, semantic properties, discourse, and everyday language (Pickreign & Capps, 2000). When students struggle with mathematical concepts because of a lack of relational or conceptual mathematical understanding, they are more at risk for struggling with the connections between five representational modes (concrete, pictorial, real-world situations, symbolic, and oral) (Niess & Mack, 2009). However, through the use of digital technology, students can utilize virtual manipulatives to help connect one mode to the other and assist the double coding of material (Suh & Packenham-Moyer, 2007). Similarly, students can access student-focused lessons through the use of technologies with dynamic representations (e.g., virtual manipulatives, graphic calculators, mobile applications, etc.) allowing for safe, easy opportunities to explore and problem solve (Bell, Juersivich, Hammond, & Bell, 2012).

Overall, technology, including computers, Internet, mobile devices, cloud computing, etc., enhances the educational experience for many students by allowing qualitative thinking to be used as they engage with their learning, making discoveries and meaning, as the result of more flexible design (Papert, 1993). This type of technology has been found to be effective in both directive and nondirective models of instruction (Mitra & Dangwal, 2010). The benefits of digital technologies are not limited to the impact on students' procedural or instrumental understanding (Skemp, 2006), but also pave the way for a myriad of critical thinking strategies, contexts, applications, and interactions (e.g., online discussion board, Google docs, cloud computing, etc.), assisting learners to conceptualize and construct relational understanding (Polly, 2011). These technologies support and scaffold mathematical learning (Sharma & Hannafin, 2007).

Equitable access to and use of practical and essential resources is an obvious advantage of using digital technologies such as mobile technology and Web 2.0 applications. Not only are students able to master skills, but also these technologies help to level the playing field in education (Meyen, Poggio, Seok, & Smith, 2006). Students who have special needs, such as dyscalculia, a specific learning disability that hinders learning and understanding mathematics, are able to use necessary tools, including a talking calculator (DO-IT, 2011). In mathematics instruction, digital technology can have broad impacts on methodology and strategies, curriculum, and content (National Council of Teachers of Mathematics [NCTM], 1991), and experience and skills educators need to be effective and consistently include technology in their lessons (Association of Mathematics Teacher Educators [AMTE], 2009). This consensus on the importance and effective use of technology corresponds with the tenet of the TPACK framework in which mathematical teachers should consider the pedagogical and content knowledge when integrating technology to enhance the learning outcomes.

The overall caliber and rate of instruction can be affected by digital technology, regardless of whether one considers it to be a primary or secondary factor (Clark, 1994). Two professional math organizations acknowledge the need for increasing students' mastery of and competency with mathematical concepts (NCTM, 1991; AMTE, 2009). As a result, instructors of mathematics are increasingly expected to infuse technology into their lessons (Grandgenett, 2008). The integration expectations are delineated by the technological pedagogical content knowledge (TPACK) framework (AMTE, 2009; Mishra & Koehler, 2006), a combination of the three areas of knowledge: technology, pedagogy (teaching and student learning), and content (Mishra & Koehler, 2006). The level of integration of technology in lessons can be planned and assessed with the TPACK framework (Bowers & Stephens, 2011; Chai, Koh, Tsai, & Tan, 2011; Hofer, Grandgenett, Harris, & Swan, 2011). This framework can help teachers assess their own development through the use of standards (Mathematics Teacher TPACK Standards) and guidelines designed to aid in the implementation of digital technologies in math instruction (Niess & Mack, 2009).

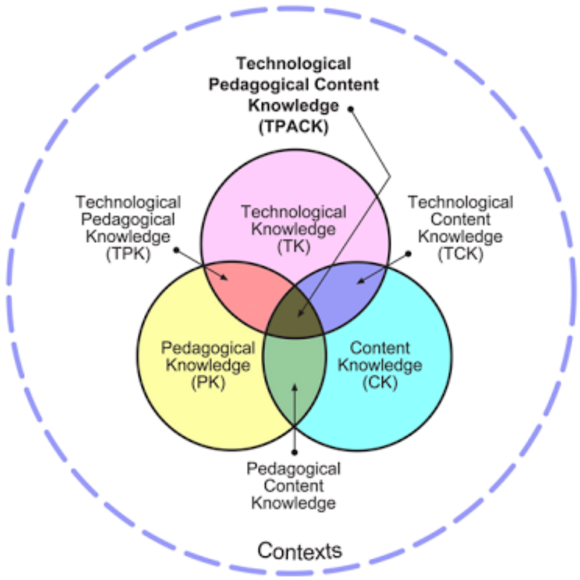

Figure 2. Technological-pedagogical content knowledge (TPACK) (taken from http://ww.tpack.org/).

This study premises on the Technological Pedagogical Content Knowledge framework (TPACK). This framework provides ways to show the educators' understanding of and skills (abilities) to integrate technology combined with pedagogy and content knowledge into their classroom. The TPACK has attained huge attention in the last decade (Koehler & Mishra, 2005). Researchers in the field of education, educational technology, and information communication technology emphasized the essential benefits of the TPACK framework. The TPACK has the potential to construct new venues for educators to successfully and efficiently resolve the educational issues and challenges via the positive technology integration in the classroom to enhance the teaching and learning process (Hewitt, 2008). The purpose of the TPACK framework is to provide ways to give educators the necessary knowledge and skills to integrate technology with pedagogy and content knowledge in the classroom.

Historically, Shulman (1987) suggested that successful teaching takes place by understanding and implementing pedagogy and content knowledge and the resulting interaction between the two. The Pedagogical Content Knowledge framework (PCK) was proposed by Shulman (1986) as a full scope of educators' knowledge of effective instruction. He explained the Pedagogical Knowledge (PK) as teachers' knowledge about how to effectively teach, Pedagogical Content Knowledge (CK) as teachers' knowledge about the content (i.e., subject matter), and PCK as teachers' knowledge about how to effectively teach the subject matter (i.e., content). Shulman (1986) claimed that effective teaching extends beyond just mastering general pedagogical methods and gaining knowledge about the subject matter (i.e., content). Therefore, he argued that "pedagogical content knowledge" (p. 9) is the content knowledge that handles the teaching process, including "the ways of representing and formulating the subject that make it comprehensible to others" (p. 9). The PCK framework introduced by Shulman's perspective suggested that the PK, CK, and PCK are dissimilar constructs of teaching skills. Also, he emphasized the interactions that exist between these constructs. It is worth mentioning that Pierson's (2001) articulation for the idea of TPACK was an onset attempt followed by subsequent attempts by other researchers to conceptualize the implementation of a technology orientation to view the TPACK as a content-specific framework (Koehler & Mishra, 2005).

Mishra and Koehler (2006) added the technology knowledge domain to the framework under the concept that technology, content knowledge, and pedagogy are interdependent domains and must be considered in the complex environment of the classroom. As a result, three main purposes of the TPACK model have become clear.

The first purpose is to offer a model for technology integration to teachers which focuses on three fundamental elements of teaching (content, pedagogy, and technology) and the interactions between them. The second purpose of TPACK is to create a systematic approach to understanding the ill-suited nature of teaching and the complex context in which it happens (Mishra & Koehler, 2006). The third purpose is to create a framework in which future research can be conducted in the areas of teacher education, technology integration, and teachers' professional development which is efficient and meets the needs of the other goals of TPACK (Koehler & Mishra, 2009).

Although it has been almost a decade since the emergence of the TPACK, the TPACK was tremendously widespread, specifically in 2006 right after Mishra and Koehler's seminal publication explained the major constructs of the model. Until 2008, TPACK was recognized in the literature and was called "TPCK" until researchers suggested the use of the term TPACK to ease the spoken term (Thompson, 2008).

According to Koehler and Mishra (2009), "Integration efforts should be creatively designed or structured for particular subject matter ideas in specific classroom contexts" (p. 62). Therefore, the TPACK opposes the "one best way" (p. 62) approach in teaching. Instead, effective teaching occurs when the teacher recognizes the active interaction between teachers' knowledge and the pedagogical methods integrated to deliver this knowledge to learners in a specific setting.

That being said, three major sources of knowledge construct the TPACK framework: technological knowledge (TK) refers to the knowledge of how to successfully and efficiently operate technologies (computers, smart phones, tablets, and relevant software); pedagogical knowledge (PK) refers to the knowledge of how teachers construct the planned instruction, support learners' differences, and organize lessons; and content knowledge (CK) refers to knowledge in the specific subject content (e.g., knowledge in science or mathematics etc.). The TPACK proposed that the four additional categories of knowledge are constructed when these three major categories of knowledge are combined: technological content knowledge (TCK) refers to the educators' knowledge of how to sufficiently employ technology to introduce the content to the learners (e.g., creating visual words to represent and explore the geometry concept); technological pedagogical knowledge (TPK) refers to the knowledge of how teachers can support pedagogical strategies (e.g., critical thinking or self-discovery) through positive integration of technology (e.g., collaboration web sites or wiki); pedagogical content knowledge (PCK) refers to knowledge of pedagogical strategies (collaboration method) in exploring the content of a subject (mathematics); and technological pedagogical content knowledge (TPACK) refers to knowledge of integrating technology sufficiently combined with the compatible pedagogical strategies to deliver particular content to support the learners' learning. Also, context knowledge is implicated as a section of the TPACK model (Akarasriworn & Ku, 2010; Mishra & Koehler, 2006).

It is important that teachers possess a recognition of representation in using technology in classrooms, pedagogical strategies that employ technologies to transfer the content knowledge in a constructive manner, a realization of the ways that make learning tasks easy or difficult to understand, and the ability to diminish issues learners encounter by integrating technology in the classroom (Koehler & Mishra, 2009). According to the American Association for Colleges for Teacher Education (AACTE) and the Partnership for 21st Century Skills (2010), new teachers must have the ability to understand, teach, and apply 21st century knowledge and skills explicitly as well as to integrate these skills into their lessons (Greenhill, 2010). Greenhill discussed the collaboration between deans to include 21st century skills in their planning of teacher education programming so that teachers could go beyond simply mastering core subjects with their students to also teaching essential skills like critical thinking, communication, collaboration, and technology literacy.

To do so, teachers should continue to learn and master new technologies such as Web 2.0 applications (i.e., cloud computing) to follow the changes and trends in learners' interests and desire to learn. The potential benefits of Web 2.0 technology such as cloud computing were highly recommended by researchers and educational experts as a factor in improving teaching effectiveness (Wallace, 2004). Particularly, Web 2.0 instructional strategies are currently obtaining far-reaching recognition among teachers, with the evidence that cloud computing and M-learning can provide learners with significant instructional opportunities to complete collaborative, interactive, individualized, and critical thinking learning tasks as well as to encourage learners to construct and build meaningful learning based on their prior knowledge (Lee & Tsai, 2005).

The literature is rich with evidence about the importance of each of this study's constructs. However, creating the connections between these constructs is still lacking support, and understanding the influence of all these constructs combined in the elementary schools is still at the amateur level in Western literature. In contrast, the literature regarding the influence of 21st century skills, collaboration, M-learning, and TPACK in mathematical classrooms at the elementary public schools in the Middle

Eastern region is far more in need of understanding because educational systems, cultures, resources, and educational visions in Middle Eastern countries (including Kuwait) are totally different than those in Western societies. To understand these differences, the following section provides an explanation of the education in Kuwait to better capture the importance and the need of implementing technology (i.e., cloud computing, M-learning, and mobile technology) in mathematical elementary classrooms based on collaborative and constructivist approaches.

Kuwait

Kuwait originated as a commercial portal among neighboring countries over 300 years ago, gaining independence in 1961. This allowed them to join the United Nations. Geographically, Kuwait is located on the Arabian Peninsula between the Kingdom of Saudi Arabia, Iraq, and Iran, meaning citizens are of a variety of nationalities (MOE, 2009). The population of Kuwait is comprised of over 140 different nationalities from all over the world that work in a multitude of professions. Large concentrations of the population are found in the Kuwait City metropolitan area, especially the areas near the Arabian Gulf coast (MOE, 2010).

Reflecting back to 1887, primary learning was the main form of education, made up of *Alkatateeb* (writers), typically located in mosques. They focused on teaching children the Holy Qur'an, reading, writing, and math. This continued until 1911 when a school for boys was opened called Al-Mubarkiya (MOE, 2009). Later, in 1936, the Council of Education was implemented as part of the government to supervise teaching, to organize, plan, and design curriculum, and to provide funding. A teacher's institute was established in 1949 to train primary school teachers (MOE, 2009).

Self-management of education began in 1952 and was supported by other Arab countries in the technical sense. Two years later, reforms were made regarding the curriculum and learning plans to better align with social and cultural development needs in Kuwait. The structure created to achieve these reforms was two years of kindergarten and four years of primary learning, four years of intermediate schooling, and four years of secondary school (MOE, 2009).

The first teacher's institute for teachers of both genders was established in 1963, granting diplomas for completing their secondary-school certificates. Thirty years later, it was renamed the Basic Education College, providing Bachelor of Education degrees to students who finished four years of postsecondary school study.

After Kuwait was liberated from Britain in 1961, education became more closely aligned with global developments. In the years between 1956 and 2004, schools were structured as two years of kindergarten and four years each of primary, intermediate, and secondary school. In 2004, this changed to two years of kindergarten, five years of primary school, four years of intermediate school, and three years of secondary school (MOE, 2009). Kuwait was split into five administrative districts in 1982: Asema, ALFarwaniya, ALjahra, Hawalli, and Ahmadi. Currently, a new district was added called Mobark Al-Kaber district. Each district includes a branch charged with management of schools (MOE, 2011).

The MOE (2003) provided an opportunity for the government in Kuwait to create a vision, approved by the Minister's Council, for the future of education, specifically for 2005 to 2025. This vision includes six goals of the public educational strategic plan for the State of Kuwait. Introducing only two from the six goals that correspond with this study are:

> (1) To attain strategic requirements through institutional reform in all general education sectors. Performance evaluations are utilized to improve learning and management at schools through programs that were instituted to decentralize management. Schools need motivation to differentiate and innovate learning methods. Competition between schools leads to improved quality in learning, teachers' performance, and teachers' productivity through training and incentives.
>
> (2) To close the gap between the current general education system and the requirements of advanced technology, it is essential that all students across different scientific, practical, public, and private fields, are technologically proficient, encouraging the use of information and communication technology facilities to grow their knowledge of the world around them.
> (MOE, 2003, p. 20)

The Crisis of Education in Kuwait

Education is a responsive and progressive process that continues to change and reflect the needs of society and the functions of that society (Al-Sultan, 2010). When considering the country of Kuwait, the educational goal is their development of all citizens in the population (Al-Gonaim, 1999). The MOE's stated goal is to modernize Kuwait by giving citizens the skills and tools they need to succeed in modern times, starting with the education of their youngest citizens (MOE, 2005). Funding for a modern and effective model of education is necessary (Al-Ramzi, 2009). Kuwait has abundant natural resources, especially oil, which allows for funding to be channeled into the creation and maintenance of an up-to-date, widespread educational system (Al-Gonaim, 1999). This creates avenues by which to ensure that 21st century skills and learning are part of this educational system (Al-Kandari, 2013). Unfortunately, this optimal vision does not reflect the real status of education in Kuwait, despite the eager desire of the MOE in Kuwait to modernize leaning environments across all grades and directing tremendous resources toward achieving this desirable goal. The Kuwaiti government sought the assistance of a Tony Blair company to evaluate the educational system. The company provided a report that envisioned the Kuwait educational system in 2030 and the procedural changes in the current system that were necessary to improve the learning outcomes and enhance learning performance (Winokur, 2014).

In his report, Blair (2012) noted that education in Kuwait was in danger of backsliding. Previously, Kuwait was known as the *school of the Arab world* because of the high caliber of its educational system; students from many Arab countries aspired to continue their education in Kuwait. Unfortunately, the current educational system is having difficulty adequately preparing students to pursue careers in the modern economy. If changes are not made, Kuwait will have difficulty developing and competing in the modern economy. Blair, a consultant for the Kuwaiti government, suggested that those are the difficulties Kuwait may face. As the former British Prime Minister, Blair provided a report detailing his vision for Kuwait in 2030. He suggested that the current educational system is not prepared to equip students with the necessary skills to compete in the modern world. He claimed action must be taken to implement changes for both public and higher education systems (Winokur, 2014).

The report by Blair (2012) explained that those changes were needed, even though the Kuwaiti educational spending was among the highest in the world. For example, the Kuwaiti spending volume ranges from 6.2% to 8.3% of the gross domestic product (GDP) compared with other nations such as Singapore at 3.1% and United Arab Emirates at 1.3%. Despite this financial support, major problems continue to exist.

When looking at the educational objectives according to its derived sources (Ministry of Education Website, 2015), the MOE has outlined general educational goals.

The goals inferred from modern trends in education are the basis for the three primary educational objectives and involve: (a) growth in capability to implement self-learning; (b) assisting learners in lifelong learning; and (c) benefitting from contemporary technologies in education. The report (Blair, 2012) indicated that apathy on the part of the Kuwaiti government related to the teaching profession regarding the level of cost-effective material and morale support. Blair is clear that quality education is essential with graduates who are creative and talented. Currently, there are low levels of educational outcomes, calling into question the quality and efficiency of education in Kuwait.

The Kuwaiti educational system has changed dramatically since 1887. Formerly, it was a very traditional system, but now it is significantly more developed, based on dynamic changes in the modern world. Thus, development of community and identification and treatment of social problems through short- and long-term planning are all part of Kuwait's educational planning (Al-Sharrah, 2002). Moreover, the system has shifted to improve the quality of life of its population and to prepare the next generation to excel in the 21st century era. Unfortunately, considering the previously discussed efforts by the MOE to improve the educational system in Kuwait, learners' performance, as outcomes of the educational system in Kuwait, have yet to reach a satisfactory level, and there are many voices calling for further revision of the educational system and modification of the curriculum to correspond with the 21st century including the pedagogical practices, quality and quantity of content in the curriculum, and levels of technological integration to improve learners' performance in the workforce of the 21st century (Blair, 2012). In addition, Al-Kandari (2013) stated that those at the school level and other stakeholders (such as parents and head teachers or civil society institutions) do not have an obvious role in the manifestation of the strategic plan. This implies a top-down hierarchy of power and authority in which the MOE is the top level, with authority flowing down to the committees, districts, and schools (including teachers). In addition, the literature lacks research that explains and explores the teachers' perspectives (i.e., in Kuwait) regarding the reasons and solutions to the inconvenience of integrating mobile technology and adopting Web 2.0 (e.g., cloud computing) in the modern collaborative learning environment. Therefore, it is important to explore teachers' perceptions regarding the best practices for and the strategies to avoid the primary barriers to integration of appropriate technologies in the learners' environment that improve and enhance the that environment. It is critical to understand the reasons behind the unsatisfactory student performance in Kuwait.

CHAPTER III

METHODOLOGY

Kuwait's educational curriculum and system, while influenced by Western educational practices and system, is different in terms of pedagogical practices (e.g., constructivist collaboration), curriculum content, mobile technology integration opportunities (e.g., mobile technology and cloud computing), and general philosophical goals that might facilitate creating 21st century learning experiences. Therefore, the current study purposely addresses inquiries related to how mathematical elementary teachers from all six different educational districts in the State of Kuwait perceive their ability to effectively integrate mobile and cloud computing technology (i.e., TPACK knowledge) in their classrooms. Kuwaiti mathematical teachers' perspective regarding the concept of teaching mathematics subjects in a collaborative and constructivist context, and how it might improve learners' readiness for the 21st century demands were measured with consideration of major barriers. This methodology chapter includes a detailed and systematical explanation for the study design, research protocols, sample details, measures (i.e., questionnaire), methods of data analysis, researcher bias, and trustworthiness.

Research Design

A concurrent triangulation mixed-method design utilized qualitative and quantitative methods of data collection, data analysis, and data interpretation when attempting to answer the research questions. A mixed method research design primarily emphasizes collecting two types of data (i.e., quantitative and qualitative data), analyzing the data with both quantitative and qualitative procedures, and finally merging the findings into one or more than one study (Palinkas, Horwitz, & Hurlburt, 2011). Furthermore, the essential tenet of the mixed method design is understanding and explaining a phenomenon or a research issue by combining both quantitative and qualitative methodologies that might lead to a better understanding than utilizing only one research approach (i.e., qualitative or quantitative approach) (Robins et al., 2008). Therefore, in the current research, the teachers' perceptions about their ability to integrate technology and the barriers that hinder their ability to effectively integrate mobile technology in their classroom were quantitatively and qualitatively measured. Also, teachers' perceptions about their ability to construct cloud computing collaborative learning environments corresponding with the 21st century skills were explored qualitatively. It is important to recognize that the quantitative data provides significant information about the teachers' perception, regardless of why and how the teachers perceive the solution and methods that could resolve these issues. For this reason, the qualitative data provides significant information about the participants' perceptions about how, why, and what are the needed practices and resources that could assist them in shifting to 21st century learning environments. In support, Bernardi, Kleim, and Lippe (2007) stated that the use of a mixed-method design is useful because it precisely underlines the similarities and differences among a phenomenon's features. In such a research design, a mixed method design is valuable due to its combining and utilizing the strengths of both qualitative and quantitative approaches (Ostlund, Kidd, Wengstrom, & Rowa-Dewar, 2011).

The qualitative approach used in this mixed-method study is an appropriate method because this approach assists in understanding the nature of a phenomenon in real-life settings, unaccompanied by any method of intervention, and it could be considered a departure point for the development of a hypothesis or thesis (Polit & Hungler, 1999). Similarly, Sandelowski (2000) emphasized that a qualitative descriptive research approach considers the most natural option to explore and understand a phenomenon (i.e., teachers' perceptions) in its real context. Pursuing this further, direct explanations of a phenomenon, specifying the what, where, and who conditions, considers a powerful aspect of the qualitative descriptive research approach.

As Elliott and Timulak (2005) noted, self-report questionnaires may be used in qualitative research if the structure of the questionnaire features open-ended questions. The open-ended questionnaire is a powerful tool, also, in that answers are not suggested by the researcher, very specific questions can be asked, responses are often highly descriptive, and respondents can use their own language, ideas, feelings, and thought processes to respond. Additionally, respondents are more able to present their own motivations in the open-ended questionnaire (Popping, 2015). In short, the self-report questionnaire might give the power to the respondent by placing the *how to answer* in the hands of the respondent, instead of the researcher.

The self-report questionnaire is an appropriate solution to the challenge of studying a phenomenon across a large population without intervening in the course of events. Additionally, a readily understood language and a rich description are of particular benefit when describing situations simply as they are (Sullivan-Bolyai, Bova, & Harper, 2005), and this tool can provide subjective accounts of a phenomenon to which content analysis can be applied to capture a broad, more objective picture. The open-ended questionnaire provides researchers exposure to participants' perspectives that may not have surfaced using other research tools by providing them with a way of giving them the space to express answers using their own words, ideas, and insights (Glasow, 2005).

Participants

A purposeful sample methodology was utilized in this mixed-method research (Creswell, 2013). Qualitative research sample size is normally purposeful and has a small sample size (Magilvy & Thomas, 2009). Specifically, Teddlie and Yu (2007) defined the purposeful sampling methodology as selecting entities such as institutions, people, and groups of people based on precise purposes related to fulfilling a study's research questions. Moreover, in this study, a purposive sampling methodology was effective because I am an active mathematical director in the Kuwaiti elementary public schools. Being a teacher in one of the educational districts involved in the current study facilitated the ability to reach more teachers with the potential accessibility to many schools in the six districts. The purposive type of sampling is known as selecting participants for specific characteristics who are willing to participate and are easy to reach (i.e., accessible participants and/or institutions), which is suitable for the current study.

Additionally, the total participants accepted to participate in the study were 562 (N = 562) and composed of 19 male (n = 19) and 543 female (n = 543) mathematics teachers with ages ranging from 21 to 41 years old. All participants were from different public elementary schools in the six educational districts (Al Farwania, Al Jahraa, Alasma, Hawalli, Mubarak Al-kabeer, and Al-Ahmadi) in the State of Kuwait. However, around 1000 electronic surveys were sent out to all potential teachers in the six districts, and the participation was voluntary for both the quantitative and qualitative parts of the questionnaire. Furthermore, for the qualitative part of this study, a purposive sample of 21 mathematics teachers was randomly assigned to respond to the electronic qualitative (open-ended) questionnaires. The participants in the qualitative sample were drawn from the original quantitative sample of the current study. In addition, I sent 60 questionnaires distributed equally between the four educational districts (e.g., 15 questionnaire for each educational district). Moreover, all teachers who participated in this research were active mathematical teachers in the public sector of the elementary school system in the Ministry of Education in Kuwait. The sample (i.e., potential participants) was teachers and heads of mathematical departments in all six districts. Indeed, collecting data from all six educational districts enhanced the generalizability of the data, and I used all my connections with many teachers in the six districts; this might have not only increased the sample size, but might have also enhanced the quality of the teachers' responses to the surveys in an effort to limit the outliers in the data, responding to the surveys with less attention to spending enough time and effort on responses, and thereby reflecting honestly to the survey's items. Moreover, all teachers in all six districts were potential participants with no consideration for their age, gender, teaching experience, nationality, or race.

Context of the Study

In the United States, there is a primary elementary teacher for each classroom, first through fifth grade. In contrast, the elementary public school system in Kuwait is totally different; there is a teacher for each subject for each classroom. In the same regard, in the first through fifth grade (e.g., around four to six classrooms), a mathematics teacher will be assigned to each classroom (i.e., it is possible a teacher teaches in one or more classrooms) for the mathematics subject. For instance, for a classroom in the third grade, a mathematics teacher will teach students who are allocated to this classroom in the first period (i.e., around 40 minutes); then in the second period, a science teacher will go to the same classroom to teach the same students science subjects, etc. Pursuing this further, the mathematics department in the elementary public school is also distinct from the United States elementary school system. In the United States, collaboration exists between the classroom teachers, and it might be in more than one subject; but in Kuwait, the collaboration between teachers exists between teachers based on the subject with very limited collaboration opportunities between teachers outside their department, and each subject teacher has their own department (i.e., teacher's room) under the most experienced teacher's (i.e., head of the department) supervision. For example, all mathematics teachers and their head of the mathematics department (i.e., one experienced mathematics teacher) will conduct weekly meetings to discuss the current and future events and plans. At a higher level, all mathematics departments represented by the head of the department conduct frequent meetings with their district's administrators (i.e., in the district and school) to discuss the general mathematical goals, strategies, and events proposed by the Ministry of Education.

Measures/Instruments

This study utilized a questionnaire and includes four sections (i.e., demographics, TPACK, barriers, and 21st century environment) (see Figure 3). However, TPACK, and barriers sections were formatted in a way as to measure and collect data quantitatively and qualitatively, while the 21st century environment section of the questionnaire (i.e., collaborative mobile and cloud-computing learning) was formatted in a way as to measure and collect data qualitatively. Additionally, the questionnaire included a demographic section to describe the sample in both electronic questionnaires (Appendix A and Appendix B). The following section of this chapter carefully delineates the instrument and its implementation process to answer this study's research questions.

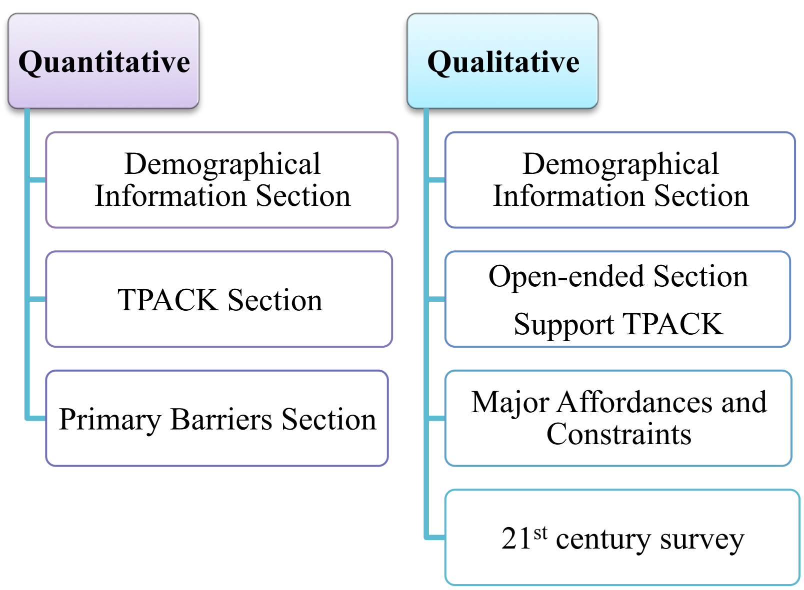

Figure 3. Survey instrumentation.

Demographic Information Survey

The demographical portion of the questionnaire included questions that were answered by the participants describing their teaching experience, age, gender, and current grade level taught (Appendix C). For example, one of the demographic questions related to teachers' previous teaching experience and was measured through requesting teachers circle only one of the offered choices: (a) 1-5 years, (b) 6-10 years, (c) 11-15 years, (d) 16-20 years, (e) 21-25 years, or (f) more than 26 years.

Teachers' Perception of Content, Technology, and Pedagogy Knowledge

The purpose of the current research was to attain elementary teachers' perceptions about their knowledge of their ability to infuse sufficient technology, pedagogy, and content in their classroom activities. Therefore, the self-evaluation TPACK questionnaire (Appendix A) includes seven domains (TK, CK, PK, PCK, TCK, TPK, and TPACK) distributed across 28 items. Each of the seven scales were quantitatively measured via asking teachers to rate their level of agreement on each of the four items in each subscale. All seven domains employed a four-point Likert-type scale: (1) strongly disagree; (2) disagree; (3) agree; and (4) strongly agree.

Each subscale is explained here. In the first subscale, technology knowledge (TK), teachers replied (i.e., self-evaluated) based upon their perception about their level of technology knowledge. For example, responses in the technology knowledge (TK) subscale are: (a) "I know how to use different digital technologies" and (b) "I keep up with important new digital technologies." In the second subscale, content knowledge (CK), teachers responded by reflecting upon their perception about their mathematics content knowledge (CK). For example, responses from the content knowledge (CK) subscale are: (a) “I can make mathematical connections with the problems outside of mathematics” and (b) “I am able to communicate mathematically.” In the third subscale, pedagogy knowledge (PK), teachers responded by reflecting upon their perception about their familiarity with integrating effective and multiple pedagogical practices including pedagogical methods and processes that formalize their teaching. For example, responses from the pedagogy knowledge (PK) subscale are: (a) “I know how to adapt lessons to improve student learning” and (b) “I know how to implement a wide range of instructional approaches.” In the fourth subscale, pedagogical content knowledge (PCK), teachers responded regarding their perception about their knowledge in mathematics and their teaching (i.e., pedagogical) strategies and practices. For example, responses from the pedagogical content knowledge (PCK) subscale are: (a) “I have a good understanding of teaching mathematics so that students are able to learn” and (b) “I have a good understanding of instructional strategies that best represent mathematical topics.” In the fifth subscale, technological content knowledge (TCK), teachers responded by reflecting on their ability to employ mobile technology to improve learning mathematics content. For example, responses from the technological content knowledge (TCK) subscale are: “I know how to use digital technologies to represent mathematical ideas.” And “I am able to select certain digital technologies to communicate mathematical processes.” In the sixth subscale, technological knowledge (TPK), teachers responded based upon their perception about their ability to integrate mobile technology to enhance their pedagogical methods and teaching skills. For example, responses include: (a) “I think deeply about how digital technologies influence teaching approaches I use in my classroom” and (b) “I can implement specific digital technologies to support students' learning for a lesson." In the seventh subscale, technological pedagogical content knowledge (TPACK), teachers reflected upon their perception of their ability to integrate mobile technology in their teaching considering, simultaneously, the importance of pedagogical practices and mathematical knowledge. For example, responses include: (a) "I can identify specific topics in the mathematics curriculum where specific digital technologies are helpful in guiding student learning in the classroom" and (b) "I can use strategies that combine mathematical content, digital technologies and teaching approaches to support students' understandings and thinking as they are learning mathematics.

The Technological Pedagogical Content Knowledge Question-naire Validity and Reliability

The Technology Pedagogy Content Knowledge (TPACK) is widely utilized in the field of education. In this study, however, the TPACK modified version by Hervey (2011) was modified and adopted. The internal consistency reliability and the coefficient alphas of the seven subscales of the TPACK modified by Hervey (2011) were as follows: TK = .79; CK = .66; PK = .85; TCK = .80; TPK = .81; PCK = .85; and TPACK = .86. In addition, Al-Shehri (2012) translated Hervey's (2011) TPACK version into the Arabic language with alpha Cronbachs for the seven subscales as follows: TK = .727; CK = .716; PK = .761; PCK = .838; TCK = .775; TPK = .813; and TPACK = .841. The Arabic version alpha Cronbach values were acceptable levels (George & Mallery, 2011). Therefore, the Arabic TPACK version utilized in this study was adopted from Al-Shehri (2012) since the Arabic TPACK questionnaire was translated from the English language into the classical Arabic language, which is used in almost all Arabic countries (i.e., including Kuwait). Moreover, the Saudi Arabian culture is strongly close to the Kuwaiti culture, thus, the Arabic version of TPACK is convenient. Therefore, in this study, the Arabic TPACK version was suitable for teachers from Kuwait with very minor modifications such as changing the phrase *digital technology* to *mobile technology*.

Teachers' Perceptions about Primary Barriers

I explored teachers' perceptions about the primary barriers that hinder or prevent them from constructing collaborative cloud-computing learning environments based on the effective integration of mobile technology to support the M-learning format and by measuring those perceptions quantitatively (Appendix D). A list of possible barriers was introduced to the participants; they identified the degree to which these barriers hindered their ability to integrate mobile technology and associated applications in teachers' classrooms. According to Pritchett, Pritchett, and Wohleb (2013), 10 barriers, including time constraints and administrative support, are preventing teachers from infusing technology into their classrooms. The researcher of this study added more items to cover more possible barriers that could influence teachers' ability and desire to integrate M-learning and cloud computing practices in their classrooms. In addition, the researcher added another two open-ended questions to gather further understanding of teachers' perceptions in regard to the barriers and affordances. The two questions are: "Are there other barriers you think could limit you from integrating M-learning in your classroom? (Please explain)" and "Are there other affordances you think could assist you to integrate M-learning in your classroom? (Please explain)."

Teachers' Perceptions about Their Ability to Create 21st Century Learning Environment

Teachers' perceptions about their ability to construct collaborative constructivist cloud-computing learning environments based on mobile technology was explored qualitatively via an open-ended-questions questionnaire (Appendix B). This questionnaire included two sections, and it answered two research questions of this study:

Q1 What are the Kuwait teachers' current perceptions about their ability to integrate mobile learning technology in their classroom?

Q3 What are the Kuwait teachers' perceptions about their ability to construct learning experiences promoting 21st century skills in collaborative cloud-computing environments that applies constructivist perspective?

Data Collection Procedures

While this study's participants were adults, this research study was submitted under the exempt review category to the Institutional Review Board (IRB). The data collection started after attaining the IRB's approval to conduct this study. Therefore, the purposeful sampling was employed in accessing teachers in the Alasma, Hawalli, Mubarak Al-kabeer, Al-Ahmadi, Al Farwania, and Al Jahraa educational districts in the State of Kuwait. A deadline was determined in advance for the teachers to complete the questionnaire, comprised of a three-week timeframe. Although this study's instruments contained two different formats, TPACK examined mathematics teachers' perceptions to answer the first research question in this study, and barriers questionnaires, and the 21st century learning environment and cloud computing and M-learning open-ended question questionnaires, the two instruments followed the exact same process and were distributed simultaneously.

I created a hierarchy distribution structure of the electronic questionnaires, created in Qualtrics software, as follows. I contacted the general director of the mathematics department in the six educational districts via text messages, which was the first step in the process of attaining permission to conduct the study. Second, the general directors were asked in a friendly manner to help forward the study's questionnaires to their assistant directors in their educational district who were responsible for visiting all schools in the district to evaluate teachers' teaching practices, methods, and performance. The assistant directors usually have very close relationships with the mathematics directors in all schools under their supervision. For example, the assistant directors had clear knowledge of the number of elementary schools in the district, all necessary contact numbers including the personal number for mathematics directors under their supervision, school addresses (because they need to visit them frequently), and with current technological advances, they are creating chat groups for all teachers (including the director in each school) to facilitate communication between schools and their district. Third, the assistant director forwarded the questionnaires to the mathematics directors after informing the principals at all schools that were considered potential study participants in the six districts. Contact was via phone calls, text messages, and/or written letter, depending on the principals' preference, to gain their permission to include their schools in the study. Fourth, the mathematical directors in the recruited schools forwarded the questionnaires to their teachers and encouraged them to effectively participate in the study. In addition, since I am an experienced mathematics teacher with more than 11 years' experience and still hold a position as the director of a mathematics department in one of the Hawalli elementary schools and have direct relationships with most of the heads of the mathematics department teachers, I encouraged, in a friendly manner, direct contact with all primary individuals in the constructed hierarchy to request their support in encouraging their teachers to positively participate in the research. Additionally, after determining the participating schools and the number of recruited mathematics teachers, I sent text messages to some mathematics assistant directors in the six districts, and the text message contained a link for the electronic questionnaires; the electronic survey included the title of the research, the purpose of the research, and the attachment. Then I contacted some assistant directors in all six districts to explain and organize the best methods by which to administer the study's questionnaire. Also, I gathered the directors' feedback and comments on the quality of the questionnaire, explained the questionnaires to the mathematics directors, and answered all inquiries that might evolve from not understanding or from ambiguity in the translated questionnaire format. This step was significant because it helped me to gather technical and valuable feedback from the mathematics directors about the clarity of the questionnaire (e.g., terminology and phrases) for all four sections (demographic, TPACK, barriers, and creation of a 21st learning environment) and discussed what was needed to include or exclude to improve the quality of the translated questionnaire. Moreover, I did not need to revise the questionnaire items before administering the final version of the questionnaire to all participants.

I delivered all questionnaires to all participants via the educational districts, and all mathematics general directors in the participating districts were informed about the three-week completion deadline period from the date of receiving the questionnaire.

Specifically, all questionnaires were electronically delivered to the heads of mathematics department in all participating schools via text message. Nonetheless, I retuned all personal calls and text messages from the participants and mathematics directors before, during, and after the implementation of the questionnaire. Pursuing this further, in the week following the distribution of the questionnaire, a friendly call and/or text message to remind the participants about the three-week completion interval was sent to the mathematics assistant directors in all participating schools in the six districts. Then, all collected questionnaires were sorted and saved for analysis.

Because all of the participants were adults, consent to participate was assumed with the completion of the survey. No signed consent forms were shared at the opening of the survey, with the statement that completion of the survey signified consent to participate. The voluntary nature of the survey was clearly explained by me and also was explained in the consent language presented to each potential participant. Information was provided to ensure that all participants were aware of their right to volunteer, or not, and that any information gathered would remain confidential and be presented in an aggregate form. It also explained the general nature of activities for which they were being asked to volunteer. Participants were informed that they might withdraw from participation at any time.

No deceptive practices were employed and no debriefing was necessary. Teachers were told honestly about the researcher's interests. Moreover, teachers were also instructed to answer honestly and told their answers would not be linked to them in any way in the potential publication of the research results. Results would be published in aggregate form, and no identifying information about participants would be revealed. Also, the participants were informed their answers would not be shared with the head of their mathematics department and/or their principals, and their participation in the study would not influence their teaching jobs. Furthermore, participants were informed that the confidentiality of participant data was protected because no identifying information would be solicited on the actual survey form. No names were included on the participation consent form; thus, names were not connected to specific completed surveys. In addition, all records were stored in my personal laptop or in a password-protected survey account, and any computerized data generation through analysis were securely saved with the mandatory password to access them. Dissemination of results was aggregated so no particular participant was identifiable in reports of the study findings.

Quantitative Data Analysis

The TPACK survey (Appendix A) was conducted electronically (mobile version). The survey was conducted to examine Research Question 1. The original survey showed internal consistency (alpha = 0.92) for the whole TPACK question section that contained seven domains, in general.

The SPSS 20 version was used to analyze data in this study (available at the UNC statistics lab). First, the reliability (i.e., Cronbach's alpha) for TPACK survey was measured to evaluate the internal consistency of the seven subscales. Second, descriptive statistics were examined to transform computed variables (such as mean and standard deviations) to understand the findings and measure of teachers' perceptions. In addition, the barriers questionnaire was analyzed via SPSS 20 to compute descriptive statistics such as mean and standard deviation and *t* test (one sample test) for all barriers.

The CFA was computed via M*plus* (Version 5.0) (Muthén & Muthén, 2007), and the CFA statistical procedures were based on the WLSMV (weighted least squares mean- and variance adjusted) estimation procedure, which has been displayed to be applicable with ordinal data (Flora & Curran, 2004). Inclusive model fit was measured by multiple indicators: the robust chi-squared test based on the WLSMV estimator (Muthén & Muthén, 2007), the root mean squared error of approximation (RMSEA) (Steiger, 1990), Tucker-Lewis Index (TLI) (Bentler & Bonett, 1980), and comparative fit index (CFI) (Bentler, 1990). The TLI and CFI have a probable range between 0 and 1.0 (although the TLI can exceed 1.0 in some cases), with higher values showing enhanced fit. The RMSEA can range between 0 and infinity, with values closer to 0 indicating better fit. While there is no agreement on what values of fit indicators recommend a well-fitting model, the following cutoff values were utilized in the present study. An RMSEA of ≤ .08 represented "reasonable fit" (Browne & Cudeck, 1993), whereas TLI and CFI values ≥ .95 were reflected as indicative of adequate model fit (Hu & Bentler, 1999). Moreover, the standardized factor loadings and correlations between factors were assessed in terms of their magnitude, direction, and statistical significance ($p < .01$).

Qualitative Data Analysis

Content analysis (i.e., code-based method) was utilized as the primary analytical qualitative analysis because of high recommendations from researchers in the field of qualitative research (Jackson & Trochim, 2002). This method of data analysis is suitable for understanding and answering this study's research questions:

Q1 What are the Kuwait teachers' current perceptions about their ability to integrate mobile learning technology in their classroom?

Q2 What are the major affordances and constraints impacting Kuwait teachers' ability to prepare future-ready students through an integrated technology environment?

Q3 What are the Kuwait teachers' perceptions about their ability to construct learning experiences promoting 21st century skills in collaborative cloud-computing environments that applies constructivist perspective?

Although content analysis has multiple definitions, there is consensus on the usefulness of this analytical method. Even more, content analysis is recognized as a method to deliver and create a subjective interpretation via implementing the systematical process of coding to classify patterns and themes (Hsieh & Shannon, 2005). Neuendorf (2002) identified the content analysis method as "the systematic, objective, quantitative analysis of message characteristics" (p. 1). Indeed, efforts directed toward reducing or making sense of materials collected qualitatively in an effort to make rich, prominent connections and meanings consistently endure throughout qualitative data as a central characteristic that is recognized by researchers as the content analysis method (Patton, 2002). Pursuing this further, using content analysis to better recognize text data is considered a keystone technique to avert hasty and easy qualification, rather than depending on methodological and empirical analytical methods (Mayring, 2000). In brief, content analysis is a beneficial analytical technique that enables a researcher flexible space to interpret qualitative data subjectively and simultaneously follow a systematical model (empirical) of inquiry in an effort to construct essential meaning and understanding of the data.

Nevertheless, finding themes, meanings, and patterns via counting words from qualitative data is not the solitary purpose of utilizing the content analysis method in qualitative research (Wildemuth, 2009). Rather, concurrent subjective and scientific methods can be utilized via adopting the content analysis approach to explain and understand a social reality. In addition, Jackson and Trochim (2002) stated that researchers who construct classification schemes by implementing the content analysis method might proactively describe qualitative raw data. Therefore, intensive reading and understanding of the qualitative data enables researchers to become familiar with the data, and consistent revision of the classification schemes including codes, themes, and patterns enables them to appropriately reflect the data via effectively utilizing an appropriate content analysis approach. This deep-reading approach underpins content analysis methods, permitting well-defined relationships and connections among the research codes, patterns, and themes drawn from the qualitative data and avoiding the excessively deterministic venues approach when explaining the data to the research audience (Streubert & Carpenter, 2007). Thus, the content analysis method can be a strong and beneficial method utilized in the explanation and understanding of qualitative research, especially when properly employed.

This process of analyzing qualitative data (i.e., methodical) is suitable to draw the most significant themes and concepts. In this regard, Wildemuth (2009) proposed eight systematic and transparent steps for the content analysis technique. Theses eight steps are supported by a handful of seminal sources (Schilling, 2006) and were utilized in the current study as follows.

1. *Prepare the data.* Although multiple analytical processes can be utilized, the written format of the data was the primary format when preparing the data (Wildemuth, 2009). In this current study, the data were already in the written format (i.e., answering

open-ended questions in the questionnaire), so there was no need for a transformation procedure with the data.

2. *Define the unit of analysis.* In order to effectively analyze the data in qualitative content analysis, the data should have a specific unit, which is referred to as a theme (Wildemuth, 2009). In the present study, defining the themes from the raw data as an analytical unit was used to measure participants' responses.

3. *Develop categories and a coding scheme.* In order to describe a situation or circumstance, establish categories and a coding system procured deductively from the data itself (Wildemuth, 2009). In the current study, teachers' perceptions were categorized and coded based on general and consistent categories across the participants' responses.

4. *Test your coding scheme on a sample of text.* Testing a sample of data via utilization of the code developed is considered an efficient method to maximize the accuracy of the coding system as well as reaching confidence in the coding accuracy via consistent testing, checking, and revision of the coding scheme (Wildemuth, 2009). Therefore, in the current study, a coding scheme was established during an early stage of the coding process to enable the researcher to test and revise the accuracy of the codes as many times as possible.

5. *Code all the text*. In order to escape falling into the error of assuming the meaning of a code (i.e., automatic sense) without examining it against the data, the code, established during early stages, should undergo constant evaluation to maximize the coding accuracy (Schilling, 2006). In the current study, I constantly evaluated my coding and the themes against the entire raw data to enhance coding accuracy.

6. *Assess your coding consistency.* Ensure the applicability of the codes in regard to the entire data set by frequent rechecking of the coding process (Wildemuth, 2009). In the current study, this step was accomplished via continuous peer debriefing procedures during the coding process.

7. *Draw conclusions from the coded data.* Identify and formalize inferences and forming meaningful themes from the data itself (Wildemuth, 2009). In the current study, I identified the similarities in the characteristics between codes, categories, patterns, and themes to create reasonable relationships between them throughout the entire data set.

8. *Report your methods and findings.* Transparency and honesty should be considered when reporting the processes and procedures utilized by the researcher (Wildemuth, 2009). In the current study, I honestly reported and recorded all the decisions made and the methods followed during the coding process and through the progression of this research.

Researcher Bias

Throughout the study, I was aware of and accounted for researcher bias. Knowing from studying (i.e., studying in the same elementary school) and working with many participants in this study might establishes early familiarity with the participants, as I am a colleague of and have worked with many participants in the same school or district, especially in my district, over the course of 11 years. Knowing handfuls of the potential participants in the research, objectivity during the processes of data collection, data analysis, and interpretation of the data were constantly considered. Although the instrument utilized in this research (i.e., questionnaire) does reflect an objective method of collecting data, caution and consideration with regard to researcher's bias was recognized and monitored across all stages of this research. In this regard, Merha (2002) recommended employing writing techniques as a beneficial strategy for encountering issues related to subjectivity such as recognizing the participants as experts, rather than individuals, under the researcher's examination and judgment. In order to accomplish this important task, in distinguishing among the voices of the participants, I was supported by honest and transparent recoding of the participants' responses with, as much as possible, no desire or effort to influence the participants' perceptions by sharing with them the desired expectations, researcher's goals, and personal opinion about the studied topic.

I strove to encounter the challenges and issues related to subjectivity. Also, early on, I explicitly acknowledged the certainty of the influence of my background in an attempt to clarify my research bias to this research audience (see subjectivity section).

Subjectivity

During my 11 years of experience as a mathematics teacher and as the director of a mathematics department in a public elementary school, I have had tremendous challenges to effectively find ways to integrate technology in the classroom. Mathematics is a core subject, and some K-12 students struggle to conceive of it as an enjoyable subject, which sometimes leads students to feel negatively toward mathematics (i.e., mathematics anxiety). In this regard, technology is considered a beneficial venue by which to change learners' perspectives about mathematics, and it could add the flexibility needed for the subject to improve learners' performance and introduce it as enjoyable content. Furthermore, during teaching and observing of other colleagues' teaching, I found some technologies that were beneficial when appropriately integrated in the classroom, but unfortunately, the teachers' lack of understanding about new or advanced technology led to inadequate use of these technologies in their classroom. Yet, teachers usually integrate technology in accordance with the pedagogical strategies they adopt in order to deliver the content. I have empathy for teachers and learners because I know how hard it is for them to master (i.e., teach and learn) the necessary mathematical skills, especially when there are many different technologies that can assist and motivate them to enjoy mathematics subjects. On the other hand, pursuing my graduate degree in educational technology is another aspect of my subjectivity considered during the current study. Learning about the advanced technologies, best pedagogical practices to integrate different technologies, and understanding the advantages and disadvantages to integrating technology (mobile and cloud computing) in elementary schools might nurture my bias.

Consciously, I realize that the bias I hold concerning technology integration in mathematics learning and its optimistic features and my previous rapport with many of the teachers might play an influential role in data interpretation. Trustworthiness techniques, such as peer debriefing and member checks, which are detailed in the following section, assisted me as I attempted to enhance objectivity throughout this study.

Trustworthiness

There are multiple methods that might lead to the accomplishment of quality trustworthiness in descriptive research. Creswell (2013) suggested multiple criteria for constructing trustworthiness in the qualitative approach to research. These criteria are conformability, credibility, dependability, and transferability. I will next expand upon these four methods that were employed in this study.

Credibility

Accomplishing credibility in the current research was achieved via three primary principles. First, *prolonged engagement*, according to Creswell's (2013) description in regard to prolonged engagement research activity, is that to enhance the credibility of the produced data, the researcher should devote ample time to understanding and familiarizing her/himself with the participants' culture and context. In addition, he emphasized the importance of the researcher's efforts for creating trust rapport with the participants. In the current study, I was not able to spent adequate time with participants during the data collection phase due to the distance issue (i.e., studying in the United States), and school context in Kuwait is very difficult to access and spend tremendous time on because of the teachers' teaching loads. Nevertheless, being a native Kuwaiti (e.g., born and raised in Kuwait) and because I am still an active mathematics director who has worked with many participants in this study for many years, I have adequate knowledge about the participants' culture and surrounding environment. This natural and native understanding of the teachers' culture and setting provided an important opportunity for creating trust rapport with participants.

Second, *peer review* (i.e., peer debriefing), according to Creswell's (2013) description is the procedure in which the researcher constructs an external source for observing and validating the research progressive processes. This aspect (e.g., peer debriefing) is significant in assisting the researcher to maintain high levels of honesty throughout the research. This approach is meant to encourage researchers to expose themselves to an unbiased peer who inquires and advocates for meanings from the researcher (i.e., teasing out the researcher's biases) about the research processes

(Creswell, 2013). By the same token, peer review is a beneficial aspect because it yields a cathartic experience helping the researcher diminish the stress and emotions toward the research. Two reviewers (doctoral students) who have a satisfactory understanding of analyzing qualitative data, reviewed the raw qualitative data (i.e., approximately 20%), and the reviewers were be asked to infer themes. Here, I discussed conclusions from the data and compared identified themes. This provided the ability to defend the themes and interpretations taken from the raw data.

Third, *member checks* consisted of sharing my conclusions with the teachers to verify the accuracy of the data. The teachers were asked to give their opinions on the accuracy of the data and its interpretation. This fits with the idea that member checking is the utmost reliable critical method for warranting credibility (Creswell, 2013). Adopting this design, teachers were given data, coding, and conclusions in order to evaluate the accuracy of the researcher's materials (Creswell, 2013). In this study, I provided the participants with the choice to receive copies of the data analysis (e.g., coding system and themes) and conclusions so they could provide clarification and possible corrections. This allowed teachers the opportunity to clarify and extend their responses, if necessary, to the questionnaire. Using this strategy could also give teachers time to review their responses in order to ensure that they were correctly interpreted. Teachers were asked to give any needed modifications, and additions to the interpretation of the data were appropriately made.

Transferability

Transferability indicates the researcher is offering the audience sufficient knowledge (i.e., information) as to create consistency in the data and findings and the conclusions made from them. Transferable research can be recognized as having results that can be used in other settings (Creswell, 2013). In the current study, I gave simple descriptions of the teachers' perspectives and environments and the findings from them. By giving enough detail, audiences are able to conclude whether or not the findings can be transferred to other environments.

Dependability

Dependability has to do with the consistency of research findings, regardless of the researcher or where the research is done. It is also important the processes followed by the researcher are clear and can be followed by the reader (Creswell, 2013). In this study, I ensured dependability with peer debriefing, as described in a previous section. In peer debriefing, the debriefer was requested to make observations and inquire as to the process of data collection, analysis of the raw data, and the findings and inferences made from them. They were also requested to specify their own inferences in order to corroborate the amount of similarity to those of the researcher. Lastly, a peer debriefer was requested to provide thoughts regarding research transparency and applicability throughout time and research.

Conformability

Conformability reflects the clarity of objectivity, the ability of multiple individuals to discover consistency in the data, and warranting that the information and the results, interpretations, and conclusions are precise and represent the perspectives of the teachers and not the bias or perception of the research (Elo et al., 2014; Polit & Beck, 2012). In other words, a core component of conformability is showing the thought process of the researcher and how he or she arrived at his or her conclusions from the data (LoBiondo-Wood & Haber, 2010). To show conformability in this study, I clearly expressed my assumptions as a researcher from Kuwait regarding the subject of this study, the teachers, and the context in which it took place (see subjectivity section).

All participants in the study can provide a valuable point of view to the teachers' perceptions of technology integration, in general and in Kuwait. There may not be one accepted mode of integration and creating a 21st century learning environment for teaching mathematics to elementary students in the United States. This is also seen in Kuwait. The data in this study might provide a base of information from which to understand the current state of mathematics education in Kuwait as well as to shed light on future possibilities. A more complete understanding of the specific and general approaches to teaching elementary mathematics in Kuwait may allow educators to sharpen their teaching methods, benefitting both the instructors and the students.

CHAPTER IV

RESULTS

This mixed-method design utilized qualitative and quantitative methods of data collection, data analysis, and data interpretation to attempt to answer this study's research questions. I surveyed mathematics teachers across the State of Kuwait about their use of mobile technology and cloud computing to create a modern learning environment using the constructive collaborative perspective. The study attempted to answer the following research questions:

Q1 What are the Kuwait teachers' current perceptions about their ability to integrate mobile learning technology in their classroom?

Q2 What are the major affordances and constraints impacting Kuwait teachers' ability to prepare future-ready students through an integrated technology environment?

Q3 What are the Kuwait teachers' perceptions about their ability to construct learning experiences promoting 21st century skills in collaborative cloud-computing environments that applies constructivist perspective?

Using an electronic based format (TPACK, barriers survey), the survey gleaned quantitative information about how teachers viewed such use of technology as well as the barriers they faced in integrating it into the classroom. I also collected qualitative data using a survey of open-ended questions to provide context to survey answers and better understand perceptions of affordances and barriers experienced by the participants. In addition, using the electronic-based format (21st century survey), the survey intended to collect qualitative data to understand teachers' perceptions about their ability to integrate mobile technology and creating a 21st century learning environment utilizing a collaborative cloud-computing learning experience based on the constructivist perspective. The following sections provide a thorough explanation of the data analysis and results.

Demographic Description

The study included two purposive samples. A quantitative purposive sample (n = 562) took the TPACK and barriers survey to provide the quantitative portion of the qualitative data for the study, while a purposive qualitative sample (n = 21) answered a survey of open-ended questions, which provided the majority of the qualitative data (see Figure 4).

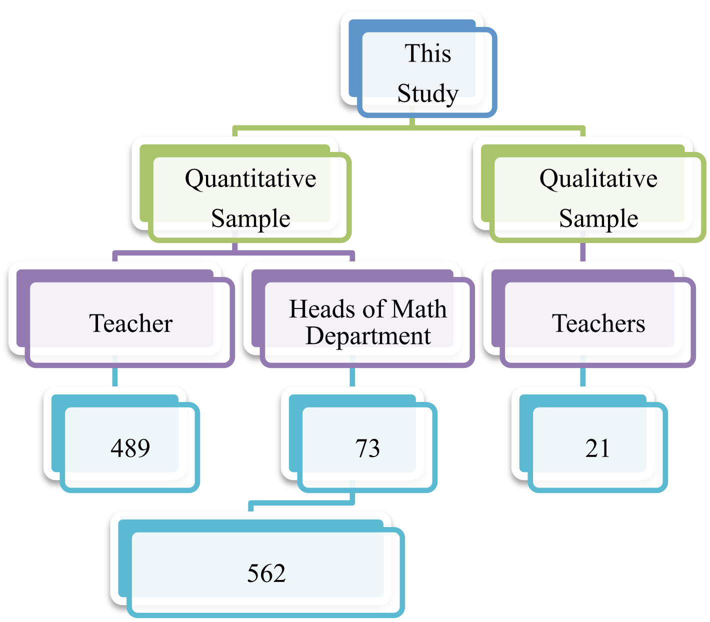

Figure 4. Demographics description.

Demographics of the Quantitative Sample

The sample was taken from a population of active mathematics teachers currently teaching at one of the six educational districts in the State of Kuwait. The population of around 1000 mathematics teachers was contacted and asked to electronically complete the TPACK and barriers surveys for this research study, with 562 mathematics teachers ultimately responding to the survey.

Age

The age of the sample (n = 562) ranged from 21 to 40 years and older (mean = 3.20, SD = 1.29). The age of participants was balanced among the groupings, with 11% aged 21-25 (n = 61), 23% aged 26-30 years (n = 131), 20% aged 31-35 years (n = 114), 26% aged 36-40 years (n = 147), and 19% aged 40 and above (n = 109) (see Figure 5).

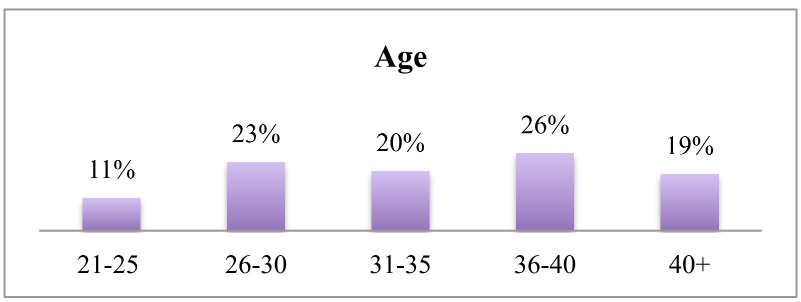

Figure 5. Age.

Gender

Males were represented less than females because in the Kuwaiti public elementary school system, females are the predominant gender across all educational districts. Actually, the Ministry of Education (MOE) in Kuwait purposefully allows for one or a maximum of two elementary schools in each educational district to be under male teachers, administration, and staff management, and the majority of the elementary schools are operated by female administrative staff and female teachers. This fact is represented in the study results, with only 3% of respondents being male (n = 19), and 97% of respondents being female (n = 543) (mean = 1.97, SD = 0.18) (see Figure 6).

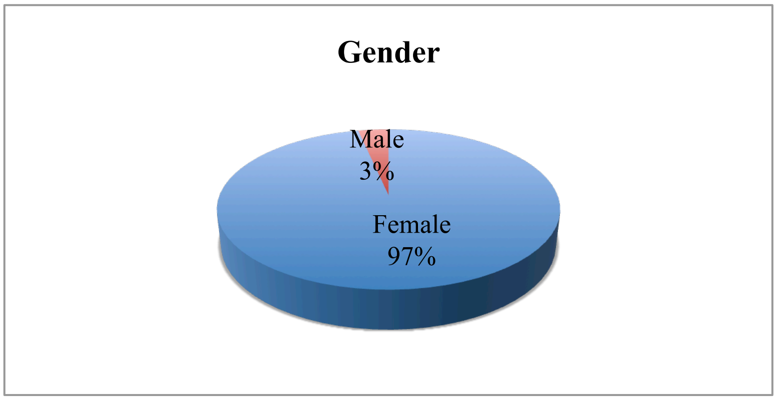

Figure 6. Gender.

Current Position

The sample included elementary mathematics teachers (n = 489, 87%) and heads of mathematics departments (n = 73, 13%) (mean = 1.13; SD = 0.34). In Kuwait, the heads of the mathematics departments began as mathematics teachers and were later promoted to lead the mathematics department. Usually, the head of the mathematical department does not teach any classes, and he/she just manages the department. However, in some schools, heads of the mathematics departments may teach one or more classrooms along with their responsibility of managing the department. Therefore, their participation in this study added a unique point of view that enriched the findings.

Teaching Current Grade Levels

The participants in the study were mathematics teachers who were currently active in elementary schools, teaching grade levels one through five. Teachers of the various grade levels were represented quite evenly, with 36% teaching first grade (n = 204), 28% teaching second grade (n = 160), 29% teaching third grade (n = 163), 32% teaching fourth grade (n = 182), and 31% teaching fifth grade (n = 147), while 13% were heads of mathematics departments **(**n = 72) and were currently not teaching in any classrooms.

Educational Districts

The participants were recruited from all six educational districts in Kuwait. The districts were represented as follows: Hawalli (n = 189, 34%), Al-Asema (n = 75, 13%), Mubark Al-Kabeer (n = 44, 8%), Al-Ahmadi (n = 64, 11%), Al-Farwaniyah (n = 37, 7%), and Al-Jahra (n = 153, 27%), with a mean of 3.26 and SD of 2.06 (see Figure 7).

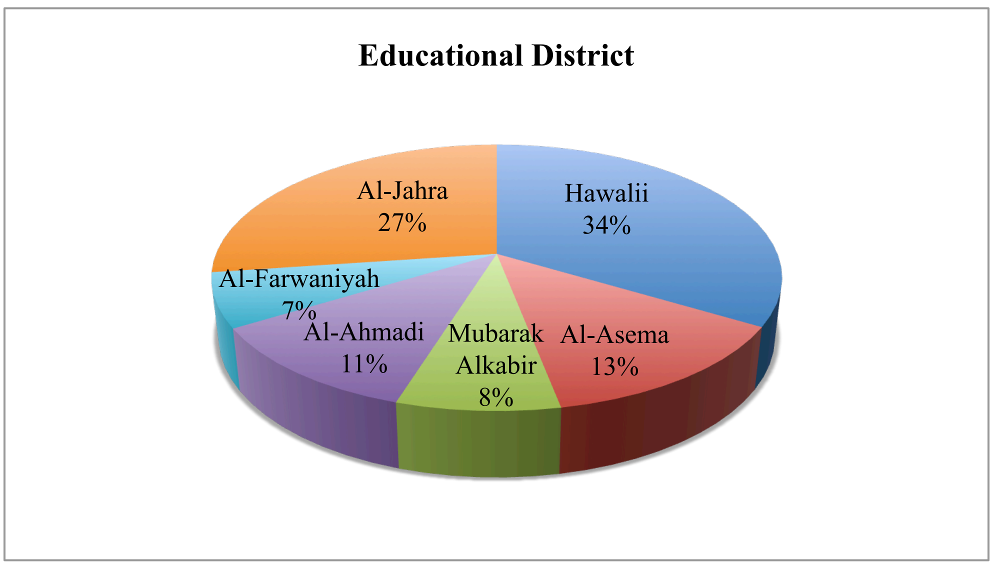

Figure 7. Educational district.

Professional Development

For this study, professional development was divided into two types: non-technology-related and technology-related. For the non-technology-related workshops, 19 % of teachers responded they participated in no workshops (n = 106), 69% in 1-5 workshops (n = 387), 9% in 6-10 workshops (n = 51), and 3% participated in more than 10 workshops (n = 18) (see Figure 8). For the technology-related workshops, 44% of teachers responded they attended no workshops (n = 245), 52% participated in 1-5 workshops (n = 290), 4% in 6-10 workshops (n = 24), and 1% in more than 10 workshops (n = 3) (mean = 1.62, SD = 0.60) (see Figure 9).

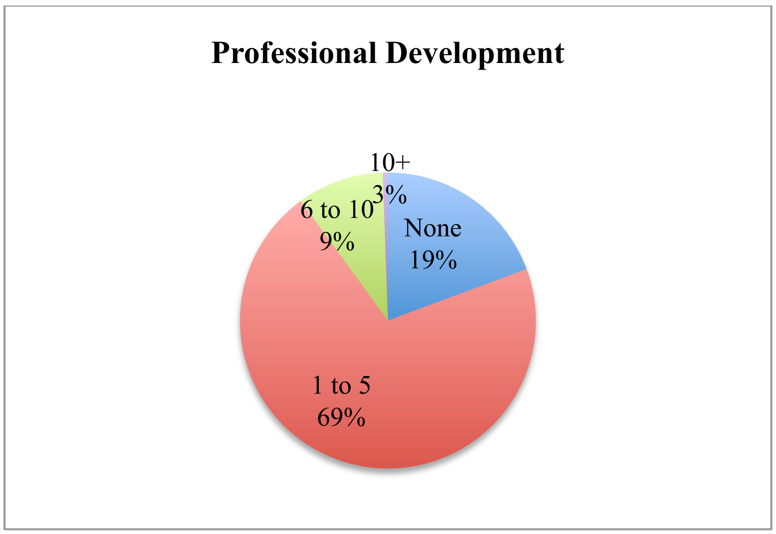

Figure 8. Professional development.

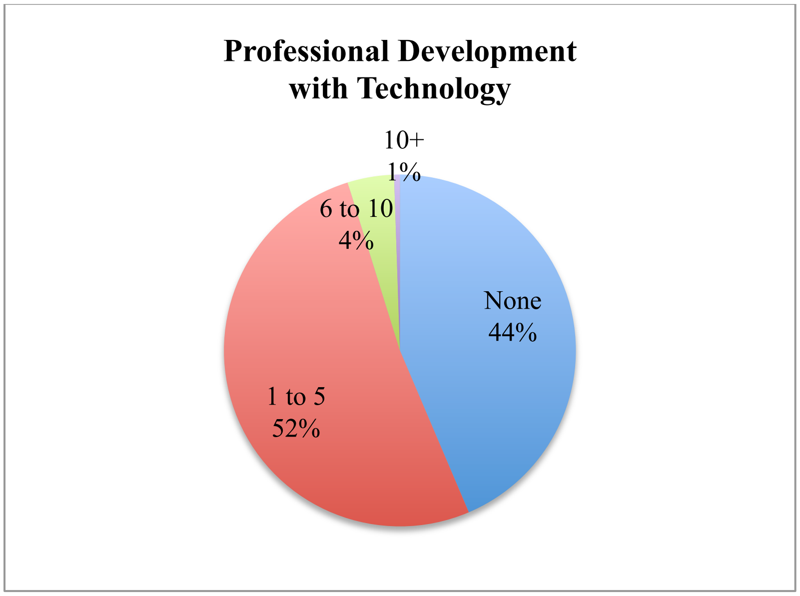

Figure 9. Professional development with technology.

Teaching Experience

Mathematics teacher participants had taught at their current or previous elementary schools for various lengths of time as follows: 28% of teachers (n = 157) had taught for 1-5 years, 24% of teachers (n = 136) had taught for 6-10 years, 26% of teachers (n = 146) had taught for 11-15 years, 14% of teachers (n = 76) had taught for 16-20 years, and 8% of teachers (n = 46) reported teaching for more than 21 years, with a mean of 2.50 and SD of 1.26 (see Figure 10).

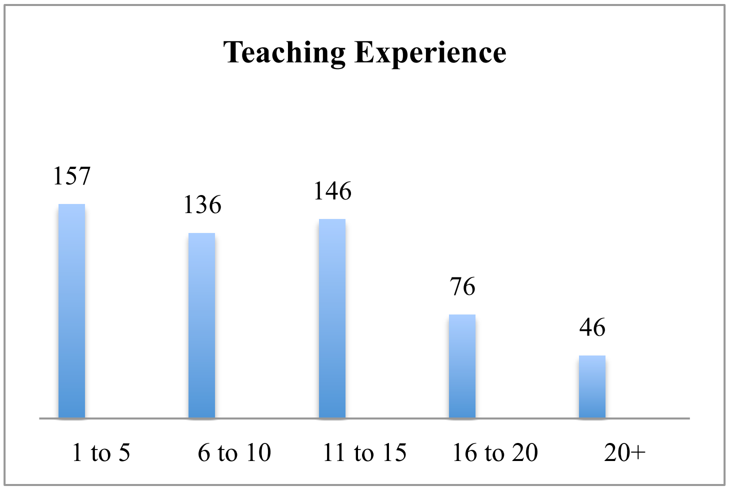

Figure 10. Teaching experience.

Teaching Experience with Technology

Participants in this study had integrated technology in their teaching at their current or previous elementary school. Descriptions of their experiences are as follows: 7% of teachers (n = 41) did not employ technology in their teaching, 70% of teachers (n = 394) had incorporated technology for 1-5 years, 16% of teachers (n = 92) had incorporated technology for 6-10 years, 4% of teachers (n = 21) had incorporated technology for 11-15 years, and 2% of teachers (n = 14) had incorporated technology for 16+ years (mean = 2.24; SD = 0.74) (see Figure 11).

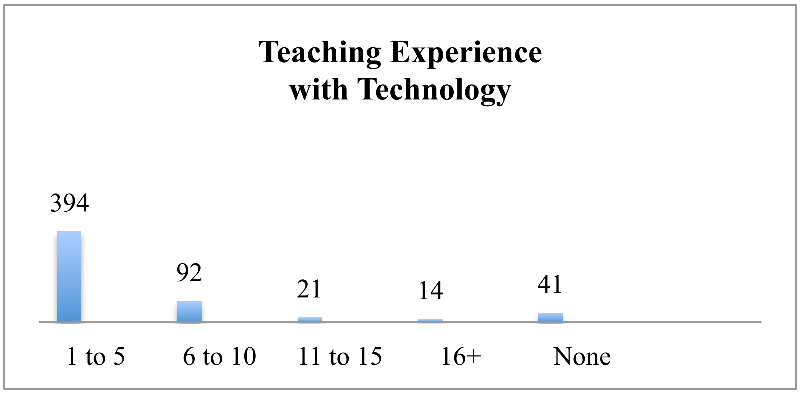

Figure 11. Teaching experience with technology.

Demographics of the Qualitative Sample

A total of 21 mathematics teachers participated in the qualitative part of this research: male, n = 7 (33%) and female, n = 14 (67%). The age average was between 21 and 40+ years, and all age groups had representation in the qualitative sample with different rates. In addition, participants' teaching experience ranged from 1 to 20 years. The participants represented three educational districts: 52% from Hawalli (n = 11), 29% from Mubarak–Alkabeer (n = 6), and 19% from Alahmadi (n = 4). The reason for collecting the qualitative data in these three districts was related to my accessibility there; my accessibility to these three districts was greater than to the other districts, and the mathematics teachers responded rapidly (see Figure 12).

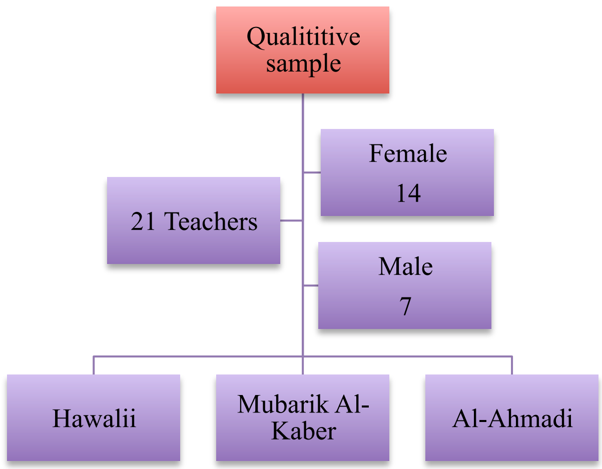

Figure 12. Demographics of the qualitative sample.

Research Question 1

In this study, the first research question was:

Q1 What are the Kuwait teachers' current perceptions about their ability to integrate mobile learning technology in their classroom?

This research question was answered via the TPACK survey (quantitatively) and via the open-ended survey (qualitatively). Therefore, the following analysis will include descriptive statistics such as mean, standard deviation, and confirmatory factor analysis. In addition, content analysis materials such as coding, themes, and quotations will be utilized to answer this question.

Quantitative Approach to Answer Research Question 1

Descriptive statistics. To answer this question, the web-based TPACK survey was conducted, and data were stored and downloaded from the Qualtrics website and imported into an SPSS data file. The TPACK survey's reliability was computed for the

28 items (Cronbach alpha = .949). In addition, the TPACK's seven subscale values suggested that the scores on the TPACK exhibited good internal consistency reliability in the study's sample as presented in Table 1. Descriptive statistics including subscale means and standard deviations were computed to analyze the seven TPACK subscales. Table 1 presents the descriptive statistics for the TPACK survey subscales.

Table 1

Analysis of TPACK for Each of the Seven Subscales

Subscale	*M*	*SD*	α
Technology Knowledge (TK)	3.086	0.572	.842
Content Knowledge –Math (CK-M)	3.256	0.437	.793
Pedagogical Knowledge (PK)	3.271	0.447	.836
Pedagogical Content Knowledge (PCK)	3.331	0.473	.872
Technological Pedagogical Knowledge (TPK)	3.094	0.542	.909
Technological Content Knowledge (TCK)	3.044	0.501	.870
Technological Pedagogical And Content Knowledge (TPACK)	3.063	0.486	.871

Confirmatory factor analysis for the TPACK. The seven-factor structure of the TPCK score in the current sample was confirmed by CFA. Although the chi-square goodness of fit statistic was statistically significant, χ^2 = 393.30 (86, N = 562), $p < .001$, indicating a lack of model fit, the CFI (Comparative Fit Index), TLI (Tucker Lewis Index), and RMSEA (Root-Mean-Square Error of Approximation) all met criteria suggesting adequate fit, with values of .964, .991, and .08, respectively.

The standardized factor loadings of the 28 items on the seven scales of the TPACK (see Table 2) all displayed statistical significance at the p < . 001, identifying the relationship between the observed items and their theorized primary scales. Based on evidence supporting both the overall model fit of the hypothesized seven-factor model as well as the high (and statistically significant) standardized factor loadings, in conjunction with the pattern of correlations among the factors, results of the CFA provide support for the factorial validity of scores on the Arabic version of the TPACK in a population of the mathematics teachers in public elementary schools in Kuwait.

Table 2

Standardized Coefficients Model Results

Item	Question	TK	CK	PK	PCK	TCK	TPK	TPACK
Q 1	I know how to use different digital technologies.	0.873						
Q 2	I know how to solve my own technical problems with digital technologies.	0.814						
Q 3	I frequently play around with digital technologies.	0.758						
Q 4	I keep up with important new digital technologies.	0.907						
Q 5	I reason mathematically when I solve problems in my daily life.		0.712					
Q 6	I can make mathematical connections with the problems outside of mathematics.		0.749					
Q 7	I am able to communicate mathematically.		0.832					

Table 2 (continued)

Item	Question	TK	CK	PK	PCK	TCK	TPK	TPACK
Q 8	I use multiple mathematical representations when I solve problems.		0.864					
Q 9	I know how to adapt lessons to improve student learning.			0.838				
Q 10	I know how to implement a wide range of instructional approaches.			0.890				
Q 11	I know how to organize a classroom environment for learning.			0.846				
Q 12	I know how to assess student performance in a classroom.			0.831				
Q 13	I have a good understanding of teaching mathematics so that students are able to learn.				0.910			
Q 14	I have a good understanding of instructional strategies that best represent mathematical topics.				0.948			
Q 15	I have a good understanding of students' conceptual and practical understanding of mathematical concepts.				0.874			

Table 2 (continued)

Item	Question	TK	CK	PK	PCK	TCK	TPK	TPACK
Q 16	I have a good understanding of the mathematics curriculum that meets students' needs for learning mathematics.				0.881			
Q 17	I know how to use digital technologies to represent mathematical ideas.					0.911		
Q 18	I am able to select certain digital technologies to communicate mathematical processes.					0.906		
Q 19	I am able to use digital technologies to solve mathematics problems.					0.957		
Q 20	I am able to use digital technologies to explore mathematical ideas.					0.907		
Q 21	I am able to identify digital technologies to enhance the teaching approaches for a lesson.						0.927	
Q 22	I can implement specific digital technologies to support students' learning for a lesson.						0.946	
Q 23	I think deeply about how digital technologies influence teaching approaches I use in my classroom.						0.796	

Table 2 (continued)

Item	Question	TK	CK	PK	PCK	TCK	TPK	TPACK
Q 24	I can adapt digital technologies to support learning in my classroom						0.823	
Q 25	I know specific topics in mathematics are better learned when taught through an integration of digital technologies with my instructional approaches.							0.868
Q 26	I can identify specific topics in the mathematics curriculum where specific digital technologies are helpful in guiding student learning in the classroom.							0.922
Q 27	I can use strategies that combine mathematical content, digital technologies and teaching approaches to support students' understandings and thinking as they are learning mathematics.							0.851
Q 28	I can select digital technologies to use with specific instructional strategies as I guide students in learning mathematics.							0.932

Note: (TK) Technology Knowledge, (CK) Content Knowledge, (PK) Pedagogy Knowledge, (PCK) Pedagogy content Knowledge, (TCK) Technology content Knowledge, (TPK) Technology Pedagogy Knowledge, (TPACK) Technology Pedagogy content Knowledge.

In addition, the correlation between the seven factors (subscales) in the TPACK survey ranged between moderate (0.333) to high (0.907) at the level of $p < .001$ (see Table 3).

Table 3

Correlation Matrix between Factors

	TK	CK	PK	PCK	TCK	TPK	TPACK
TK	1.0						
CK	0.453	1.0					
PK	0.505	0.830	1.0				
PCK	0.333	0.713	0.815	1.0			
TCK	0.801	0.583	0.636	0.560	1.0		
TPK	0.760	0.573	0.624	0.535	0.936	1.0	
TPACK	0.667	0.579	0.610	0.492	0.841	0.907	1.0

Qualitative Approach to Answer Question 1

It was one of the current study's goals to understand teachers' perception in regard to their ability to integrate mobile technology in their teaching practices. Therefore, it is beneficial to understand teachers' perceptions via the quantitative method (TPACK survey). It is also beneficial to enrich our understanding via the exploration of teachers' perceptions qualitatively (via an open-ended question survey). The following section is a thorough explanation in regard to teachers' perceptions.

The qualitative section consisted of 11 open-ended questions (Appendix A). Analysis of these questions provided an understanding about the teachers' perceptions about their own ability to integrate mobile technology in their classrooms. It is beneficial to discuss these questions as one general discussion to gain a full understanding about teachers' perceptions. Therefore, a combined comprehensive qualitative analysis and discussion comprises the following section.

The content analysis of the qualitative data clearly reveal the participants perceived themselves as highly competent in their ability to integrate different mobile technologies such as the iPhone, iPad, and laptop into their classrooms if the appropriate mobile devices and necessary resource supports were provided. These resources included Arabic applications, Internet accessibility, professional development, and administrative support. The qualitative raw data were sorted and coded, and themes were inferenced. In the following section, the process of explaining each of the general themes is discussed.

Ability to use mobile technology as an attractive educational tool. According to a participant survey, "Mobile technology is effective because it could help teachers to present the mathematics lessons and deliver the mathematical concepts in interactive way combined with presenting colorful pictures and check your answer if they are right or wrong." Perceptions of competency using technology were evident in the majority of the participants' responses (n = 19, 90.5%). The participants were generally comfortable interacting with mobile technology, and their answers reflected competency in interacting with different mobile technologies.

The participants reflected their ability to interact with multiple mobile devices and understand how they functioned. To support this reflection, one participant stated, "For example, laptops are tremendously easy to interact with, and you could use it to browse and create many lessons and tests." In addition, teachers perceived high ability in facilitating this mobile technology in an attractive way in their teaching practices.

Another participant indicated, “Mobile devices have many applications that make learning as exciting for learners and ease the presentation of mathematical content.”

It is salient from teachers’ responses that they have no issues interacting and utilizing mobile technology as an attractive educational tool in their daily mathematics lessons. Many responses prompted participants’ good understanding of how to interact, operate, and use different mobile devices as attractive educational tools, if the necessary equipment and mobile devices were provided.

Readiness to utilize mobile technology in the 21st century learning environment. As reported by one survey participant, “Yes, mobile technology corresponds with technological revolution around the world and will make mathematics more fun and attractive.” This theme was developed from teachers’ responses to questions from varying perspectives that aimed to understand their perception about the effectiveness of mobile technology at the current time in consideration of current students’ technological needs. The majority of teachers’ responses consistently focused upon the importance of mobile technology when preparing the current technological generation of students and mathematics teachers who were skilled in their ability to integrate technology in their daily mathematics lessons. Further, the majority of teachers expressed a good degree of confidence in the appropriateness of integrating mobile technology in their mathematical classrooms as a modern learning environment. To emphasize this point, one participant stated, “Yes, mobile devices match the new technological era, and many concepts could be introduced via exploratory videos approach.” Teachers also acknowledged the usefulness of such technology to introduce mathematical content to the current generation of learners who interact and understand technology well, as one of the participants identified, “Yes, it is beneficial because it is easy for the high-tech children and young learners to like it, and it provides a different method of introducing the mathematical content when compared to the traditional teaching methods.”

From these quotations, it is notable that teachers are aware of the benefits of mobile technology for creating a 21st century learning environment that could facilitate teaching mathematical content. Teachers did not perceive mobile technology as benefitting the facilitation of learning mathematics from just the teaching direction, but they also justified the importance of mobile technology in the 21st century to promote learning among high-technological learners.

The advantage of mobile technology’s mobility and efficiency. “It is important educational tool for helping the teacher to teach the mathematical concepts in a simple way and efficient way such as save the lesson time” (survey participant). It was obvious from teachers’ responses that they appreciated the fact that mobile technology afforded mobility. It seemed the mobility of mobile technology was considered a tremendous advantage that gave confidence to the teachers to constantly interact with mobile devices such as smartphones, tablets, and laptops, as one participant stated, “Yes, it easy to carry it and move with it.” In their responses, teachers gave a great deal of attention to the ability to have their mobile devices with them everywhere they went. For example, one respondent noted, “Smartphones are my favorite because I can carry it everywhere.”

Moreover, it was notable in the raw data that teachers appreciated the efficiency of mobile devices when teaching mathematics. The majority of participants indicated that the mobile devices enabled them to introduce mathematical concepts and content in different ways, saving time during the lesson in teaching new mathematical information. This convenience is compounded by the reality that mobile technology is already in children's hands, and they are used to it. For instance, one participant stated, "Yes, it helps in saving and transferring the necessary information during the lesson," and another participant indicated, "I support mobile devices in learning because they facilitate smoother learning transformation." Finally, the participants acknowledged the importance of mobile technology in saving lesson time. It seemed from the participants' responses that lesson time is an issue, and utilizing mobile devices might help teachers overcome this issue. To illustrate, one participant stated, "It is useful because it eases the complex information, and it rapidly delivers the concepts in shorter time." Another participant identified, "It saves teachers' time, effort, and money of creating educational tools."

It can be inferred from participants' responses that teachers recognize the importance of mobile technology in delivering mathematical content, especially of complex mathematical concepts, in a variety of easy and effective teaching approaches. They considered this technological means important and helpful in assisting them in their daily teaching and believed it could be effective for different learning styles. Along these lines, one participant indicated, "[mobile technology] facilitates different mathematics concepts to different types of learners' mindsets via different means."

Deficiency and negative perception. "Sometimes mobile technology is beneficial in delivering mathematical concepts; however, there are some other mathematics concepts that need detailed steps, and technology can't do it" (survey participant). The majority of participants showed high levels of competency in operating mobile technology and confidence in integrating different types of mobile technology, and most of the participants perceived themselves positively when it came to integrating mobile technology in the mathematics classroom. Most acknowledged that this could lead to positive learning outcomes and improvement in learners' performance in mathematics.

Conversely, some teachers did not perceive technology or mobile technology positively or as the absolute solution to all mathematical issues in elementary public schools in Kuwait. They hesitated or showed limited ability to integrate mobile technology devices in their classrooms. For example, one participant stated, "I am mostly proficient with the use of laptop, but I have very limited knowledge in the iPad." Also, another participant indicated, "I know how to use some mobile devices, but I am not totally proficient with integrating them into the lessons." Furthermore, some teachers did not believe technology could be a partial or primary educational tool to support the traditional teaching methods, with one participant stating, "In some interactive lessons, yes, mobile technology might be great tool, but for lessons that need solving problems and equations, you cannot find anything that could replace the paper, pencil, and whiteboard."

It is natural to have distinct perceptions in regard to teachers' perceptions toward technology, in general, and mobile technology, specifically. Teachers reflected different degrees of competence in interacting with and the ability to utilize mobile technology in the mathematics classroom. Some teachers did not mind integrating mobile technology in their classroom, but they reflected deficiency in understanding some types of mobile technology. On the other hand, other teachers expressed negative perceptions about technology, stating technology is not appropriate in some learning situations. Both perceptions are acceptable in the field of technology and education.

Health concerns. One of the survey respondents stated, “Of course, I will not agree to integrate technology in my classrooms, mobile technology will harm children because they are at the developmental age and might also harm their vision.” Only a very few participants saw no advantage to mobile technology. Instead, they perceived technology negatively due to perceptions that it could impact their health. Potential issues such as vision problems, cancer, dangerous waves from iPads, and other health problems were mentioned only a few times by a limited number of participants. Some participants were concerned about the negative impact of technology on children’s health, with one participant stating, “I do not prefer to integrate iPad in my mathematics classrooms, and I don’t prefer my students to use it. It will damage their vision.” Another participant indicated, “Technology will hinder the brain development because using more than one sense during learning will help in improving learners’ brains.” Finally, one participant did not even have the desire to perceive her/his ability because she/he stated technology was dangerous, stating “No, because there are harms caused by the iPad when they are charged or there are dangerous waves and frequent uses of technology causes cancer.”

These participants’ responses suggested that technology might not be acceptable to some mathematical teachers in Kuwait. They did not perceive mobile technology as an effective educational tool; instead, they perceived it as a dangerous or life-threatening device that could cause serious damage to children’s health.

Complexities of elementary mathematics curriculum. "It is not easy to integrate technology in the current mathematics curriculum; because there are intensive and difficult mathematics concepts and activities need to be taught in the lesson, it is very hard to utilize technology when teaching them" (survey participant). A handful of teachers were very specific in regard to the difficulty in integrating technology into education, in general, and into mathematics, specifically. Some participants emphasized that mobile technology is not applicable for mathematics and it is difficult to integrate technology for all mathematics concepts. For instance, one participant stated that technology in another field might be more beneficial than in education: "I don't believe mobile technology is helpful in the current curriculum. There might be other fields that need it more, and it could positively improve them." Another participant responded when she/he was asked about integrating mobile technology in mathematics classroom, "I don't think it is applicable for mathematics concepts, but I agree to adopt technology in other subjects." A different opinion was expressed by one participant, emphasizing mathematical applications incorporating mathematical concepts are crucial to magnify the benefits of integrating mobile technology in classrooms: "Yes, mobile technology is beneficial if the right application was utilized to match elementary mathematics curriculum."

Teachers specified that the content of the elementary mathematics curriculum in the current format is not applicable for mobile technology integration. Teachers identified the need for considering the complexity of the mathematics curriculum to enable teachers to successfully and effectively integrate mobile technology in their classrooms.

Summary

Generally, both qualitative and quantitative approaches to answer the first research question suggested that mathematics teachers have high perceptions of their ability to integrate technology in their classrooms. All themes proposed under the first research question provide a thorough understanding of perceptions of mathematics teachers in elementary schools in Kuwait toward mobile technology integration. The majority of participants perceived themselves as highly capable in their ability to interact with and integrate mobile technology in their mathematical lessons and classrooms and saw mobile technology as an attractive and effective educational tool. However, some participants did not agree with this perception and did not favor mobile technology integration. Overall, the majority of the mathematical teachers perceived themselves as highly capable in their ability to integrate mobile technology in their classrooms.

Research Question 2

In this study, the second research question was:

Q2 What are the major affordances and constraints impacting Kuwait teachers' ability to prepare future-ready students through an integrated technology environment?

This research question was answered through a survey regarding a list of 10 barriers (quantitative). The survey included a section of two open-ended questions (qualitative) to understand teachers' perceptions of the affordance and barriers influencing their integration of mobile technology.

Quantitative Analysis

The following analysis will include descriptive statistics and *t* test to answer Research Question 2. To do so, the survey data for the quantitative sample (n = 562) was stored and downloaded from the Qualtrics website and then downloaded into the SPSS.

Table 4 illustrates the descriptive statistics for the barriers survey.

Table 4

Descriptive Statistics for Barriers Survey

Barrier	Frequency				Mean	SD	Variance
	Strongly Prevents 1	Prevents 2	Does Not Prevent 3	Strongly Does not Prevent 4			
Time constraint	84 15%	242 43%	196 35%	40 7%	2.34	0.82	0.67
IT limitations	97 17%	232 41%	201 36%	32 6%	2.30	0.82	0.67
Budget constraints	195 35%	224 40%	125 22%	20 4%	1.94	0.84	0.71
Administrative support	107 19%	216 38%	198 35%	41 7%	2.31	0.86	0.74
Technological knowledge	26 5%	138 25%	305 54%	93 17%	2.83	0.75	0.57
Professional development for mobile learning	25 4%	134 24%	335 60%	68 12%	2.79	0.70	0.50
Personal interest	22 4%	121 22%	317 56%	102 18%	2.89	0.74	0.54
Professional development and training	22 4%	117 21%	333 59%	90 16%	2.87	0.71	0.51
Pedagogical knowledge	15 3%	19 16%	362 64%	94 17%	2.95	0.66	0.43
Mathematics knowledge	24 4%	81 14%	326 58%	131 23%	3.00	0.74	0.55

The *t* test (one-sample test) indicated that all barriers were statistically significant at the level of $p < .001$. Additionally, perception of components impeding technology implementation was created using the average participant rankings for four variables, and the percentage of the respondents were combined for both the preventing and strongly preventing responses. For example, the percentage of the strongly preventing and preventing were added together, resulting in one overall preventing percentage (a cumulative percentage). Respondents consistently ranked these variables similarly (high) in the technology integration in order, from the most hindering (preventing) variable to the least. The four factors preventing technology implementation emerged as follows: budget constraints (75%), IT limitations (58%), time constraints (58%), and administrative support (57%). The mathematics teachers clearly had high perceptions about the lack of support from their school, district, and the Ministry of Education (see Figure 13).

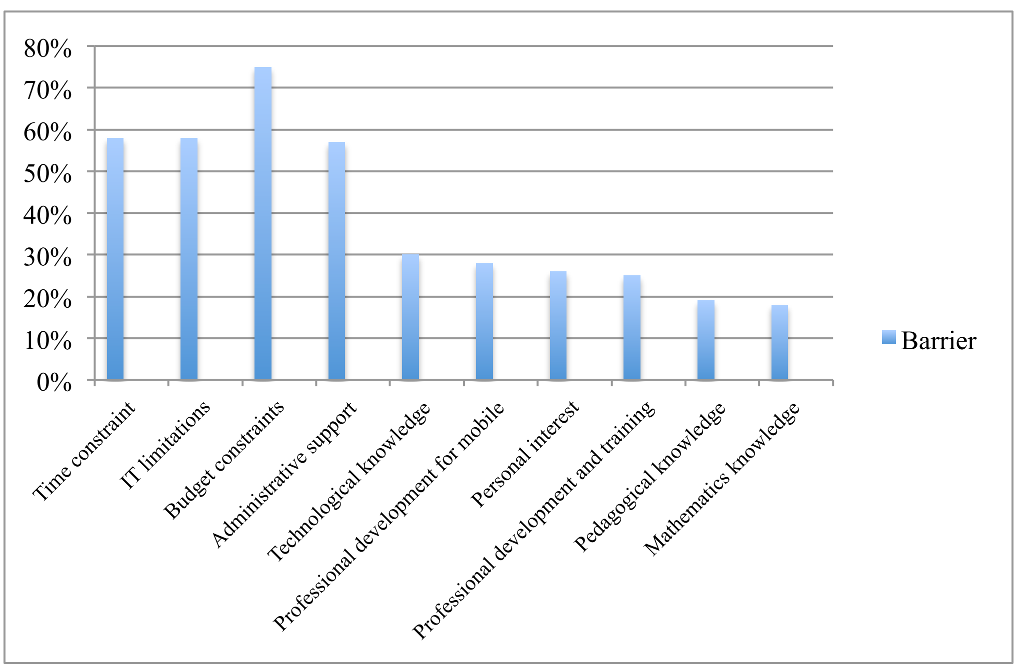

Figure 13: Barriers perceived by participants.

In contrast, mathematics teachers in Kuwait thought more factors did not prevent technology implementation, which was described through the average participant rating for six variables. The percentage of the respondents was merged together to account for both the non-preventing and strongly non- preventing responses as follows: pedagogical knowledge (81%), mathematics knowledge (81%), professional development and training (75%), personal interest (74%), professional development for mobile learning (72%), and technological knowledge (71%). From the findings, it is obvious that the mathematics teachers had extremely high perceptions in regard to their pedagogy, content, and technology knowledge. Their personal interest and perpetration (professional development) toward technology integration in classroom was also very high.

Qualitative Analysis

In this section, all participants (n = 562) were given the opportunity to express their opinions and thoughts about the barriers that hindered their ability to integrate mobile technology in their mathematical classrooms. Teachers were also provided the chance to express what they perceived as current factors that encourage them to integrate mobile technology. The reasoning behind this idea was twofold. First, it was important to understand the mathematics teachers' perceptions, not only from the negative side, but also accounting for encouraging factors, opportunities, and efforts available to the teachers to effectively integrate mobile technology. This includes providing new mobile devices, changes in the pedagogical practices, and/or revising the mathematical content in the curriculum. Second, it was important to not direct or encourage the Kuwaiti mathematics teachers to perceive the surveys as negative in any way, prompting them to always answer in favor of the need to integrate mobile technology or feel disappointment about their current situation in the public elementary schools in Kuwait.

Of all participants accepted to participate in this study, only 179 mathematics teachers answered the following qualitative question: “Are there other barriers you think could limit you from integrating M-learning in your classroom? Please explain.” Only 150 mathematics teachers responded to the second question: “Are there other affordances you think could assist you to integrate M-learning in your classroom? Please explain.” Although the teachers expressed their opinion in regard to the affordances and other factors influencing their ability and degree of employment of mobile technology in their mathematics classrooms, there was no new factor that was needed more than what was proposed in the barriers survey. However, the teachers did specifically identify some important factors that could be considered as significant factors under the primary categories provided in the barriers survey. The following section includes a brief presentation of the specific obstacles teachers indicated as additional factors that influence their ability to integrate mobile technology in their mathematics teaching practices.

The Kuwaiti mathematics teachers identified very specific barriers, such as the lack of the mobile technology and devices in their classrooms. For example, one participant stated, “It is a must that the schools provide enough mobile devices such as iPad and laptop inside all classrooms to enable the teachers to utilize them in their lessons, simply there is no mobile devices in our classrooms.” Another participant indicated, “We do not have mobile devices for our students, and the school does not provide Internet access.” This factor might be considered as administration support, although some of these proposed barriers for teachers can be grouped or can even be used to further explain the original barriers in the survey.

There are some very unique and significant barriers proposed by teachers, reflecting the culture and nature of the mathematics-learning environment in Kuwait. To illustrate, teachers identified that the mathematics curriculum (as mentioned in the discussion regarding Research Question 1) is a barrier for teachers to integrate mobile technology in their classroom. The length and intensity of the mathematics concepts in the curriculum and the intensity of the supplemental mathematical activities required by the mathematics curriculum were frequently considered as obstacles. For instance, as one respondent indicated, “Some of the primary issues are the length of the curriculum, the high intensity of daily required mathematical activities compared with the short lesson time, and the activity implication section in the lesson, they do not match.” Other examples were the lack of consistent Internet accessibility in the school and inside the classrooms as well as the deficiency of the mathematical applications in the Arabic language, which were frequently proposed by teachers to be significant barriers for effectively integrating mobile technology in classrooms. To emphasize this point, one participant stated, “There are many and a huge variety of English mathematical applications, whereas we have a tremendous lack of the Arabic mathematical applications.” Moreover, mathematics teachers suggest lesson time was wasted in transferring the mobile technology from one classroom to another because the teachers needed to transfer their own devices, such as projectors and laptops, from one classroom to another. This process consumed time from the actual lesson time which forced teachers to neglect integrating technology or cut out part/s of the lesson plan to be able to integrate technology in their teaching. To illustrate, one participant stated, “The lack of modern mobile devices and relying on the old version of portable projectors is consuming precious time from the lesson, and it is tedious process, imagine that I have to transfer the projector between my classrooms every day.” Teacher assistants, allowing teachers to bring their smartphones or tablets into the classrooms, and teachers’ class load were also mentioned as barriers. For instance, one participant stated, “To effectively integrate mobile technology, we need assistant technical teacher who have knowledge in how to utilize technology and provide technical support.”

The second open-ended question included in the qualitative part of the barrier survey concerned the factors that might assist teachers in integrating technology in their classrooms. It was surprising that the teachers did not identify any factor, variable, or material, in their current classroom that could assist them integrating technology in their classroom. It was clear from their responses that there is a tremendous lack of necessary resources to help teachers to integrate mobile technology in their current classrooms. To illustrate, the most frequent responses were the lack of Internet access and the need for modern and adequate mobile devices and provision of professional development workshops, increases to the mathematics department budget, preparation of modern classrooms and schools, support from the head of the mathematics department and administration, etc. However, interestingly, some participants stated that if there were few affordance or factors that were currently assisting them to integrate mobile technology in their classrooms, they were because these factors were totally the teacher's personal efforts, and neither the school nor the Ministry should get the credit for these efforts. For instance, one respondent indicated:

> All technological efforts you see in our classrooms are purely our personal efforts with our personal devices, which mean the school and the Ministry have nothing to do with these efforts; the school did not afford the devices or maintain them when a damage occur.

Another participant supported this notion by stating, “If you see devices in classroom, they are from the teacher's own money; therefore, integrating these devices could be difficult for some of the teachers to afford in their classrooms.” In my opinion, teachers did not misunderstand the question. Instead, the need for basic and necessary mobile technology dominated their perceptions.

It was clear the qualitative findings were on the barrier side, and there is a tremendous need to reconstruct the schools’ facilities to be ready and appropriate for effectively accommodating the fundamental pillars to adopt mobile technology in mathematics classrooms. From the research data, it seems teachers were not focusing on what currently existed in their schools, which they perceived was not enough and needed significant improvement. Teachers were calling for many necessary changes and more support to overcome those barriers.

Summary

In sum, the qualitative data support the quantitative in that the Kuwaiti mathematics teachers highly perceive themselves as competent in mobile technology, pedagogy, and content knowledge combined with high perceptions of readiness to integrate mobile technology in their classrooms. However, the majority of the participants listed the existence of barriers such as the outdated school facility, mathematics curriculum, deficiency in Internet accessibility and mobile devices, and administrators’ lack of support. All these barriers were outside the participants’ locus of control and power. The findings relate to the second research question support those of the first research question in which the teachers perceived themselves as highly competent in technology, pedagogy, and content knowledge.

Research Question 3

In this study, the third research question was,

Q3 What are the Kuwait teachers' perceptions about their ability to construct learning experiences promoting 21st century skills in collaborative cloud-computing environments that applies constructivist perspective?

This research question was answered via several open-ended questions. Therefore, the thorough description of the raw data that follows includes codes, themes, and participant statements that were referenced to answer Research Question 3. The data collected to answer this question were stored and downloaded from the Qualtrics website.

Part 1. Collaborative Cloud-Computing Learning

The mathematics teachers were encouraged to respond to several questions to assist the researcher in understanding their perceptions of their ability in constructing a cloud-computing learning environment. Teachers qualitative responses were coded, sorted, and categorized based on their similarities and were categorized into *themes*. In the following section, all themes inferenced from this thorough content analysis process are presented. The majority of the participants agreed upon the concept of cloud computing in schools; however, they did not think it was a necessarily applicable or even important concept to adopt in elementary schools in Kuwait. In addition, it is important to explain that not all themes were positively perceived by the mathematics teachers; actually, most of the themes represent negative perceptions. It is important to note that, overall, teachers positively perceived the use of almost all types of technology (e.g., mobile devices and cloud computing), and they indicated their high ability and understanding in using and integrating them in their mathematics classrooms. However, the necessity and applicability of integrating them in their classroom was, as a matter of fact, another concern they emphasized in their responses. Therefore, differentiating between teachers' ability and their desire to integrate cloud computing should be recognized to avoid misunderstanding their perceptions regarding cloud computing. The following section provides a detailed explanation of each theme that emerged from analysis of the participants' responses.

Cloud Computing as Educational Technology Tool

"Cloud computing is beneficial and effective method to teach mathematics because it opens many venues for teachers and their students to explore the mathematics content in easy, different, and effective way" (survey participant). There was a consensus regarding the concept of cloud computing as an educational tool that could be used in educational communities. The majority of the teachers appreciated the advantages of adopting this type of technology in the Kuwaiti school system. Based on the data collected, enhancing the students' learning environment was seen as a positive impact of adopting cloud computing in mathematics classroom; the teachers supported the concept and agreed upon the benefits of this kind of technology in enhancing teaching practices and learners' performance and their learning environment. For example, one of the participants indicated that this concept would improve not only the students' learning, but also that of their parents: "Yes, cloud computing will help a lot the parents and students to learn the lessons." Another benefit considered was that cloud computing provided a distance-learning environment. Some of the participants perceived cloud computing as a distance-learning tool; they specified that this technology might be a tremendous tool in solving one of the significant issues encountered by some students with special needs (e.g., chronic diseases) or student travelers. For example, one participant stated, “Cloud computing is great and wonderful, especially for the sick, or students outside the country.” In addition, considering cloud computing an effective educational tool was supported by a handful of mathematics teachers. They emphasized the importance of cloud computing in delivering knowledge and information to students, they identified that students could easily access information needed for classes such as that for homework or exam preparation as well as lesson materials from outside the classroom. For example, one teacher stated, “Yes, it will help the absent students to check the materials that he missed and prepare themselves for exams.” Another participant supported the same idea, saying, “Wonderful and excellent for frequent absent students or students who miss some classes because of travel or sickness reasons.”

Generally, cloud-computing technology was positively perceived by most of the mathematics teachers. They understood the significant potential of cloud computing in solving issues or improving teaching practices they were currently encountering. It is notable that teachers perceived cloud computing from two standpoints. First, they perceived it as a solution to some issues they were facing in their daily interactions with their students. Second, they perceived cloud computing as a means by which they could create a new and effective environment in which they could enhance their teaching practices to eventually enhance learners’ performance.

Enhancing Students’ Collaboration

According to one survey participant, “One of great advantages of the collaboration cloud computing is it provides equal opportunities for all learners to utilize their imagination and creativity and positive collaboration between learners, especially in the geometry concepts." Although the majority of teachers supported the collaborative cloud-computing approach as a beneficial tool some teachers perceived the usefulness of collaboration somewhat differently; some participants perceived students' collaboration as a significant and beneficial concept in learning. One participant indicated the importance of collaboration in developing learners psychologically and improving their knowledge, saying, "Yes, collaboration in learning is tremendously beneficial to students' academics and psychological improvement." Also, expanding communication between learner-teacher and learner-learner were proposed by the participants as an advantage of integrating this concept. For example, a participant stated, "Collaborative cloud computing will help teachers to keep consistent communication with their students, in the same time it will improve the communication between the students."

Another perspective was that the collaboration in the classroom and between humans is much stronger than collaboration via screens. For instance, one participant stated, "Collaboration between each other in classroom is much better and successful method of collaboration than interaction between students over bright screens and electrical cords." Another teacher's perception pointed to the effectiveness of collaboration in giving the opportunity to every single learner to express his/her own opinion, stating, "Yes, it will help learners to share the class their own opinion." Another perception provided by some teachers was that collaboration activities might negatively impact students as they might become distracted: "No, in my opinion children will play, instead of studying or will not effectively participate in the collaboration activities." Finally, some teachers approached collaboration differently, expressing that individual interaction in classrooms was even better than using the collaboration approach. For example, one responded noted:

> No. Individual participation is better than collaboration activities that could help student to note their mistakes directly and avoiding distraction from his/her peers when receiving the knowledge because it is difficult to employ mathematical concepts in group format.

Another responded, “One of the disadvantages is the intensity of collaboration between teacher and learners will be negatively impacted with adopting collaboration cloud-computing concept.”

The findings suggest that teachers support cloud computing to enhance students’ collaboration. The teachers had a good grasp in regard to the benefits of this approach in enhancing learners’ performance in mathematics classrooms. It was clear that the majority of participants thought cloud computing significantly offered new methodology to promote positive collaboration between students compared to the teaching practices that were currently in use.

Not Age-Appropriate

“The primary benefits from using collaboration cloud computing could be noticed if integrated in the high school and university such as increasing learners’ confidence and self-dependent learners, however, it would not be notable for elementary students” (survey participant). This theme was a dialectical theme. Interestingly, many participants responded that collaboration and cloud computing as an educational tool were beneficial, in general. However, when the participants were asked specifically about whether they were able to, and desired to, integrate it in their classrooms, the responses were divided between agreement and disagreement. Even among the respondents who were in agreement, some of the mathematics teachers linked their support to collaboration and cloud computing and some prerequisite steps in order to fully perceive themselves integrating it in their classrooms. These steps included revising the curriculum, changing the structure of the classroom by including an assistant teacher, and providing technology and Internet accessibility (discussed in the following sections). On the other hand, some responses were on the opposite end of the spectrum, and teachers did not perceive cloud computing as an appropriate educational tool for elementary students, age-wise. Instead, they thought it was distracting, consumed extra time, and could damage their health. To better understand, cloud computing as time-consuming was identified as an issue by some participants, even the supporters of this approach. One participant stated, “In my opinion, integrating technology in mathematics lessons was supposed to help by saving time and efforts, and not for spending extra time and effort from both teachers and learners.” Also, another participant stated, “It takes extra time to communicate with students via cloud computing, whereas in the lesson, it is faster.” Another issue addressed the age of learners; it was interesting to see some resistance from the participants in regard to inappropriateness of collaborative cloud computing for elementary students. For instance, one participant responded, “Adopting cloud computing should be based on a learner's age, and it should be implemented on learners who reflect proficiency in using multiple technologies and understand the importance of lesson time.” In the same regard, another participant stated, “The cloud computing might be utilized at college level only; it is not useful for kids, and it is hard to use it at elementary level.”

In this dialectical theme, it was notable that the participants had different perspectives in regard to the suitability of integrating such an advanced technology in elementary schools. Teachers' opinions were divided, even between the supporters of this approach. Some participants had no problem with integrating cloud computing in their classrooms; others supported this advanced approach, but felt that they needed additional types of support to enable them to integrate it. Moreover, few teachers had an issue perceiving their ability to integrate cloud computing in their classrooms, and they acknowledged its potential in education. Finally, some teachers rejected the idea of adopting this technology in their classrooms from the beginning.

Elementary Schools are Not Ready

One of the survey respondents stated, "No, I cannot integrate this concept in my teaching because I need training workshops to prepare me to be proficient in this type of technology approach." This theme of needing training had distinct directions and was based on different perspectives. To illustrate, providing professional development was demanded most by many of the teachers, if not the majority. The reason for their agreement or disagreement in adopting collaborative cloud-computing environments in their classrooms was based on their perceived competence with this concept and its adoption. They frequently demanded some type of training, not only for themselves as teachers, but also for learners and parents. To explain, one participant responded, "Providing training workshops for teachers, parents, and students before integrating the collaborative cloud-computing approach in the school system."

Some teachers did not perceive themselves as able to integrate technology in their lessons because the mathematical curriculum did not support it. A statement made regarding this perception was that "The curriculum does not support integrating cloud computing at the elementary level." Other teachers linked their ability to integrate technology in their lessons to factors such as whether the supported lessons, programs, and applications were ready for them to use in advance. One participant shared, “We need to be supported with ready and prepared mathematical lessons that correspond with the curriculum to help the learners to learn and evaluate themselves independently.” Another participant indicated, “The curriculum should be revised and changed to technological mathematics curriculum. It should be also supported with a website from the Ministry to incorporate electronic mathematics lessons and programs to help teachers to adopt this concept.” Another thought in support of revising the mathematics curriculum voiced by a participant was that “We should revise the mathematical curriculum first to correspond with the use of modern technology like cloud computing.”

Overall, teachers connected their support of cloud computing to multiple needs that enabled them to integrate this technology in their classrooms. Even when they reflected their ability and desire to integrate this technology, they expressed a need for support such as professional development training and revising the mathematical curriculum. It was salient that teachers need more support in providing the cloud-computing technology that would enable them to fully integrate it in their classrooms.

Balance between Traditional and Modern Teaching

One survey participant responded, “The traditional and cloud computing and other technological devices could provide effective and attractive learning environment if they were both adopted.” *Old methods of teaching are not bad* and *Cloud computing is not necessary* were both themes drawn from the raw data. These two concerns were strongly linked together when teachers reflected on their perceptions of the most beneficial and significant teaching methods, specific to mathematical concepts, when comparing the traditional and cloud-computing methods. The majority of participants supported the integration of both teaching methods and felt balancing teaching practices between these two approaches was crucial for a better learning experience. In other words, the majority of participants indicated that the traditional and technological methods of teaching complement each other and suggested teaching elementary learners needs to be supported with both methods to increase learners' improvement in mathematics. The following are some teacher respondent statements when they were asked to provide their preference between traditional and modern collaborative cloud-computing teaching methods that support this notion: "Both methods will support each other to confirm the information that children receive from the mathematics teacher," and "Combining between both teaching methods will maximize and enrich the learning attainment."

However, some teachers could not hide their preference of one teaching method over the other. For instance, a participant indicated the need for both, stating, "Each mathematical lesson and/or concept has its own best teaching practices. It could be the traditional teaching methods are more successful than the technological teaching methods." In the same vein, another teacher stated, "Both of methods are important, but the traditional teaching methods are essential and we cannot neglect them." On the other hand, some teachers preferred the technological cloud-computing method as a teaching environment over the traditional teaching method as explained by "Both of them are useful, but the most beneficial one is using the modern technological means, especially if they were integrated in the appropriate way." Also, one participant clearly specified that "utilizing technology in mathematical lessons is always beneficial."

Interestingly, when considering the importance of combining both teaching methods in mathematics instruction, some teachers simply did not see many benefits of utilizing cloud-computing technology in their classrooms. This can be seen in comments such as “I don’t think collaboration cloud computing is necessary or will improve learners’ performance in math; however, the traditional methods are the most effective ways to not forget the information provided in the classroom.” Another participant stated, “I do not prefer to totally rely on technology in my classrooms.” More support of this idea was “What we have in school is enough.”

This study’s findings suggest that combining both traditional and modern (cloud computing) methods of teaching mathematics is significant for enhancing learners’ performance, although the majority of participants supported the integration of cloud computing in teaching to profit from the unique advantages cloud computing offers to enhance the teaching practices and teachers’ effectiveness. Some teachers, however, did not see that neglecting the traditional teaching methods and relying solely on technologically based teaching practices would necessarily be significantly better. Even with the positive, optimistic point of view of infusing mobile technology and cloud computing, some teachers did not conceive cloud computing as an imperative need to enhance their teaching practices.

Conditions to Adopting Collaborative Cloud-Computing Environment

According to one survey participant, “Sure, it will be beneficial to integrate collaboration cloud computing, if they incorporate the right and necessary needs and students were well trained about this concept.” The Kuwaiti mathematics teachers had high perceptions of their ability to integrate technology in their lessons and classrooms.

However, in many instances, they connected this perception and ability with circumstances and other factors that significantly influenced their ability to integrate collaborative cloud computing in a 21st century learning environment. From the teachers' responses in this study, multiple and different conditions were drawn from the raw data. These conditions were crucial because teachers' perceptions depended on them, and teachers would not be able to effectively integrate technology without addressing them. These conditions (themes) included the following:

1. *Internet accessibility* was frequently linked to teachers' ability to integrate technology in mathematical lessons such as "Schools should first provide teachers with Internet accessibility to the Internet to ensure this concept would be successful" (participant response).

2. *Examine the applicability first* was proposed by some participants as explained by the statement,

> This new educational concept should be first tested in one elementary school to evaluate the appropriateness and the benefits from adopting it. If it was successful, then cloud computing could be generalized to all elementary schools because constant changing of the learners' learning environment will not help learners and might distract them. (participant response)

3. *Prepare the right applications and corresponding educational programs* was another condition (theme). To enable teachers to successfully shift to new 21st century learning experiences such as cloud computing, schools, districts, and the Ministry of Education must provide and prepare all necessary conditions to facilitate this major shift in the teaching methods. As one participant explained, "The Ministry and district should provide Arabic and math software or programs that support the mathematics curriculum and cloud computing."

4. *Train teachers (professional development) and learners* as mentioned above; because it was constantly requested by the mathematics teachers, it is listed again. It was one of the primary reasons teachers suggested, as seen in comments such as "professional development for all teachers before integrating this concept" and "train teachers and learners how to use this technology in classrooms." Other statements included: "Intensive professional development workshops should take place to enhance teachers' understanding of how to appropriately use this technology;" "If the school provides the right technology, I am willing to start adopting the collaboration cloud-computing concept in my lessons, but I need more preparation and training;" and "I do not mind using it if the appropriate circumstances were available."

In sum, considering these combined conditions might provide a broader understanding about the fact that the learning environment in public elementary schools in Kuwait needs to be purposefully prepared in regard to facilitating the infusion of cloud computing. Teachers expressed their readiness and their desire to fully or partially embrace technology in their teaching practices; however, with the current school preparation, this notion will be a desire only and will not be achieved until consideration of these critical conditions.

Culturally Unique Perceptions

"I do not think the Ministry is serious to infuse technology in their public school system; what they are really doing is just trying to integrate any technology without any serious desire to enforce them" (survey participant). Several themes emerged regarding culturally unique perceptions. The theme regarding *consistency* was a unique issue because teachers did not have faith or confidence in their administrator to bear the challenges and commit to the changes. For example, one respondent indicated, “Leaders and administrators in the Ministry and district should be serious in committing to what it takes to implement this technology or it will not happen.” *Health issues related to technology use* was a thematic issue that was also mentioned a few times. Teachers had concerns relating to student health in integrating technology such as “relying on integrating cloud computing has health disadvantages such as vision” and “the light and waves coming from the device’s screens could negatively impact the eyes.” *The culture of learning from home is not here yet* was emphasized by mathematics teachers who suggested that neither teachers nor students were familiar with the concept of studying from home. Therefore, it would be very hard to adopt this concept of studying until thorough education for teachers, students, and parents took place, as indicated by statements such as “not all families could utilize or know how to communicate via the Internet applications.” One participant actually stated, “Time outside the school should be advocated for our families only.” Another participants identified that “school work should not be extended outside the school time.”

This finding was interesting because it was related purely to a belief that the Kuwaiti mathematics teacher have regarding the MOE. Some teachers had difficulty trusting the MOE’s decision and desire to fully infuse technology in learning. They felt that the MOE’s arbitrary decisions were not consistent and were basically superficial solutions to advance learning practices in Kuwait. On the other hand, teachers identified important points of view that the culture of teaching inside and outside the classroom walls still needed to be taught to the mathematics teachers, parents, and students. Finally, some teachers were concerned with the possible negative health impacts on young learners. This entire theme seemed to hold and reflect the cultural perspective that is highly related to the Kuwait learning environment.

Part 2. Adopting the Constructivist Approach

One survey participant said, “Yes, it will help learners to build their confidence, and it will assist them to think creatively, especially if teachers’ goal is to find and explore new knowledge by themselves.” The constructivist approach was well supported by teachers. They highly perceived that they were able to integrate a constructivist-learning environment. Although collaboration was perceived dialectically, the constructivist approach was constantly perceived positively and as significant. Participant statements described the notions behind the perceptions of constructivism in the Kuwaiti mathematics teachers. Participants’ comments included, “Yes, a constructivist approach would help learners to self-regulate their learning and what they missed from the mathematical lesson and study for assignments.” Another participant stated, “Yes, the possibility to search for themselves and find new information would be beneficial for learners.” In the same vein, another participant identified, “Yes, a constructivist approach will help learners’ mathematics performance and will support them to search and explore for new knowledge as researchers.”

It was amazing to find teachers appreciated the constructivist-learning environment. Teachers generally had the desire to adopt this beneficial learning approach in their learning environment. They reflected an understanding of the benefits of such an approach in improving learners’ performance and preparation of learners in meeting 21st century skills.

Part 3. Creating a 21st Century Learning Environment

According to one survey participant, “Cloud computing is definitely an appropriate 21st century technology that could be used to facilitate effective learning practices and prepare students to the 21st century challenges.” When asking teachers about the necessity of shifting to a cloud-computing approach in teaching in the present time, the majority of responses were “yes.” The majority perceived that there was a need to shift to a modern and 21st-century-based learning approach. Some responses that were supportive included, “Yes, because teaching with collaborative cloud computing corresponds with the 21st century era,” and “Yes we need to move to new and modern teaching approaches because of the expansion of most of the disciplines in this century.”

Teachers’ responses were clearly in favor of adopting a 21st century learning environment as important in preparing students for the challenges and demands of the 21st century. Teachers clearly acknowledged that the current century was based on technology and students needed to be ready to learn via technological means to improve their academic performance.

Summary

Several themes emerged from the data analyzed in this study. The following table summarizes these themes as they relate to the research questions posed (see Table 5).

Table 5

Emergent Themes

Research Question	Themes
Q1 What are the Kuwait teachers' current perceptions about their ability to integrate mobile learning technology in their classroom?	Ability to use mobile technology as an attractive educational tool Readiness to utilizing mobile technology in 21st century learning environment The advantage of the mobile technology's mobility and efficiently Negative perception Health concerns Curriculum mathematics complexities
Q2 What are the major affordances and constraints impacting Kuwait teachers' ability to prepare future-ready students through an integrated technology environment?	The qualitative part in the open-ended section did not indicate new themes.
Q3 What are the Kuwait teachers' perceptions about their ability to construct learning experiences promoting 21st century skills in collaborative cloud-computing environments that applies constructivist perspective?	Part 1. Collaboration Cloud-Computing Learning: -Computing as educational technology tool -Students' collaboration -Not age appropriate -Not ready -Balance between traditional and modern teaching -Conditions to adopt collaboration cloud-computing environment -Culturally unique perceptions Part 2. Adopting Constructivist Approach Part 3. Creating 21st Century Learning Environment

CHAPTER V

DISCUSSION

Before discussing this mixed methods study, it is important to introduce the purpose of this study which measured the Kuwaiti teachers' perception regarding their ability to integrate mobile, cloud-computing technologies and their ability to construct 21st century learning communities based on collaboration and constructivist perspectives. Additionally, this research pursued efforts to diminish the gap in recent knowledge involving TPACK, 21st century constructivism, collaborative cloud computing, mobile learning, and barriers as well as preferences for each of these by offering a perspective of how these elements come together for teaching and learning in mathematics classrooms in Kuwait. This research arose from the necessity to explain and identify how Kuwaiti teachers were using advanced technology, such as mobile technology and cloud computing, since technological deviations have designed the educational landscape in the State of Kuwait. The important role of mathematics teachers was emphasized in this study because of their significant role in learners' lives. More importantly, the Ministry of Education in Kuwait (MOE) in the 2015-2016 academic years chose to integrate mobile devices (iPad) in the public school system with no empirical confirmation of the usefulness of such a step. In addition, active mathematics teachers and directors of mathematical departments in the MOE did not consult mathematics teachers in the field regarding this step to understand their perceptions and abilities to effectively integrate this multimillion dollar decision. Therefore, teachers' perceptions about their ability to integrate mobile devices and collaborative cloud computing is essential, especially since the majority of teachers and students are now relying more intensely than ever on their personal mobile devices. Moreover, it is important to first understand whether teachers are able to construct technological 21st century learning environments.

The mathematics teachers' demographics were not included in the data analysis, and none of the research questions included in this study intended to link mathematics teachers at elementary public schools with the study interest. However, brief facts about the characteristics of the sample are helpful in providing the readers and experts in the field of education a better understanding of the relevance of generalizing these mixed method findings to similar learning contexts.

First, the participants incorporated in this study were male and female teachers and directors of mathematics (of whom females were the majority). Second, teachers ranged in age from 21 to over 40 years. Third, teaching experience in mathematics varied from 1 to over 20 years. Fourth, teachers who participated in this study were teachers from all elementary grade levels, first to fifth grade. Fifth, the mathematics teachers were recruited from all educational districts across the State of Kuwait (urban and suburban cities). Sixth, the majority of participants have had one or more professional development courses and technology training workshops during the last five years.

Research Question 1

Q1 What are the Kuwait teachers' current perceptions about their ability to integrate mobile learning technology in their classroom?

The purpose of the first question of this study was to explore teachers' perceptions about their ability to use and implement mobile technology (e.g., smartphones, tablets, and laptops) using a perspective offered by TPACK (Technological, Pedagogical, and Content Knowledge). The TPACK questionnaire assessed the first question quantitatively, and an open-ended questions survey examined the first question qualitatively. Therefore, this question will be discussed based on both quantitative and qualitative findings.

Within the discussion of this research question, two general discussions will take place. The first discussion will be based on discussing mathematics teachers' perceptions about their ability, which is the primary discussion, to answer the first research question. The second discussion will be based on mathematics teachers' perceptions regarding the reasons why they were not able to integrate technology. The second research question examined (quantitatively and qualitatively) participants' perceptions of the barriers and affordances that might influence their perceptions and ability to ingrate mobile technology in their classrooms. In addition, suggestions of conditions for successful integration of mobile technology were voluntarily proposed by the teachers, although the quantitative and qualitative questions did not intentionally inquire about them. Therefore, to avoid redundancy when discussing the findings, the second discussion will simply mention them and briefly indicate the barriers and conditions the participants justified in the first question.

The first discussion focuses on teachers' perceptions about their ability to integrate technology in their classrooms. Mathematics teachers were encouraged to express their perceptions about their ability to personally use and integrate mobile technology in their daily lessons and classrooms. From both the quantitative and qualitative (themes) findings, the majority of mathematics teachers were clear about their ability to interact with, operate, and utilize mobile devices for personal purposes (i.e., perception of personal ability). In the second focus, the majority of mathematics teachers also reflected confidence in integrating mobile technology in their lessons and classrooms (utilizing technology in their lessons and classrooms). Teachers' high perceptions about their ability to interact with technology (mobile technology) and their ability to utilize it in classrooms corresponded with the literature. According to Project Tomorrow (2008), it is certain that teachers in the current century are increasingly interacting and utilizing mobile technology in their daily personal and teaching activities.

It was not surprising that the mathematics teachers had relatively very high perceptions of their knowledge of interacting and integrating technology in their classrooms. With all this technological revolution and the wide spread of social media applications that are mostly mobile version applications, teachers use these tools in personal and professional ways. Teachers play a significant role in any learning environment. To ensure positive and effective integration of technology, teachers should feel competent in integrating different technologies, which was the case in this finding. This is important because when teachers are familiar with and have confidence in their technological ability, it positively impacts their technological integration attitudes. Relating to the literature, confidence is the most influential factor in determining teachers' perceptions about how to integrate technology and their actual integration of technology in the classroom (Ertmer & Ottenbreit-Leftwich, 2010). As an example of this notion, many mathematics teachers across all grade levels have some sort of social media account such as the YouTube channel and/or Instagram accounts they use as an educational venue for students, teachers, and parents. This confidence could be recognized at not only the teachers' level, but also at the students' level. Continuing with this idea, it is critically important that teachers believe in their own abilities toward technology (mobile technology) to implement it in their schools and subject cultures (Ertmer & Ottenbreit-Leftwich, 2010). This result is an implicitly noteworthy benefit for administrators in the educational field in Kuwait who are interested in encouraging teachers to integrate technology, knowing that the majority of teachers are already motivated to adopt mobile technology in their classroom. Therefore, knowing teachers are ready to implement mobile technology, administrators are waiting for the opportunity to assist them to fully and effectively implement technology. Some mathematics teachers had already begun to infuse technology via personal efforts; for example, they were already utilizing technology (You Tube channel) for their students as an after-school resource. The educational culture in Kuwaiti is unofficially integrating mobile technology outside the school boundaries. This is a cornerstone because the MOE might have no resistance from the majority of mathematics teachers when the actual decision to fully incorporate technology in elementary schools in Kuwait takes place.

Of course some teachers saw no magic in mobile technology that could influence learners' mathematical performance, and few others did not perceive technology as an appropriate learning tool for elementary-level learners. This was significant because educational leaders hoped teachers would explore technological advantages and disadvantages to effectively integrate technology in their teaching practices. This accommodates Buabeng-Andoh's (2012) teachers' levels of interaction and behaviors toward technology (mobile technology) that significantly impacted and shaped their levels of technological integration in their learning contexts. It showed evidence that there is still work to be done in preparing teachers to use technology successfully in their classrooms.

It was expected that teachers would have different perspectives in regard to the efficiency of integrating mobile technology in elementary schools because teachers were at varying developmental levels. This argument also existed between the research scientist in the field of educational technology and instructional design. Some mathematics teachers may not be proficient in interacting with mobile technology or they did not actually see the benefit of technology in mathematics classrooms simply because they lacked access to or familiarity with mobile devices in their schools. To support this notion, Ertmer (2005) asserted that it is significant that teachers observe successful practical examples of lessons utilizing technology (mobile technology), acknowledging that previous teaching experiences and beliefs will have an influence on teachers' perceptions of technology integration. This leads to the essential conclusion that teachers will encounter difficulties in integrating technology without a clear model, notwithstanding the ability to obtain technology (Ertmer, 2005).

Even capable teachers who were confident in their ability to integrate mobile technology in their classrooms and lessons suggested some significant fundamental requirements and conditions that would assist them to effectively integrate technology in their classrooms. These conditions included revising the mathematical curriculum at the elementary levels, providing training workshops for all personnel involved in the learning environment (teachers, parents, and learners), and providing the necessary technological devices and equipment inside the classrooms. The identified conditions proposed by the mathematics teachers in public elementary schools in almost all educational districts were significant because even if the teachers are capable to completely and effectively adopt the technological learning concepts, this capability will never ensure full integration with the existence of the current extreme technological deficiency in schools. In the course of my educator experience as a teacher and director of the mathematics department in different elementary schools in Kuwait, I experienced similar issues; I did not find the necessary support (e.g., classrooms lacked the essential technology devices) or professional development workshops that would enable me or mathematics teachers in the department to integrate technology in the daily mathematics lessons. Relating this study's findings with research in the field, findings appear to be similar. Linked to the literature, it was confirmed by this research that teachers and students highly utilized technology such as laptops and tablets when classrooms were equipped with technology (Inan & Lowther, 2010b). Moreover, professional development programs structured by schools have significant impact on teachers' self-efficacy and educational needs and will help diminish some of the barriers related to school culture (Ertmer & Ottenbreit-Leftwich, 2010). All confirm the need for support in professional development, curriculum, and access, despite the teachers' comfort level or perceptions about technology.

Research Question 2

Q2 What are the major affordances and constraints impacting Kuwait teachers' ability to prepare future-ready students through an integrated technology environment?

The second research question was also examined quantitatively and qualitatively. The quantitative results suggested that the mathematics teachers in Kuwait perceived budget constraints (75%), IT limitations (58%), time constraint (58%), and administrative support (57%) as the primary hindrances to integrating mobile devices in their lessons and classrooms which are statistically significant at the $p < .001$ level. From the findings, there are two possible explanations for mathematics teachers rating these factors that were outside of their control as significant barriers limiting their ability to integrate technology in their classrooms.

One explanation is that the majority of participants did actually perceive themselves as a highly competent individual with ability to interact with and integrate technology in their daily lessons (the first research question). This would be possible if their schools considered addressing specific considerations such as revising the mathematical curriculum, increasing the number of professional development workshops, and providing the necessary mobile devices. In this regard, the mathematics teachers have perceived that, because the barriers were outside their control and authority, it impacted their ability to successfully integrate mobile technology. In support of this notion, Ertmer and Ottenbreit-Leftwich (2010) stated that teachers involved in a school's existing teaching practices are grounded in their personal knowledge, teachers' self-efficacy, teachers' pedagogical practices and beliefs, and their schools' fundamental culture and structure. The teachers clearly specified that the learners are a high-tech generation who are familiar with the mobile technology, and they are ready and able to effectively engage in the technological learning environment, if it is introduced.

Another possible explanation is related to the clear indication made by the mathematics teachers that they perceived a lack of support from their schools, districts, and the Ministry of Education. In their justification about their perceptions of whether they were capable of effectively integrating mobile technology in their classrooms, they pointed directly to the schools' and districts' very limited support in almost all basic fundamental pillars of success. This is emphasized by Khalaf (2011) who indicated that school administrators in Kuwait may be unfamiliar with the work and expectations, lack the experience with or be unsuccessful in requirements of the job (teaching), and have poor relations or interpersonal skills required to relate to teachers and directors. He further suggested that large disconnects between teachers and administration can significantly and negatively impact teacher performance. In addition, Baldwin-Evans (2006) proposed certain specific, necessary components that enable educators to successfully implement modern technology (mobile) such as making sure that schools and teachers had access to the necessary technology, allowing access—regardless of place or time, training for teachers and learners, and providing ongoing support and training. Important components may be missed or lost in initial training, so ongoing support is essential.

In contrast, mathematics teachers in Kuwait in this study perceived a majority of certain components did not hinder the implementation of technology, based on the averages from participant responses for six variables. The preventing and not-preventing responses were merged as follows: pedagogical knowledge (81%), mathematics knowledge (81%), professional development and training (75%), personal interest (74%), professional development for mobile learning (72%), and technological knowledge

(71%); each is statistically significant at the $p < .001$ level. From the findings, it is obvious that the mathematics teachers had extremely high perceptions in regard to their pedagogy, content, and knowledge of technology. These findings were similar to the findings gathered from the first research question. This is a valuable finding because it implies that the majority of teachers did not perceive these factors as barriers. Logically, this means that the majority of mathematics teachers in Kuwait were competent in all necessary areas to ensure effective mobile technology integration in the elementary public schools in Kuwait. For example, if the majority of the teachers perceived themselves competent in integrating technology, using the best pedagogical practices, and having high mathematical knowledge, and they did not see the need for any workshops to practice combining all these crucial areas in their classrooms, then, what is missing? It is the financial (devices) piece, the need to revise the curriculum, and the lack of administrative support only. Pursuing this further, the MOE is willing to provide mobile devices, as was shown in their technological efforts mentioned previously. Then, there is actually an easy fix to transform the traditional elementary learning context into a high-tech learning environment by providing the appropriate mobile devices, reforming mathematics curriculum, and supporting teachers administratively and resolve the issues. In the first research question's investigation, teachers indicated that they perceived their ability as high in integrating technology, and the majority felt competent in interacting with technology. Interestingly, teachers did not perceive professional development as a barrier, although a tremendous number of calls for providing professional development workshops were salient across all three research questions. It is important to clarify that the mathematics teachers in the barrier survey were asked about the barriers or affordance in regard to mobile technology only. In my opinion, the mathematics teachers did show extremely high percentages of ability to interact and integrate mobile technology in their lessons. Therefore, they might have felt they had no desperate need for professional development and training. Another possible reason for this confounded result is that the mathematics teachers also had enormously high perceptions of pedagogical and content (mathematics) knowledge in the same survey, indications of high competency. Finally, since the majority of participants reflected a high percentage of ability to interact with and utilize mobile technology, it might be acceptable that the majority of the responses support this notion of high mobile technological competency. This corresponds with the suggestion by Ertmer and Ottenbreit-Leftwich (2010) that teachers who spend time constructing their teaching beliefs usually are conscious of them. This is crucial because if the majority of mathematics elementary teachers are competent in *mobile* technology integration and they feel they do not need tremendous professional development support, this eases the mission of the MOE, understanding that providing the essential factors (e.g., providing the mobile devices, revising the curriculum, and providing IT support) might be enough for shifting to a mobile technology learning environment. Moreover, this finding could be important because it could give the MOE a sense of where the issues and the obstacles lie that hinder their efforts to create 21st century schools. It is a great checkpoint for the MOE to determine whether they are headed in the right direction toward achieving their goal, or they are taking the wrong path and wasting their efforts and money.

In addition, the open-ended questions incorporated in the second section of the barriers survey gave insight into the barriers and affordances that might encourage or hinder teachers from integrating mobile technology in their classrooms. Of the 562 participants, only 179 teachers (32%) responded to the open-ended question, "Are there other barriers you think could limit you from integrating M-learning in your classroom? Please explain?" Specifically, teachers' responses were significant in determining the most salient barriers such as the short duration of the lesson, lack of mobile devices, and the idea that the current mathematical curriculum was inappropriate for a technology-based environment. Moreover, these significant barriers are mostly related to the elementary school system in Kuwait. It is beneficial to understand that the barriers are not in the teacher's' ability to effectively integrate mobile technology nor that administrative supports are the only angles that should be examined and explored, but the elementary system is also a significant approach for enhancing the ability of teachers to adopt new and modern technologies such as mobile technology. For example, all teachers, including mathematics teachers, must rotate in their classrooms, unlike in the United States where teachers have their own classrooms. In addition, the length of the lesson in elementary schools, depending on the semester, ranges from 35 minutes to 45 minutes, barely enough time to satisfy the content and lesson's activities, and there is not enough time to set up the mobile devices or access and browse the Internet. This might be the primary reason why the school system, including the curriculum and lesson duration, needs to be revised to accommodate technology in the lessons. This finding aligned with arguments about the major problems Kuwait's educational system currently faces. In a new extended study conducted by the Al-Qabas Newspaper (2012) on Kuwait's educational system, it was suggested there has been a decline in the quality of education since the 1960s and 1970s. The system faces significant difficulties, including those related to curriculum and teacher preparation. Furthermore, Harriman (2004) suggested that technological learning communities present a myriad of challenges. The educational system must be managed and controlled for cost and designed with specific roles and responsibilities in mind in order to find success with technology implementation.

On the other hand, the second open-ended question, "Are there other affordances you think could assist you to integrate M-learning in your classrooms? Please explain?," was included to assist mathematical teachers to not only reflect on mobile technology integration from the negative side, but also to think about the barriers and ignore the affordance of the capability of schools' current preparation and structure. Therefore, this specific question was supposed to provide insight about what elementary schools currently had that might help integrate mobile technology in the classroom. Interestingly, all participants (n = 150, 27%) who answered this question provided no affordance that might have currently existed in schools that might help them integrate mobile learning in their classrooms. From teachers' responses, what was lacking were all fundamental needs, such as mobile devices and professional development that would enable them to integrate mobile technology. Unquestionably, deficiency in resources provided by schools was considered a significant barrier that might hinder teachers in adopting technology in their teaching practices (Hew & Brush, 2007). This shows evidence that the schools at the elementary levels were in great need of a general evaluation of their readiness to adopt 21st century learning experiences. This result corresponded with a report released by the AlJarida Newspaper (2007), suggesting an educational report issued by the National Commission for the Development of Education blamed Kuwait's educational administration for idleness, corruption, and lack of discipline. Additionally, leaders and employees have failed to execute their job responsibilities, altered the image of the educational institution of school, made bad or conflicting decisions, and had not utilized or implemented research foundations. The report suggested the decline could be attributed to a lack of long-term planning and poor management of the political educational stakeholders in successive ministries of education (AlJarida Newspaper, 2007). Zayton (2005) suggested that additional challenges existed, including slow Internet connections which can disrupt connectivity, the high cost of this type of learning, utilization of electronic communication across educational institutions, and training and encouraging enthusiasm among teachers and students to diminish anxiety.

Overall, both the qualitative and quantitative findings were significant in providing an in-depth description and an understanding of the mathematics teachers' perceptions about the barriers and affordance in the public elementary schools in Kuwait. Overall, there was compelling support from the participants for needing to restructure the school system and revising the mathematical curriculum to facilitate mobile technology infusion in the mathematical classrooms. However, in regard to professional development, it is in the midst of rapid change, and mathematics teachers should not rely only on their previous technological knowledge. Participants contradicted themselves on this point, as illustrated in the findings from Research Questions 1 and 3. Teachers are life-long learners and should always be supported in updating their knowledge to, in this case, specifically, better integrate mobile technology in their classrooms.

Research Question 3

Q3 What are the Kuwait teachers' perceptions about their ability to construct learning experiences promoting 21st century skills in collaborative cloud-computing environments that applies constructivist perspective?

This research question consists of three major considerations related to the ability of elementary mathematics teachers to construct a 21st century learning environment by utilizing collaborative cloud-computing learning based on the constructivist approach. This research question was assessed qualitatively through several open-ended questions. All participants (n = 21) were asked to answer all open-ended questions. Therefore, this research question will be discussed based on these three considerations.

Collaborative Cloud-Computing Learning

Generally, the majority of the participants' responses supported this modern and advanced method of teaching when they were asked to provide their opinion about their ability to construct collaborative cloud-computing learning environments. It is noteworthy that teachers were consciously eager to adopt the collaborative cloud-computing learning context among the Kuwaiti mathematics teachers in most of the elementary schools in all six education districts.

However, from the seven general themes inferred under this section of the third research question in this study, teachers repeatedly demanded appropriate preparation (teacher and facility) and consistently linked their ability and desire to adopt cloud computing with many essential needs. The majority of the mathematics teachers constantly proposed several conditions and needs that could be categorized into four primary categories, such as providing professional development, revising the mathematics curriculum, negatively perceiving cloud computing, and providing the appropriate technology. Therefore, these four categories will be discussed because other needs could be resolved if these four major issue were satisfied. It was obvious that teachers had different perspectives about the importance and the advantages of collaborative cloud computing in education. Contrary to the findings of the investigation of the second research question, teachers constantly emphasized their need for professional development when they were asked about their perception of integrating cloud computing in their mathematics classrooms.

The first category, providing the appropriate technology, to adequately prepare schools to correspond with the modern methods of teaching is always a challenge. Metaphorically, sufficient financial support to prepare schools (e.g., providing modern technology, mobile devices, and Internet access) is a global issue, including in Kuwait. Fleischer (2011) stated that schools are still struggling to prepare their classrooms with the necessary technology that corresponds with the learners' out-of-school society as in using mobile devices and access to the Internet. Indeed, preparing schools to correspond with the learners' actual technological lifestyle and society outside their school must be considered an issue.

However, in Kuwait, preparing elementary schools in the use of modern technologies including cloud computing might not be a financial issue; rather, it might be the planning and a fragile future vision. It is a matter of belief and priority in the hands of stakeholders in the MOE. They have the power to spend the money to prepare schools if they feel it is the time to shift the learning system into a 21st century learning environment. This becomes very clear in looking at the multiple attempts the MOE took such as in the use of electronic textbooks and the iPad integration (as discussed in

Chapter I). The MOE claimed that they were spending millions of dollars to integrate technology in the educational system. But, these technological integration attempts were not well planned, and the stakeholders in the MOE did not consult experts in the practical field about the affordance and the benefits of these wasted attempts. As evidenced by the results of this study, a lack of technological preparation was one of the most challenging issues of adopting cloud computing in mathematics classrooms.

With regard to the second category, negative perceptions of cloud computing, the majority of the participants acknowledge the importance of cloud computing in improving learners' performance in mathematics subject. However, some teachers perceived cloud computing negatively (e.g., it was not age appropriate and could distract learners from the actual learning task). These concerns could be perceived differently under effective teaching practices and classroom management. In line with the literature and according to Al-Qahtani (2011), forums that allow for immediate responses and interfacing create possibilities for students to have real-time discussions and share ideas. Students are provided with the opportunity to hear other opinions and ideas and combine them with their own or add them to their learning. Additionally, according to Alvarez (2005), students are able to keep pace with the class, regardless of their absence. Student-centered learning is viewed as engaging and attractive and encourages autonomy and self-reliance (McMahon & Oliver, 2001).

The problem does not emerge from the technology itself, but it emerges from the teachers' perceptions about their ability to integrate such advanced technology. To illustrate, teachers' knowledge about how to utilize technology does not necessarily ensure actually infusing it in lessons and classrooms simply because of a lack in confidence (Mueller, Wood, Willoughby, Ross, & Specht, 2008). This could be related to the teachers' need for intensive and frequent professional development (the third category in this discussion), or it could be related to the teachers' efficacy in using technology with which they are not familiar in teaching contexts. Teachers also conceive cloud computing as not being age appropriate and being hard to adopt for young learners in their learning because teachers needed to learn more about the best teaching practices in order to adopt this technology in mathematics classrooms. Moreover, the data supported teachers' perceptions that cloud computing is a significant means to enhance teaching practices and promote students' collaboration. Actually, the majority of the Kuwaiti teachers perceived cloud computing as promoting student-student and student-teacher collaboration, such as promoting the effectiveness of collaboration that gives the opportunity to every single learner to express his/her own opinion. This corresponds with a statement by Al-Mousa (2004) that technology opportunities in the classroom allow students to send communication and opinions without concern or anxiety related to peer reaction. This is especially beneficial to students who have a predisposition toward shyness or anxiety because it can help bolster their courage (Al-Mousa, 2004). This negative perception toward cloud computing could lead us to the third category of professional development.

Providing professional development was the third category of participant concerns with adopting cloud computing. The participants were concerned about adopting cloud computing in their classrooms because it is a new technology. It is the responsibility of the school, the district, and the MOE to prepare the mathematics teachers to effectively understand the educational potentials of cloud computing.

Smoekh (2008) discussed schools' technical and pedagogical support such as providing teachers with frequent professional development workshops. He also emphasized that schools should provide teachers with a supportive culture and suitable opportunities to practice new technological and pedagogical practices. More specifically, Ertmer and Ottenbreit-Leftwich (2010) recommended that providing professional development workshops to teachers might assist them to:

> 1. Align experiences with existing pedagogical beliefs and knowledge.
> 2. Provide examples of other teachers' successes emphasizing student outcomes.
> 3. Provide support for risk-taking and experimentation.
> 4. Expand the definition of "good teaching" to include technology integration.
> (p. 266)

They further stated that teachers greatly need constant professional development to support their technological integration due to the rapid changes in the hardware and software related to the technology (Ertmer & Ottenbreit-Leftwich, 2010).

The fourth category identified was revising the mathematics curriculum to avoid redundancy. Although the mathematics curriculum has gone through many modifications in the last two decades, those modifications were always done in the absence of the most influential agent, the teachers. Historically, the MOE introduced no modification to the elementary curriculum in collaboration with the heads of the mathematics departments or teacher groups. Teachers always received one- to three-day workshops at the beginning of the year in which the new modifications were shared. Teachers did not have the power or were not in a position to give their opinion and participate in the mathematics curriculum improvement. To illustrate, Al-Kandari (2013) stated that those at the school level do not have an obvious role in the manifestation of the educational strategic plan. It is important the MOE be represented by educational districts and schools, giving opportunities to teachers to provide their valuable opinions before making crucial decisions about curriculum because these decisions are meant to improve student learning. Teachers are the best individuals who can reflect on the efficiency and applicability of these decisions before they are officially implemented. Consulting and engaging with teachers before decision-making might save time, effort, and resources. As reality evidence, all the MOE efforts to promote 21st century and advanced technological learning environments failed to shift their goals of transforming current traditional learning environment into technological learning experience. In this study, the primary issue with the current curriculum was that it was loaded with mathematical content and supplemental mathematical activity that had to be covered in each single lesson. This limited the ability to infuse technology, especially when teachers needed to carry mobile devices such as portable projects between her/his classrooms.

Constructivist Approach

The Kuwaiti mathematics teachers believe in the constructivist perspective (student-centered) in the learning setting and how much they could benefit from utilizing this approach to enhance the learners' mathematical performance. The majority of teachers' responses supported utilizing constructivism in their teaching practices. The usefulness of the constructivist-learning environment on learners' performance is well documented in the literature. Nevins and Floden (2009) suggested that utilizing technology such as laptops could promote a learner-centered learning approach and could enhance students' participation in the classroom. They also emphasized the most-engaging classroom activities for learners are those activities that promote self-learning and give learners the opportunity to learn on their own. In addition, Maninger and

Holden (2009) stated that when learners have the opportunity to work on an individual basis to attain pieces of and the necessary knowledge that unifies them with their peers' knowledge, it might lead to powerful learning and improvement in the learner's performance when compared with traditional teaching methodologies. Kuwaiti mathematics teachers view the constructivist learning approach as enhancing learners' performance in mathematics. This finding was significant because the notion behind engaging Kuwaiti learners in the learning environment is not just to connect them to their peers in advanced nations. It is simply because the Kuwaiti students across all grade levels lack the ability to creatively process knowledge. This does not mean Kuwaiti students are somewhat less-intelligent students. Actually, they show high ability in memorizing and recalling information from their lessons. This was a clear indication about the type of learning that was currently promoted in Kuwait was outdated and needed to be refined. Specifically, according to Aljarida Newspaper (2016), this was confirmed by a report conducted by the Central Statistical Bureau in Kuwait that indicated that students' performance in English and mathematics dropped tremendously for the 2014-2015 academic year. Also, the Kuwaiti elementary students' performance in mathematics was that across all grade levels in Kuwait, they scored higher percentages in memorizing mathematical knowledge, whereas they scored tremendously lower in their ability to process this knowledge in higher-thinking processes and showed deficiency in creativity skills when employing this knowledge (Aljarida Newspaper, 2016). It appears this is the perfect time to modify and transform teaching practices to correspond with the constructivist perspective as most of the high-tech students are technologically ready to utilize technology in their exploratory journey, and technology is rapidly changing and developing in a way that makes it more compatible for utilization in educational settings.

Although there was nearly consensus among the participants in regard to adopting the constructivist approach in the mathematics classroom as a beneficial learning approach, a very few mathematics teachers thought the traditional teaching approaches (teacher-centered) were strong enough and needed no extra effort or reformation of the existing mathematics curriculum and teaching practices. Providing the opportunity for those few mathematics teachers to explore and observe the constructivist approach via workshops or observation sessions might help them understand the teaching potential that underpins the approach. To support this notion, offering traditional teachers chances to witness the benefits of the student-centered approach on their students' performance (in mathematics) might be considered the optimal way to support changes in their teaching practices (Ertmer & Ottenbreit-Leftwich, 2010).

The 21st Century Learning Environment

The findings of this study indicate that teachers perceive the significance in shifting the elementary schools' learning environment to the 21st century learning context. The participants reflected their ability and desire to create a 21st century learning environment in their mathematical classrooms. Moreover, when teachers were asked about the necessity to shift to a modern cloud-computing approach in teaching, the majority of the responses were positive, indicating the majority of participants perceived the need to shift to a modern and 21st century-based learning approach. According to Kay and Greenhill (2011), the primary goals of an educational environment in the 21st century is to prepare learners to attain knowledge and the necessary skills and expertise to outshine in life, including career and education. This is consistent with the findings of Warschauer (2011) who declared in the 21st century that education has tremendously shifted and increasingly adopted mobile devices such as tablets and smartphones in the teaching practices and as an infrastructure construct in classrooms. Furthermore, the student-centered approach is constantly acknowledged as the primary and the most efficient structure to modify educational settings to correspond with the 21st century learning environment (Voogt, 2008).

Teachers in this study reflected an eager desire to construct a 21st century learning environment. The participants were not pushing toward a modern learning environment just because it was modern and attractive to young learners. Teachers understood that the old and traditional methods were not efficient in the current day because the learners' needs and interests have been changing tremendously over the last decade, whereas the public elementary system in Kuwait was not effectively accommodating this huge shift in learners' lives. Placing the blame entirely on the public elementary system and/or the mathematical curriculum is not totally fair because the MOE, districts, and schools have made keen efforts to revise and improve mathematics subjects across all educational levels. It is better to frame the claim around the notion that the public elementary school system failed to achieve the desired goals to improve the school system in order to correspond with the 21st century learning due to the miscommunication between the MOE as the decision-maker and the elementary mathematics teachers as the actual facilitators and the experts who directly interact with learners. In support of this, Reio and Lasky (2007) recommend that involving teachers in decisions related to the curriculum, environment, and learning process is important to create effective learning experiences. Teachers are a primary pillar in assisting the MOE and schools to make the appropriate decisions to improve the educational system, and neglecting teachers' input might not only hinder enhancement of the learning process, but also could lead to the collapse of all efforts in improvement and lead to wasted time, efforts, and resources of everyone involved in the learning environment.

Recommendations

Based on the findings of this study, the following recommendations present actions that can be implemented to further technology integration in mathematics teaching:

- Teachers' perceptions were high regarding integrating mobile technology in mathematics classrooms. Therefore, schools, districts, and the MOE should invest in this high, positive perception by providing schools and classrooms with the essential technology.
- Teachers perceived a lack of school and district financial, technological, and administrative support. Thus, the MOE as the primary decision-maker and only funding source, should bear the responsibility to adequately address these issues.
- Teachers reflected a high perception of their ability and desire toward learning new technological pedagogical practices, but they need professional development programs to successfully adopt new technologies such as cloud computing. Therefore, schools, districts, and the MOE should frequently and all year long provide professional development programs to all teachers if

they desire to improve teachers' ability to effectively integrate technology in their mathematics classrooms.

- Teachers constantly acknowledged the incompatibility of the current mathematics curriculum with integration of mobile and cloud-computing technologies. Thus, districts and the MOE should team up and work with all personnel including teachers who are involved in the learning experience. This will help the stakeholders to revise the mathematics curriculums to effectively accommodate technology in teaching practices.

Conclusions

The findings from the analysis of qualitative data in this study supported the results from the quantitative data analysis of this study. This mixed method research contributed to the literature in different ways. Furthermore, in this study, a direct intention was directed upon a significant national issue in Kuwait regarding the quality of elementary mathematics subjects. Almost all personnel involved in the educational system such as mathematics teachers, administrators, learners, and parents identified this issue and nearly all individuals were striving to resolve and improve the quality of the mathematics learning environment by calling for integrating or infusing technology, such as mobile technology, to enhance learners performance.

First, this study focused on teachers' perceptions of their ability to integrate mobile technology in their classrooms. This was a significant direction of this study because teachers were accused of not supporting young learners with constructing an attractive technological learning environment that satisfied their needs and interests as high-tech learners. However, from this study's findings, it was impressive to see teachers perceived themselves capable of interacting with and integrating mobile technology in their classrooms. They were capable of integrating mobile technology; the Kuwaiti teachers were striving toward and calling for the provision of the fundamental and essential technologies to enable them to develop a technological learning experience. Yet, not all teachers are capable of striving toward the integration of technology in their classrooms. But, these teachers were in the minority and had different and negative perspectives about technology in the first place. In this line of research, teachers voluntarily suggested some obstacles (barriers) they perceived to limit their abilities to successfully and effectively infuse technology in their lessons and classrooms such as the need for a variety of technology and mobile devices and the revision of the mathematics curriculum.

Second, this study examined mathematics teachers' perceptions of barriers and affordance that might influence their degree of integration of mobile devices in the mathematics classrooms. The findings suggested that the Kuwaiti teachers perceive themselves competent enough in this integration in that they had no personal or in-control barriers that might impact their ability to integrate mobile technology. Instead, they felt the schools, districts, and the Ministry of Education were the decision-makers that were creating the barriers and limiting their ability to effectively incorporate mobile technology in their classrooms. The primary barriers were budget constraints, IT limitations, time constraints, and administrative support. These barriers were highly perceived by mathematics teachers as factors hindering their ability to infuse mobile technology. It was interesting to note that teachers did not perceive their ability or current technological knowledge as a barrier. Nor did they believe they needed professional development in integrating mobile devices such as tablets, smartphones, and laptops.

Third, mathematics teachers in Kuwait perceived themselves capable of constructing a 21st century learning environment. They expressed notable perceptions of ability to integrate collaborative cloud-computed learning experiences based on the constructivist approach. Again, teachers showed high perceptions of their ability to construct such a learning environment. However, teachers emphasized the need for professional development to support their ability to integrate cloud-computing technology. In addition, teachers supported the need for shifting the current teaching methods and practices to correspond with the 21st century collaborative learning environment. Moreover, they believed that the constructivist-learning approach was important to prepare high-tech learners for the 21st century challenges.

In conclusion, this study added to the literature a new perspectives about the reasons a nation like Kuwait is struggling to integrate mobile technology in elementary public schools. This study may assist the Ministry of Education in Kuwait in shifting the current traditional school system to a modern learning environment based on 21st century skills. The last message taken from this study is that in order to successfully create a modern learning environment based on 21st century skills, all interested personnel in the field of education should gather and work together as a team, instead of in their scattered individual attempts that may cause wasted time, effort, and resources. These lost efforts are leading to one conclusion, which is that the only loser in this equation is the young mathematics learner.

Implications for Future Research

Since this mixed study explored perceptions of elementary mathematics teachers in the public schools in Kuwait, I recommend that researchers conduct more in-depth interviews with mathematics teachers to thoroughly understand their perceptions of mobile technology infusion in their classrooms. It is suggested that future research be conducted to investigate the barriers mentioned in this study and examine them in depth via quantitative, qualitative, or both research methods to assess the specific reasons for and best solutions to improve teaching practices. In this research, the 21st century skills were not examined from teachers' and administrators' perceptives. It would be beneficial to focus on closing the gap between these two pillars of the educational system because from the findings of this research, it was salient that both parties lacked effective communication. A future research study is recommended to understand in depth the barriers in the technological, pedagogical, and content knowledge, individually and/or combined, from the teachers' perspectives. The findings of this study suggested that professional development, revising elementary mathematics curriculum, and providing mobile devices were salient factors in hindering teachers' abilities to integrate advanced technologies in their classrooms. Therefore, future research should be initiated to explore these three areas to examine the reasons for and potential solutions to improve the learning outcomes.

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APPENDIX A

TPACK SURVEY

TPACK Survey

Your self-perceived knowledge of content, pedagogy, and technology in your mathematics class this section will measure. Digital technology term is utilized to represent to digital tools and resource such as laptops, iPods, tablets, Smartphones, interactive whiteboards, video games, mathematics application, software programs, etc. Please answer all of the questions as best as possible.

Please note that all following questions are related to integrating mobile technology in your mathematics classroom.

Question Number	Statement	Strongly Agree	Agree	Strongly Disagree	Disagree
1	I know how to use different digital technologies.				
2	I know how to solve my own technical problems with digital technologies.				
3	I frequently play around with digital technologies.				
4	I keep up with important new digital technologies.				
5	I reason mathematically when I solve problems in my daily life.				
6	I can make mathematical connections with the problems outside of mathematics.				
7	I am able to communicate mathematically.				
8	I use multiple mathematical representations when I solve problems.				
9	I know how to adapt lessons to improve student learning.				
10	I know how to implement a wide range of instructional approaches.				
11	I know how to organize a classroom environment for learning.				
12	I know how to assess student performance in a classroom.				
13	I have a good understanding of teaching mathematics so that students are able to learn.				
14	I have a good understanding of instructional strategies that best represent mathematical topics.				
15	I have a good understanding of students' conceptual and practical understanding of mathematical concepts.				

16	I have a good understanding of the mathematics curriculum that meets students' needs for learning mathematics.				
17	I know how to use digital technologies to represent mathematical ideas.				
18	I am able to select certain digital technologies to communicate mathematical processes.				
19	I am able to use digital technologies to solve mathematics problems.				
20	I am able to use digital technologies to explore mathematical ideas.				
21	I am able to identify digital technologies to enhance the teaching approaches for a lesson.				
22	I can implement specific digital technologies to support students' learning for a lesson.				
23	I think deeply about how digital technologies influence teaching approaches I use in my classroom.				
24.	I can adapt digital technologies to support learning in my classroom				
25	I know specific topics in mathematics are better learned when taught through an integration of digital technologies with my instructional approaches.				
26	I can identify specific topics in the mathematics curriculum where specific digital technologies are helpful in guiding student learning in the classroom.				
27	I can use strategies that combine mathematical content, digital technologies and teaching approaches to support students' understandings and thinking as they are learning mathematics.				
28	I can select digital technologies to use with specific instructional strategies as I guide students in learning mathematics.				

APPENDIX B

TWENTY-FIRST CENTURY QUESTIONNAIRE

Twenty-first Century Questionnaire

Please answer your questions based on your opinion to use mobile technology such as laptops, iPods, tablets, Smartphones, interactive whiteboards, video games, mathematics application, software programs, social media applications etc. in mathematics classroom with students from 1st to 5th grade.

PART 1:

1. Do you feel comfortable using mobile technology in your life outside the school? Could you explain which device you think is your favorite and why?

2. Do you think mobile technology is useful in education (e.g., mathematics classroom)? Why?

3. Do you think integrating M-learning (e.g., students using iPad inside and outside the mathematics classroom for educational tasks) will benefit students to improve their mathematical ability? Explain?

4. If you have the decision, would you choose to integrate technology in your mathematics classroom? Explain your answer.

5. Do you think if the school immediately provided modern laptops, smartphones, and tablets, it would be easy to integrate them in your daily lessons? If yes or no:

    a. Explain your answer. Reasons for being comfortable or uncomfortable such as personal use, professional development offered by school, team collaboration, and other?

    b. Do you think the students are ready to interact right away with the devices in educational setting? Explain.

    c. Do you think the mathematics curriculum supports your use of mobile technology? Why?

d. Do you think the district, school, and mathematical department pedagogical strategies are aligned with mobile learning (teaching with mobile devices)? Do they support the use of mobile technology in classroom? Explain.

6. Why do you think we are still not efficiently integrating mobile technology in our mathematics classrooms? Explain.

7. What do you think we, as educators, should do to enhance our teaching to correspond with the 21st century?

PART 2:

Cloud Computing: is a model for enabling ubiquitous, convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (The National Institute of Standards and Technologies, 2011).

1. What is your opinion about the collaborative cloud computing environment that utilizes mobile learning technology? Explain your answer.

2. Do you think you are ready to start creating collaborative cloud computing environment next year, if the school provided the necessary mobile devices? Why or why not?

3. Do you think students will benefit from cloud computing and mobile technology in a constructivist-learning environment? Why or why not?

4. Do you think it is easier to teach mathematics with the current teaching methods or with mobile devices in cloud computing environment? Why or why not?

5. Do you think the education system needs to move to collaborative cloud computing with the use of mobile technology? Why or why not?

6. Do you think it is beneficial for students' improvement to give them permission to collaborate with each other in the cloud computing environment by using their own mobile devices in the mathematics classroom? Why or why not?

7. Do you believe that a collaborative learning environment (e.g., giving students more space to engage and share with each other and the teacher; students have opportunities to make learning decisions) in any learning setting is beneficial? Why or why not?

8. What are the advantages and disadvantages of integrating mobile learning technology in collaborative cloud computing environment?

9. How do you think teachers could create constructivist collaboration cloud computing learning environment via integration mobile technology?

10. What other ideas or thoughts do you have about collaborative learning in the cloud computing environment with the use of mobile technology?

APPENDIX C

DEMOGRAPHIC INFORMATION SUREY

Demographic Information Survey

1 Gender:

a. Female
b. Male

2 Current position:

a. Teacher
b. Head of math department

3 Educational District:

a. Hawalli, and
b. Alasma
c. Mubarak Al-kabeer
d. Al-Ahmadi
e. Al Farwania
f. Al Jahraa

4 Age range:

a. 21 – 25
b. 26 – 30
c. 31 – 35
d. 36 - 40
e. 40+

4 Grade you are currently teaching:

a. 1
b. 2
c. 3
d. 4
e. 5
f. None

5 Years of teaching experience:

a. 1 - 5
b. 6 - 10
c. 11 - 15
d. 16 – 20
e. 21 +

6 Years of teaching with technology:

a. None
b. 1-5
c. 6-10
d. 11-15
e. 16+

7 Professional certifications attained in last 5 years:

a. None
b. 1 - 5
c. 6 - 10
d. 10 +

8 Technological certifications attained in the last 5 years:

a. None
b. 1 - 5
c. 6 - 10
d. 10 +

APPENDIX D

BARRIERS SURVEY

Barriers Survey

Rate any of the following factors that you feel may prevent you from implementing M-Learning. Rate each factor with:

1 = Prevents all the time
2 = Prevents most of the time
3 = Rarely prevents
4 = Does not prevents

	Barriers	**1**	**2**	**3**	4
1	Technological knowledge				
2	Pedagogical knowledge				
3	Mathematics knowledge				
4	Time constraint				
5	Administrative support				
6	Personal Interest				
7	Professional development and training				
8	Professional development For mobile learning				
9	IT limitations				
10	Budget constraints				

Q11: Are there other barriers you think could limit you from integrating M-learning in your classroom? (Please explain):

Q12: Are there other affordances you think could assist you to integrate M-learning in your classroom? (Please explain):

APPENDIX E

TRANSLATED SURVEYS

لاءزج لولأا : اذه ءزجلا فوس سيقي ككاردا يتاذلا يوتسمل كتفرعم لكب نم ىوتحم ،ةداملا تاينقتلاو
ةيمقرلا (يهو لك تاودلأا و لئاسولا ةيمقرلا لثم بساحلا يلآلا هيعونب يبتكملا ،لومحملاو بلالا بوت
يلآا، دابةزهجلأا، ةيكذلا ، ةروبسلا ةيلعافتلا ،ةيكذلا جماربو تاقيبطت فتاوهلا ةيكذلا ٠٠٠ خلا)
ءاجرلا ةباجلإا ىلع عيمج ةلئسلأا ةيلاتلا :

لا أوافق بشدة ١	لا أوافق ٢	أوافق ٣	أوافق بشدة ٤	السؤال	م
				آنا اعرف كيف أستخدم أنواع مختلفة من التقنيات الرقمية داخل الفصل	1
				أنا أعرف كيف أحل المشاكل الفنية التي تواجهني في االفصل عند استخدام التقنيات الرقمية	2
				أنا آتسلى باستخدام التقنيات الرقمية بشكل مستمر	3
				أنا على اطلاع دائم بالتقنيات الرقمية الحديثة والمهمة	4
				أنا أوظف التعليل الرياضي عند حل المسائل الرياضية في حياتي اليومية	5
				أنا أستطيع ربط المسائل غير الرياضية بمادة الرياضيات	6
				أنا أمتلك القدرة على التواصل الرياضي	7
				أنا أستخدم العديد من التمثيلات البيانية عند حل المسائل	8
				أنا أعرف كيف أتبنى دروس تحسن تعلم الطالب	9
				أنا أعرف كيف آطبق نطاق واسع من الأساليب التدريسية	10
				أنا أعرف كيف أنظم بيئة الصف لتساعد على التعليم	11
				أنا أعرف كيف آقيم أداء الطال في الفصل	12
				أنا أمتلك فهم جيد لتدريس الرياضيات بحيث يمكن الطلاب من التعلم	13
				أنا امتلك فهم جيد للاستراتيجيات التعليمية التي تمثل المواضيع الرياضية بآفضل صورة	14
				أنا أمتلك ادراك جيد لفهم الطلاب النظري والعملي للمفاهيم النظرية	15
				أنا أمتلك ادراك جيد لمناهج الرياضيات التي تلبي احتياجيات الطلاب لتعلم الرياضيات	16
				أنا أعرف كيف استخدم التقنيات الرقمية لتمثيل الأفكار الرياضية	17
				أنا استطيع اختيار تقنيات رقمية معينة لتوصيل مفهوم العمليات الرياضية	18

19	أنا استطيع استخدام التقنيات الرقمية لحل المسائل الرياضية				
20	أنا استطيع استخدام التقنيات الرقمية لإستكشاف الأفكار الرياضية				
21	أنا استطيع التعرف على التقنيات الرقمية التي تعزز آساليب التدريس للدرس				
22	أنا استطيع تطبيق تقنيات رقمية تدعم تعلم الطلاب للدرس				
23	أنا أفكر بعمق في كيفية تأثير التقنيات الرقمية على طرق التدريس التي استخدمها في الفصل الدراسي				
24	أنا استطيع تبني تقنيات رقمية تدعم التعلم في الفصل الدراسي				
م	**السؤال**	**أوافق بشدة 4**	**أوافق 3**	**لا أوافق 2**	**لا أوافق بشدة 1**
25	أنا أعرف مواضيع محددة في الرياضيات تتعلم بشكل افضل عندما تدرس من خلال دمج التقنيات الرقمية في طرق التدريس				
26	أنا أستطيع التعرف على مواضع معينة في منهج الرياضيات يمكن لتقنيات رقمية محددة أن تساعد في توجيه تعلم الطالب لها في الفصل الدراسي				
27	انا استطيع استخدام استراتيجيات تجمع بين المحتوى الرياضي و التقنيات الرقمية و طرق التدريس لدعم فهم و تفكير الطلاب عند تعلمهم للرياضيات				
28	انا استطيع اختيار تقنيات رقمية لاستخدامها مع استراتيجيات تعليمية لتوجيه تعلم الطلاب للرياضيات				

الجزء الثالني : قيم أي من العقبات آو الحواجز التالية التي قد تمنعك كمعلم لمادة الرياضيات، من تطبيق تكنولوجيا الأجهزة الذكية المحمولة (اللاب توب، الاي باد، الهواتف الذكية ٠٠٠ الخ).
١ = يمنع في كل وقت،٢ = كثيرا ما يمنع، ٣= نادرا ما يمنع،٤= لا يمنع

م	العقبات	يمنع في كل وقت ١	كثيرا ما يمنع ٢	نادرا ما يمنع ٣	لا يمنع ٤
1	مدى إلمامك بالتكنولوجيا				
2	مدى إلمامك بطرق التدريس				
3	مدى إلمامك بمحتوى مادة الرياضيات				
4	الوقت الزمني للحصة الدراسية				
5	الدعم الإداري				
6	إهتمامات شخصية للتكنولوجيا				
7	التطوير المهني والتدريب للمعلم				
8	التطوير المهني للتعلم المحمول				
9	قيود تقنية المعلومات				
10	القيود المفروضة على الميزانية				

١١ . هل هناك عقبات أخرى تمنعك كمعلم من تطبيق تكنولوجيا الأجهزة المحمولة داخل الفصل الدراسي ؟ أذكرها.

١٢ . من وجهة نظرك كمعلم رياضيات، هل هناك عوامل تساعدك على تطبيق تكنولوجيا الأجهزة المحمولة داخل الفصل ؟ أذكرها.

الجزء الثالث : الرجاء الاجابة على الأسئلة التاليه بناءاً على رأيك في استخدام تكنولوجيا وتطبيقات الأجهزة المحمولة الذكية (الهاتف النقال ـ الآي باد ـ اللاب توب) داخل الفصول الدراسية في المرحلة الابتدائية :

١ـ هل تشعر بالراحة عند استخدام تكنولوجيا الأجهزه االذكيه المحمولة مثل الهواتف الذكية، وأجهزة الكمبيوتر المحمولة (الآي باد ـ اللاب توب) في خارج نطاق المدرسة ؟

وما هو الجهاز المفضل لديك ؟ ولماذا؟

٢ـ هل تعتقد تكنولوجيا الأجهزه الذكيه المحمولة ذو أهمية في عملية التعليم داخل الفصول الدراسية للمرحلة الابتدائية ؟ و لماذا ؟

٣ـ هل تعتقد أن التعلم عن طريق تطبيقات الأجهزه الذكية المحمولة (على سبيل المثال استخدام الطلاب للآي باد داخل وخارج الفصول الدراسية في المهام التعليمية) ستعم بالفائدة لهم في تحسين وتطوير قدراتهم في الرياضيات ؟ و كيف ؟

٤ـ هل تعتقد إذا وفرت المدرسة في الوقت الحالي أجهزة الكمبيوتر المحمولة الحديثة، والهواتف الذكية، والأجهزة اللوحية (السبورة الذكية) ، سيكون من السهل ادخالها في الدروس اليومية؟ إذا كانت الإجابة بنعم أو لا: --------

أ ـ ما الأسباب لكونها مناسبة أو غير مناسبة (الاستخدام الشخصي ، التطوير المهني التي تقدمه المدرسة للمعلم، تعاون فريق القسم المدرسي) وغيرها؟

ب ـ هل تعتقد أن الطلاب حاليا على استعداد للتفاعل بكفادة مع الأجهزة الذكية المحمولة داخل الفصول الدراسية ؟ لماذا ؟

ج ـ هل تعتقد أن المنهج يدعم استخدامك لتكنولوجيا الهاتف النقال ؟ لماذا ؟

د ـ هل تعتقد أن كلا من المنطقة التعليمية ، المدرسة ، ومنهج الرياضيات يتماشوا مع التعليم عن طريق تطبيقات تكنولوجبا الاجهزة الذكيه المحمولة في الوقت الحالي ؟ ام أنها لا تدعم استخدام هذه التطبيقات في الفصول الدراسية ؟ ولماذا؟

٥ـ إذا كان بديك القرار، هل تؤيد ادخال تكنولوجيا الأجهزة الذكيه المحمولة في الفصول الدراسية الخاصة بك ؟ ولماذا ؟

٦ـ لماذا يعتقد البعض أننا ما زلنا غيرقادرين على ادخال تكنولوجيا الأجهزة الذكية المحموله بكفاءة في الفصول الدراسية في الوقت الحالي؟ ولماذا ؟

٧ـ ما هو دورنا كمعلمين القيام به لتحسين طرق التدريس لدينا ليتوافق مع القرن ال21 ؟

الجزء الرابع : بيئة الحوسبة السحابية التعاونية :

المقصود في الحوسبة السحابية :هي إستخدام الإنترنت في إقامة دروس الرياضيات بحيث يستطيع المعلم إعطاء الواجبات المدرسية وشرح مفاهيم الرياضيات عبر الانترنت بحيث يستطيع التلميذ التفاعل مع هذه الدروس داخل وخارج الفصل الدراسي من خلال الأجهزه الذكية سواء المحمولة أو الثابته كسطح المكتب. مثلا: أن يكون للمعلم موقع (صفحة انترنت خاصه به) يشرح فيها محتوى دروس الرياضيات ثم يطلب من التلاميذ أن يجيبون على بعض التساؤلات على شكل مجموعات أو فرادي ، من خلال الأجهزه الذكية داخل الفصل أو من المنزل بعد انتهاء الدوام المدرسي

١ـ ما هو رأيك في بيئة الحوسبة السحابية التعاونية التي تستخدم في التعلم عن طريق تطبيقات الاجهزة الذكية المحمولة ؟

٢- هل تعتقد أنك على استعداد للبدء في إنشاء بيئة الحوسبة السحابية التعاونية في العام المقبل، إذا وفرت المدرسة الأجهزة المحمولة اللازمة ؟ ولماذا ؟

٣- هل تعتقد أن يستفيد الطلاب من الحوسبة السحابية وتكنولوجيا الاجهزة الذكية المحمولة في بناء بيئة تعليمية؟ ولماذا ؟

٤- هل تعتقد أنه من السهل الان التعليم مع طرق التدريس الحالية و مع الأجهزة الذكية المحمولة في بيئة الحوسبة السحابية ؟ لماذا ؟

٥- هل تعتقد ان نظام التعليم الان يحتاج للانتقال إلى الحوسبة السحابية التعاونية مع استخدام تكنولوجيا الأجهزة الذكية المحمولة ؟ ولماذا؟

٦- هل تعتقد أنه من المفيد لتحسين الطلاب منحهم الإذن للتعاون مع بعضها البعض في بيئة الحوسبة السحابية باستخدام الأجهزة الذكية المحمولة الخاصة بهم في الفصول الدراسية ؟ ولماذا ؟

٧- هل تعتقد أن بيئة التعلم التعاوني (على سبيل المثال، إعطاء الطلاب مساحة أكبر للمشاركة وتبادل الخبرات مع بعضها البعض ومع المعلم، ويكون لدى الطلاب فرص لاتخاذ قرارات في التعلم) في أي بيئة تعليمية تعتبر ذو قيمة مفيدة ؟ ولماذا ؟

----

٨ ـ ما هي مزايا وعيوب ادخال تكنولوجيا الأجهزة الذكية المحمولة في بيئة الحوسبة السحابية التعاوبية ؟

----

٩ ـ كيف كت تعتقد قدرة المعلمين على بناء بيئة الحوسبة السحابية التعاونية عن طريق ادخال تقنية تكنولوجيا الأجهزة الذكية المحمولة ؟

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١٠ ـ ما هي الأفكار أو الحلول التي لديك حول التعلم التعاوني في بيئة الحوسبة السحابية مع استخدام تكنولوجيا الأجهزة الذكية المحمولة ؟

APPENDIX F

RESEARCH INVOLVING HUMAN PARTICIPANTS
FOR UNIVERSITY OF NORTHERN COLORADO
INSTITUTIONAL REVIEW BOARD
APPROVAL LETTER

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

DATE:	January 27, 2016
TO:	Nadeyah Alqallaf
FROM:	University of Northern Colorado (UNCO) IRB
PROJECT TITLE:	[850775-2] Mathematical Teachers' Perception: Mobile Learning and Constructing 21st Century Collaborative Cloud Computing Environments in Elementary Public School in the State of Kuwait
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVAL/VERIFICATION OF EXEMPT STATUS
DECISION DATE:	January 26, 2016

Thank you for your submission of Amendment/Modification materials for this project. The University of Northern Colorado (UNCO) IRB approves this project and verifies its status as EXEMPT according to federal IRB regulations.

We will retain a copy of this correspondence within our records for a duration of 4 years.

If you have any questions, please contact Sherry May at 970-351-1910 or Sherry.May@unco.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Northern Colorado (UNCO) IRB's records.