ENABLING FACTORS AND TEACHER PRACTICES IN USING TECHNOLOGY-ASSISTED PROJECT-BASED LEARNING IN TATWEER SCHOOLS IN JEDDAH, SAUDI ARABIA

by

ABDULRAHMAN KAMAL

B.A., King Fahad University of Petroleum & Minerals, Dhahran, Saudi Arabia, 1990
M.S., Kansas State University, Manhattan, KS, 2011

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

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Abstract

The purpose of this study was to investigate teacher practices of enabling factors in the implementation of technology-assisted PBL, in Tatweer schools in Jeddah, Saudi Arabia. This study also explored how the International Society for Technology in Education (ISTE) National Education Technology Standards for Teachers (NETS.T) were used in Tatweer classrooms and for what purposes technology was used to support PBL in the Tatweer schools.

Using a constructivist framework, a convergent parallel mixed-methods design was used. The survey included closed and open-ended items, which was sent to 1073 male and female Tatweer teachers in 30 schools. Of the 710 responses received, 640 were valid, resulting in a 60% return rate.

Factorial MANOVA results indicated that gender and school level were statistically significant at $p < .05$, while other teacher characteristics (degree types, educational degree, years of teaching experience, and content area), including their interaction, were not. ANOVA results indicated that gender effects on PBL practices were statistically significant on both teacher roles (F (1,403) = 17.77, partial $\eta^2 = .042$, $p < .05$) and learning environment (F (1, 403) = 10.83, partial $\eta^2 = 026$, p < .001). A means comparison indicated that males had better technology-assisted PBL practices on both variables. ANOVA and *post hoc* test results found that high schools used technology-assisted PBL better than elementary schools, and intermediate schools performed better than elementary schools. No significant difference was found between technology-assisted PBL practices in high schools and intermediate schools within the school system. Descriptive analysis results for research question two indicated that Tatweer school teacher technology uses were aligned with ISTE NETS.T, though there was very little use of technology in PBL. Though 177 units of information were found for the seven open-ended questions, little was related to the research questions, so Grounded Theory was used to find 19 overall themes. Findings indicated several casual conditions for the lack of technology-assisted PBL, including technology access, classroom design, space, and facilities, ministry/district support, and teacher preparation. Action strategies included providing needed technology, offering technology training, providing training in new instructional methods, creating a more flexible curriculum, and adopting advanced teaching methods and authentic assessment. Recommendations for Tatweer schools included a better learning environment, greater professional technology access, and school system support. Recommendations for future studies included conducting a similar study on other schools and a further examination of Grounded Theory findings.

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Dedication

This work is dedicated to the souls of my parents who opened my eyes to the importance of learning and did what they could to pursue my learning. To my beloved wife Aysha Bajabaa and my children: Somayyah, Anas, Eyad, Layan, And Shaden. This work is also dedicated to anyone who would made ever efforts to improve our today's kids' education and made our globe better and filled with love and peace.

Chapter 1 - INTRODUCTION

United States Workforce Needs and Curriculum Reform

In his keynote speech to the State Educational Technology Directors Association (SETDA), Harvard's Tony Wagner noted that "a lot of people think the skills that students need to learn for the workforce and the skills they need to learn to be a good citizen are two separate sets" (Stansbury, 2008, para. 5). Today's technological advancements have created a "flat world" wherein the competition for jobs becomes global rather than local. As Wagner (2008) asserted, "Our young people are now in direct competition with youth from developing countries for many of what traditionally have been considered our 'good middle-class white-collar' jobs" (p. xv). President Obama (2011) stated:

> Providing a high-quality education for all children is critical to America's economic future. Our nation's economic competitiveness and the path to the American Dream depend on providing every child with an education that will enable them to succeed in a global economy that is predicated on knowledge and innovation.(*Education,* 2011a, para. 2)

Various American curriculum reform efforts to address workforce needs have taken place in its history (e.g., *The Committee of Ten, The Eight-Year Study, Sputnik*…) (Marsh & Willis, 2007). *A Nation at Risk Report* is one of the early alerts in modern American educational history that cautioned Americans about their education and the need for school reform efforts. The report, first released in 1983, was a result of 18 months study aimed to "generate reform of our educational system in fundamental ways and to renew the Nation's commitment to schools and colleges of high quality throughout the length and breadth of our land" (The National Commission on Excellence in Education, 1983, p. 9). The report's opening paragraph cautioned

Americans about the new thread, which was the economic competitors "Our nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world" (The National Commission on Excellence in Education, 1983, p. 9). The report further mentioned American schools

> The educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people. What was unimaginable a generation ago has begun to occur-- others are matching and surpassing our educational attainments. (The National Commission on Excellence in Education, 1983, p. 9).

The report included several facts about the decline in American student achievement and skills. For example, comparison of American students' achievement on 19 international tests with other industrialized nations, American students were never first or second. At the time of the report, average achievement of high school students on most standardized tests was lower than 26 years ago when Sputnik was launched. In terms of skills, 17-year-olds did not possess "higher order" intellectual skills. The report concluded, "We are raising a new generation of Americans that is scientifically and technologically illiterate" (The National Commission on Excellence in Education, 1983, p. 12).

While the report and its recommendations were circulated widely and still have an effect on American education, it drew intense criticism (*A nation at risk,* 2004; Rothstein, 2008). According to the Koret Task Force, a group organized by the Hoover Institution and Stanford University to study the status of education reform, "*A Nation at risk* did a good job of pointing out the problems in American schools, but was not able to identify the fundamental reasons for the problems or address the political influences in the public education system" (*A nation at risk,* 2004, para. 13).

Based on the same assumptions and strategies of the *A Nation at Risk Report*, the No Child Left Behind (NCLB) Act aimed to improve American education, especially disadvantaged students. Upon its approval by President Bush on Jan. 8, 2002, NCLB has placed more accountability on states and schools for student achievement than can be measured through testing. For example, since the 2005-2006 school year, states have been required to test students in grades 3-8 annually in reading and math. Starting in the 2007-2008 school year, states have also been required to test students in science at least once in elementary, middle, and high school. In addition, states were required to achieve 100% proficiency by the 2013-2014 school year. Thus, individual schools must meet the Adequate Yearly Progress (AYP) for the whole school student population and for specific demographic subgroups. Other elements of NCLB included report cards, reading first, teacher qualifications, and funding changes (*No child left behind,* 2011).

NCLB has proven to be controversial, with nearly half of the schools failing to meet the federal standards in 2011 (Hefling, 2012). As a result of NCLB, critics have complained that too much emphasis has been placed on preparing students for tests instead of investing school time on improving student kills and curiosity and teaching them to be qualified members of the workforce and good citizens (Klein, 2001; Novak & Fuller, 2003). To lessen the gap between school status quo and workforce needs, the U.S. school system have been asked to focus more on 21st century skills than content coverage standards. "Our system of public education- our curricula, teaching methods, and the tests we require students to take- were created in a different century for the needs of another era. They are hopelessly outdated" (Wagner, 2008, p. 9). The battleground for learning over increased testing has reached its apex, as the largest number of states, to date, have been allowed to opt out of NCLB (*Majority of state lining up to ditch NCLB,* 2011).

Saudi Arabian Workforce Needs and Curriculum Reform

The dilemma of high school graduate quality and readiness to fulfill employer needs in today's highly competitive global economy is not limited to the developed countries; it is more critical to developing countries, such as Saudi Arabia. An important factor that has caused the need for education reform has been high unemployment. According to Mr. Adel Faqeeh, the Labor Minister, unemployment reached 10% among Saudis in 2010 (*Unemployment rate: 10% in 2010 in Saudi Arabia,* 2011) while it was estimated at 39 % among Saudis aged 20-24 (Allam, n.d.).

Most of the public administration jobs in the country are still occupied by Saudis. However, the private sector jobs, which require highly qualified employees, are powered by foreign workers, who make up about a third of the country's population. Only 9.9% of work force employees in the private sector were Saudis in 2009 (Al Bawaba, 2011). John Sfakianakis, chief economist at the Saudi France Bank, expressed the problem of Saudi graduates' lack of job skills. "One of the main issues that the private sector faces is the fact that there aren't enough well-trained Saudis in the kind of jobs that are needed" (Lindsey, 2010, para. 10). Similar to U.S. concerns on the use of widespread testing, one common criticism of Saudi education is that more emphasis is placed on rote memorization than on the use of analytical teaching strategies, which resulted in student lack of important skills for high wage jobs.

Since Saudi Arabia does not have databases similar to ProQuest, finding recent information on schooling is difficult. The most recent data found by the researcher was the 2007

Trends in International Mathematics and Science Study (TIMSS) results, Saudi schoolchildren ranked near the bottom of the 48 countries surveyed (*TIMSS 2007 results,* n.d.).

Table 1 *TIMSS 2007- 8th Grade Math Results*

Country	Average Scale Score	Country	Average Scale Score
Chinese Taipei	598	Ukraine	462
Korea, Rep. of	597	Romania	461
Singapore	593	Bosnia and Herzegovina	456
Hong Kong SAR	572	Lebanon	449
Japan	570	Thailand	441
Hungary	517	Turkey	432
England	513	Jordan	427
Russian Federation	512	Tunisia	420
United States	508	Georgia	410
Lithuania	506	Iran, Islamic Rep. of	403
Czech Republic	504	Bahrain	398
Slovenia	501	Indonesia	397
TIMSS Scale Average	500	Syrian Arab Republic	395
Armenia	499	Egypt	391
Australia	496	Algeria	387
Sweden	491	Colombia	380
Malta	488	Oman	372
Scotland	487	Palestinian Nat'l Auth.	367
Serbia	486	Botswana	364
Italy	480	Kuwait	354
Malaysia	474	El Salvador	340
Norway	469	Saudi Arabia	329
Cyprus	465	Ghana	309
Bulgaria	464	Qatar	307
Israel	463	Morocco	381

Note. Adapted from "TIMSS 2007 results", (n.d.), http://nces.ed.gov/timss/results07.asp

These results warned the whole nation about the quality of the Saudi education and its ability to afford life-long learning to help students acquiring not only knowledge, but also long-life skills, like teamwork, social, critical thinking, higher-order thinking, and technologies skills. As one Saudi academic professor said, "I wish the result had not been announced or our students' papers were lost, so we could find an excuse for ourselves and others" (Al-Nazeer, 2011, para. 1). To improve mathematics and science teaching in the country, Al-Nazeer (2011), emphasized the importance of preparing teachers through well designed pre-service and in-service training to help them adopt new teaching and learning strategies that are more student-centered and focus on skills like problem-solving.

Al-Romi (2001) studied the extent to which general high school system and curricula in Saudi Arabia prepared graduates for the labor market. He investigated the attitude of 535 high school senior students in Riyadh boys' schools about how high school curricula developed their abilities or provided skills they felt they would need in the job market (e.g., teamwork, leadership, problem solving, computer literacy, creativity, and flexibility). Response rate was 97.9%. In addition, the researcher interviewed 11 human resources managers in Saudi companies in Riyadh about skills they needed for high school graduates to be employed in their companies and what they think about the high school curricula. Student responses indicated that 50.9% strongly agreed or agreed that "general high school curriculum doesn't prepare students to work in the labor market". Using Likert-type scale, with '1' indicating that a course "doesn't provide any skills" to '5' indicating that a course "provides very good skills", students were asked to rate their courses in terms of how well they provided basic skills. Results indicated that religious courses provided the greatest amount of skills overall (mean for overall skills provided by religious courses was 3.44), while library and research courses provided the least skills (mean for overall skills provided by library and research courses was 2.30). Teamwork was ranked as the highest skill gained (M= 3.08), followed by problem-solving skills (M= 2.92), while computer skills was least gained (M= 2.51) (Al-Romi, 2001).

Analysis of the interviews indicated that employers agreed that the Saudi education system and high school curriculum did not well prepare students with skills needed in the labor market, such as teamwork and computer skills. Participants indicated that high school graduates even did not know what they want and what job they are looking for. One human resource manager said that "The old and new general high school curricula do not provide skills for the students-even personal skills. Before, it was easy for general high school graduates to find jobs, even without skills; however, this opportunity is rare today" (Al-Romi, 2001, p. 116). This point view is very crucial and indicated how critical it is for Saudi educational stakeholders to make changes in Saudi education. The researcher concluded that "The general high school curriculum should be designed to provide all students with the personal, social, and capacity skills needed not only for immediate employment, but to facilitate lifelong learning" (Al-Romi, 2001, p. 139). Saudi authorities have called for the need of "educated young Saudis with marketable skills and a capacity for innovation and entrepreneurship" (Lindsey, 2010, para. 2).

21st Century K-12 Student Skills

Education should prepare students for the world and their future, so educators should increasingly concerned about 21st century skills for our students (Jacobs, 2010). Several organizations and scholars have tried to identify those 21st century skills that would prepare today's students for their future college, work, and citizenship (*21 century skills,* 2008). One initiative identifying 21st century skills was designed by the partnership for 21st century skills (P21), a national organization advocating 21st century readiness for every student. P21 created a framework for the 21st century education that has been adopted by 16 states. The framework aimed to help teachers integrate skills into core academic subjects. The framework incorporates content knowledge, skills, and experiences and literacies to prepare students for their future careers and lives. Successful adaptation of the P21 model requires whole system support, including standards and assessment, curriculum and instruction, professional development, and learning environments (*Partnership for 21st century skills,* 2011).

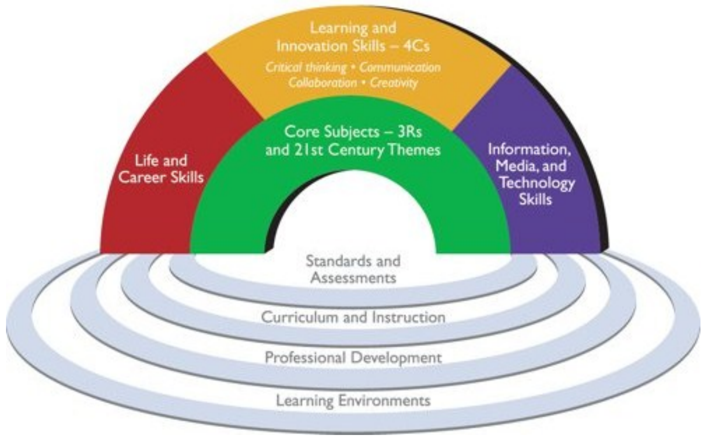

Figure 1. P21 21st Century Education Framework.
Adapted from "Partnership for 21st century skills", (2011), http://www.p21.org/

The P21 framework places 21st century skills into three main categories. The first is learning and innovation skills, including critical thinking and problem solving, communication and collaboration, and creativity and innovation. Second is information, media, and technology skills, including information literacy, media literacy, and ICT literacy. The third is career and life skills, including flexibility and adaptability, initiative and self-direction, social and cross-cultural interaction, productivity and accountability, and leadership and responsibility (*Partnership for 21st century skills,* 2011).

Technology's Role in K-12 Education

A sixth grader compared movie making with poster making for a class project: "Movie making is so much better than making a poster board for project at school. A poster board is flat, boring, and doesn't move you. It can't touch you the way our movie can" (Jacobs, 2010, p. 126). This student's description reveals the nature of 21st century learners, born in the digital era and almost always "plugged in". The Pew Internet Research Center conducted several surveys on adult use of the internet. According to the September 2009 Pew Internet survey 93% of American teens ages 12-17 go online (Pew Internet, 2009). Among the 800 participants, 73% used social networking, such as My Space and Facebook. Sixty-two percent of the participants used the internet to find news or political issues. Among the participants, 38% indicated that they used the internet for sharing something they created. While 14% created their own online journal or blog, 8% only visited virtual worlds like Second Life (Pew Internet, 2009). Daily teen texting has jumped from 38% in February 2008 to 54% in September 2009 (Pew Internet, 2010). While these statistics reveal the pervasive nature of technology for entertainment, teen usage also reflects several significant educational components, such as self-expression, connecting with people, and sharing and collaborating across time and space (Wagner, 2008).

As technology advances, schools should also change to incorporate technology. In fact, in the last 20 years, technology, especially Web 2.0 tools, has dramatically affected how people communicate and learn (Solomon & Schrum, 2007). Technology has given teachers more opportunities to design more engaging learning environments that help students succeed. The internet has helped students search for new information, promoting self-expression and creativity, easing communication and collaboration, and contributing to building new knowledge by allowing sharing information with others, which resulted in more ways for students to be successful learners.

Studies have supported the positive effects of technology on student learning (Erickson, 2010; Johnson, 2011; Thill, 2011). For example, one qualitative study examined the impact of using Power Point on high school student knowledge retention and found that using visual images and interactive activities had positively impacted student retention and comprehension in the history classroom (Johnson, 2011). A study examined the use of blogs as a tool for improving open-response writing in the secondary science classes compared to handwritten dialogue journals. Four classes were equally divided into an experimental group using the blog and a traditional group using the traditional journal (Erickson, 2010). Results indicated that the blog group had a significantly more positive attitude about the experience than the dialogue journal group. Students indicated that that blogging was fun and helpful and made them look forward to science class (Erickson, 2010). Another study focused on the impact of e-portfolios on student motivation, self-efficacy, autonomy and goal setting, and belief in foreign language classroom involved 62 Spanish IV students in a suburban high school (Thill, 2011). While the quantitative data analysis revealed no significance differences between the experimental and control groups, the focused interview group indicated e-portfolios positively affected the four variables.

Current Status of Technology in K-12 Education in the United States

The National Educational Technology Trends Study (NETTS) is the result of collaborative work by SRI International (SRI), the Urban Institute, and the American Institutes for Research (AIR), prepared for the U.S. Education Department in 2007 by Marianne Bakia, Karen Mitchell and Edith Yang. According the report "Indeed, educational systems across the country have embraced the potential of technologies to improve schooling" (Bakia, Mitchell, & Yang, 2007, p. 1). Government investment in the last 10 years has increased significantly to help integrate technology into schools. As a result, the ratio of student to instructional computer has dropped in recent years (Bakia et al., 2007). Federal government has helped through the Enhancing Education Through Technology program (EETT), one of the largest such program at the U.S. Department of Education.

Key findings from the report indicated that 42 states reported having technology standards for students in place by fall of 2004. Among these 42 states, 18 had stand-alone standards, and 16 have embedded technology standards with other academic content standards, while the remaining states have both stand-alone and integrated technology standards. Eighteen states reported that student technology literacy was a specific priority for their EETT grants in 2003 year. Thirteen states required a student technology literacy component in their competitive grant applications. Two states use statewide assessments of students' proficiency with technology. Eleven more states planned to begin assessing technology skills, while an additional 13 states reported that districts assessed student progress toward technology proficiency.

State technology standards help districts to work toward state-wide technology goals. Twenty-seven states have technology standards for teachers, specifying the knowledge and skills that teachers need to use technology for administration or instruction. While five states formally assessed teachers' technology skills at the state level, five other states reported that they were planning to do so. More than half of states reported providing activities related to online education, with 26 states providing online courses, tutorials, software, and other academic content and resources in core subject areas. Sixteen states reported offering Internet- or computer-based assessments of student academic achievement. An indication of the role of technology in education, the report (NETTS) stated that

> Educational technologies, when used properly and in coordination with a variety of school reforms, have been shown to enrich learning environments and enhance students' conceptual understanding. Indeed, educational systems across the country have embraced the potential of technologies to improve schooling. (p. 1)

Standards also exist at the national level. The executive summary of the National Education Technology Plan also asserted the importance of integrating technology in education:

“To achieve our goal of transforming American education, we must rethink basic assumptions and redesign our education system. We must apply technology to implement personalized learning and ensure that students are making appropriate progress through our P–16 system” (U.S. Department of Education, 2010, p. 12). Therefore, technology is an important factor in any school reform and both national and state technology standards provide measures to ensure that student technology skills are met.

Regardless of all these initiatives on the federal, state, and/or district levels, results of a national survey of America’s teachers and support professionals in public schools and classrooms, prepared by the National Education Association, indicated that while educators have enough access to technology, most educators used technology regularly at school for administrative tasks, but significantly fewer used it for instruction (NEA, 2008). Educators had access for computers and internet with less access to other technologies. While about half of the participants required their students to use technology at school for individual research and problem solving, one-third indicated that they required their students to use computers only few minutes a week (NEA, 2008). The report recommended that technology should be used in classrooms purposefully to design individualized lessons that help students develop cognitive skills through quality instruction enriched with interactive, real-time, and multimedia materials (NEA, 2008). Therefore, “the full integration of technology into teaching and learning will require a systematic and balanced approach that goes beyond just acquiring computer hardware and using limited technology skills” (Agnew, 2011, p. 55).

While the government support for using technology in classrooms has increased and more states have reported having technology standards in the last ten years, technology uses are still more for administrative purposes rather than instructional uses. Therefore, technology should be used purposefully in classrooms to develop student cognitive skills as proposed by the National Education Technology Plan.

Current Status of Technology in K-12 Education in Saudi Arabia

Information and Communication Technology (ICT) uses and applications have grown rapidly in the last decade in Saudi Arabia. According to the Ministry of Communication and Information Technology, the total number of mobile subscriptions grew to around 56.1 million by the end of 2011third quarter, with 198% growth, compared to 12 % in 2001(*ICT indicators in K.S.A. (Q3-2011),* 2011). The number of internet users grew from around one million in 2001 to about 13 million at the end 2011 third quarter, reaching to about 46% of the population compared to only 5% of the population at the end of 2001 (*ICT indicators in K.S.A. (Q3-2011),* 2011) . The five-year National Plan of Communications and Information Technology (2006), aimed to introduce computer and internet courses at all levels of education and raising the percentage of interactive electronic content to 30% of educational curricula for intermediate and higher educational levels. The plan also aimed disseminating Information and Communication Technology (ICT) systems and internet connectivity in all schools and creating a website for each school or educational institute; a portal for each academic level and a webpage for each subject by the end of 2011 (*The national communications and information technology plan,* 2006). This long-range vision plan emphasized the need for the development of educational curricula so as to include e-learning and increase the interactive digital content, which requires preparing students and other school staff to use technology properly.

Technology uses in education has been expanded in the last three decades in Saudi Arabia. Very early uses of technology in education, especially computers, were limited to administrative purposes at the Ministry of Education level for storing and processing student, teacher, and school data (Alshumaim & Alhassan, n.d.). After that, computers have increasingly been used by teachers for lesson planning and other classroom management activities and by students for writing assignments and repots. In the early of 1990s, computer literacy programs as a compulsory subject in the secondary school curriculum were introduced where schools were gradually equipped with a computer lab including about 30 computers and teachers were trained (Al-Mezher, 2006; Alshumaim & Alhassan, n.d.). To support the spread of computer literacy among the new generation, the Ministry of Education established many computer clubs in several cities (Al-Mezher, 2006). In 1999-2000 school year, the Ministry of Education decided to change school libraries into educational learning centers that were connected to the internet and equipped with computers, projectors, and other multimedia (Al-Mezher, 2006). In recent years, all schools were equipped by at least one computer lab.

In 2010, the Ministry of Education and King Abdullah bin Abdulaziz Public Education Development Project (Tatweer) signed a contract with the Microsoft worldwide program - "Partner in Learning", which aimed to support the ministry and Tatweer efforts to develop education through ICT integration. This partnership focused on training policy makers, school leaders, and teachers to gain knowledge and skills in integrating Information and Communication Technology in the learning process. According to Mr. Herzallah, Microsoft Arabia Academic Program Manager, the program's main goals include:

- Training a huge number of teachers annually (directly and indirectly)
- Arabization (translation into Arabic) of relevant material and content
- Providing teachers and school leaders with the tools and resources for the usage of ICT within education

- Running an annual competition to identify the best educational projects and give them awards. Invite them to participate in the regional and global "Partners in Learning Forum". (E. Herzallah, personal communication, March 10, 2012)

In the first year, 700 teachers (300 male and 400 female) were trained in using different Microsoft software, like Microsoft office, Microsoft publisher, Microsoft Auto Collage, Live Sky Drive, Bing Search, Microsoft Mathematics 4.0, and Microsoft Movie Maker. The teacher who won the annual competition for the best educational technology project was invited to attend the International Society for Technology in Education 2011 conference. In the 2011-2012 school year, the plan was to train 3,000 teachers. In addition, training included 21st century skills in education, project-based learning, educational games, Microsoft Photosynth, Microsoft OneNote in classrooms, and the teacher learning suite.

It was hard to find statistical data about the current status of using instructional technology in Saudi schools. Therefore, to get an understanding of this issue, studies found in the literature, which were related to using technology in Saudi schools will be reviewed.

In a quantitative dissertation, Al-Qurashi (2008) examined obstacles in using computers and the internet in teaching seventh graders mathematics in Al-Taif intermediate schools from the perspectives of teachers. Participants included 215 male mathematic teachers with a response rate of 88.3%. When comparing teacher uses of computer and internet in relation to teacher level of education (non-educational bachelor, educational bachelor, and graduate degree), the only significant difference found was in using computer for class management tasks and office applications (F (2,157) = 5.13, p= .007). Teachers with non-educational bachelor degree were the best at doing this (M= 19.38, SD= 1.82), teachers with graduate degree were second best (M= 16.0, SD= 1.79), and the least effective in doing so were teachers with an education bachelor degree (M= 13.07, SD= .76). Teachers with an education bachelor degree were the best in using computer in teaching mathematics (M= 13.07, SD= .55). In using computers for assessing student achievement, teachers with a graduate degree were the best (M= 12.38, SD= 1.70). In using internet in teaching mathematics, teachers with graduate degree were the best also (M= 16.75, SD= 2.77) (Al-Qurashi, 2008). The overall results of computer and internet uses indicated that the highest ranked use was in classroom management and office applications, which were the easiest, while uses that affected student learning more were less used and/or effective. The study also found that less experienced teachers (1-5 years) indicated more uses of computer in all types of computer uses in teaching (M= 16.09, SD= 1.41) than the more experienced ones did (more than 10 years of experience).

Participants reported several obstacles that hindered them form using computer and internet in teaching. Lack of projectors was the largest obstacle (85.6%), followed by weakness in English language skills (84.4%) and lack of instructional technology materials in Arabic (79.24%). Inappropriate places for using computers and lack of appropriate professional development in using computers in teaching (78.8%) were also mentioned as obstacles by mathematics teachers. For future studies, the researcher suggested an examination of the current status and teacher attitudes toward using computers and the internet in education (Al-Qurashi, 2008).

Alshumaim and Alhassan (n.d.) examined the current availability of ICT facilities to high school teachers of English as a foreign language (EFL) and how they used computers in their teaching. Participants included 353 male and female high school EFL teachers from six educational regions (Riyadh, Qassim, Western, Eastern, North, and South). Data were collected during the second semester of 2007, using a closed-ended survey. With a 100% response rate, the highest item ranked by participants was using internet to review updates of teaching English language (M= 3.58, SD= 1.04) (Alshumaim & Alhassan, n.d.). Participants also indicated that they used computers in teaching English (M= 2.89, SD= 1.16). The greatest barriers mentioned by participants in using technology in their teaching were: "I don't have enough experience in using computer" (M= 3.40, SD= 1.26), "no suitable software is available in the market" (M= 3.03, SD= .99), and "The Education Directorate does not provide suitable educational programs to be used in teaching English language" (M= 2.90, SD= 1.06) (Alshumaim & Alhassan, n.d.). While 83.3% indicated that they had at least one computer at home, 70.3% of participants said that there was a computer lab at their school, and more than half of them (54.4%) said that they attended a computer training program. Researchers conducted an ANOVA to analyze differences among participants in specific independent variables. One statistically significant difference (F (3,349)= 3.15, p= .025) was found between teachers who had a bachelor degree from a college of education (M= 2,94, SD= .64) and others who had their bachelor degree from a non-educational colleges ((M= 2.65, SD= .66) (Alshumaim & Alhassan, n.d.). A significance difference was also found in using Information and Communication Technology (ICT) between participants who reported availability of computer lab in their schools (M= 2.95, SD= .59) and those who did not have (M= 2.59, SD= .64). No significant difference was found between participants' different locations, which may indicate that technology facilities were fairly distributed among different regions in the kingdom.

This study is very important since participants represented varies and main educational regions in the kingdom. Even though the study focused only on using technology in teaching English language, it gave valuable information about the availability of technology in schools, especially computer lab. While figuring out obstacles to using computer and intern in teaching and learning is important, investigating the current status of using technology might be more important, especially since the time of conducting these two studies (2007 and 2008), several developments in facilitating schools with computers, internet access, and other technologies have occurred. Mr. Foudah, a computer science supervisor at the Jeddah education directorate, indicated that “today, all Jeddah schools have at least computer lab with internet connectivity” (S. Foudah, personal communication, February 28, 2012). Dr. Al-Sabti, Vice Minister of Education, stated that all Saudi schools will have internet access by the end of 2012. It would be helpful to examine a wider range of teachers in different disciplines and grades. Both studies results also showed the importance of years of teaching experience and the types of degree that teachers hold in using educational technology since significant differences were found in these two independent variables.

Closing the Gap: Curriculum Reform

Today’s teachers face the challenge of closing the gap between their school’s status quo and their students’ needs and how they learn; “one of the common causes of boredom in the classroom is students’ perception that the methods of how the curriculum is delivered to them are irrelevant to how they learn” (Jacobs, 2010, p. 199). Rather than focusing on memorization and teaching for the test, students need to be more responsible for their own learning and actively engaged, with their creativity is stimulated by facing real-life situations and acting as scientists (Jacobs, 2010; Wagner, 2008), who collectively investigate phenomena beyond school boundaries, collect data, search for and analyze information, solve problems, make decisions, interpret results, and share their findings with real audiences. *21st Century Schools* is an organization focuses on global professional development for educators and staff to adopt a 21st

century curriculum. *21st Century Schools* compared the attributes of traditional classrooms (20th century) with 21st century classrooms.

Table 2 *20th Century Classroom vs. 21st Century Classroom*

20th Century Classrooms	21st Century Classrooms
Teacher-centered, fragmented curriculum,	Real-life, relevant, project-based
Time-based	Outcome-based
Focus on memorization and learning on the lower levels of Bloom's Taxonomy – knowledge, comprehension and application	Focus on what students know and can do Learning on upper levels of Blooms' Taxonomy – synthesis, analysis and evaluation
Textbook-driven	Research-driven
Passive learning	Active learning
Learners work in isolation – classroom within 4 walls	Learners work collaboratively with classmates and others around the world – the Global Classroom
Teacher-centered and sole provider of information	Student-centered: teacher is facilitator/coach.
Little to no student freedom	Great deal of student freedom
Fragmented curriculum	Integrated and Interdisciplinary curriculum
Grades averaged	Grades based on what has been learned
Teacher is sole judge of student work	Self, peer and other audience assessments
Curriculum/school hierarchically driven	Curriculum is connected to student interests, experiences, and talents
Print is the primary vehicle of learning and assessment	Performances, projects and multiple forms of media are used for learning and assessment.
Diversity is ignored	Curriculum address student diversity
Literacy is the 3 R's – reading, writing and math.	Multiple literacies of the 21st century – aligned to living and working in a globalized new millennium.
Factory model, based upon the needs of employers	Global model, based upon the needs of a globalized, high-tech society
Driven by the NCLB and standardized testing	Standardized testing has its place

Note. Adapted from "What is 21st century education?", (2010), http://www.21stcenturyschools.com/What_is_21st_Century_Education.htm

By dissolving the isolation between schools and community and enriching classroom activities with authentic resources (Andrews, 2011), the 21st century curriculum focuses on a learner-centered approach that emphasizes learning rather than teaching. Moreover, it requires teachers to take the role of "facilitators/coaches" to enable engaging activities in the learning environment; teachers would not be limited by four walls in a "teaching/instructing" role in classrooms. In general, the new education approach values knowledge construction more than knowledge acquisition (Dori, 2007). Therefore, to support differentiated learning and help students be successful in work and their daily lives in a rapidly changing world, inquiry-based strategies like project-based learning, aided by promising new tools, should be adopted ."Using collaboration and communication tools with educational methods that also promote these skills [21st century skills]—such as project-based learning—will help students acquire the abilities they need for the future" (Solomon & Schrum, 2007, p. 18).

Saudi Arabian K-12 Curriculum Reform

Education in Saudi Arabia is centrally administrated by the Ministry of Education, which sets overall standards for the country's educational system. There are two main divisions - the Boys division and the Girls division, since the educational system is totally segregated. While the ministry is located in Riyadh, the capital city, several education directorates are located around the country to supervise the educational process. Each education directorate is divided into several districts, depending on geographical size. The educational ladder in Saudi Arabia consists of three levels; primary school (six years), intermediate school (three years), and high school (three years). At the high school level students can choose between either high schools offering art and science programs or vocational education.

As the largest oil producing country in the world, Saudi Arabia income has mostly depended on oil production, which is a finite resource. Therefore, the Saudi Government has established several economic initiatives to diversify the country's income resources and compete in today's global economy (Jenkins, 2008). As a result of acknowledging the role of education in preparing Saudis for this competitive global market, the government has established several educational reforms. "Essentially, the Kingdom of Saudi Arabia has done very well for itself to identify education as the most important driving force of development and in building a knowledge economy" (Jenkins, 2008, para. 14).

The *Development of Education Report* prepared by the Ministry of Education in Saudi Arabia and published by UNICCO (2004) stated that "the world is governed by the economics of knowledge and the power of ever renewing sciences… In addition, we face a world with complex relationships and interactions, and those who possess the knowledge, skills and will can join the march of human progress" (Ministry of Education: Saudi Arabia, 2004, p. 8). This clearly indicates that the Ministry of Education in Saudi Arabia has understood the current challenges for Saudi graduates and how important it is to prepare them with the skills that will enable them face these challenges and be ready for the future progress. Therefore, the report stated the solution for this problem which emphasized educational reform. "Changes and developments of educational systems, with its methodologies and approaches, are an urgent national strategic requirement" (Ministry of Education: Saudi Arabia, 2004, p. 8). To properly deal with the knowledge-based economy of today, the report pointed to the importance of information technology communication and student acquisition of new skills to deal with the renewable knowledge, which requires adoption of new learning and teaching methodologies integrated with new technologies.

> The educational system has no alternative to changing the way people acquire knowledge and the kind of knowledge they use. Maintaining the old ways would lead to acquiring skills and specializations that cannot meet the demands of the economy of knowledge. (Ministry of Education: Saudi Arabia, 2004, p. 9)

Curriculum development is a continual process in Saudi Arabia (Ministry of Education: Saudi Arabia, 2004). Several initiatives were tried at a tryout small scale to improve secondary education, such as *Developing secondary education* in 1975, C*omprehensive secondary education* in 1983 (Al-Romi, 2001), and *Pioneering schools* in 2002 (*Al-Qassim general* *education directorate,* 2007). All these initiatives were terminated and replaced with the *Flexible secondary education in 2005*, which is still being applied in increasing number of schools today (*Secondary education development project,* n.d.). At the elementary level, the *Primary Classes System* and the *Ongoing Evaluation System* have been applied (R. AL-Abdulkareem, 2009).

The General Project for Curricular Development was established in 2004, as a part of the Educational Ten-Year Plan (2004-2014), focused on Saudi curriculum reform with emphasis on learner needs. The project aimed to prepare students for their future life and meeting labor market needs through making fundamental and typical changes in the curriculum for it to be more suitable for quick growth and development, locally and internationally. The project also emphasized providing effective methods to accomplish educational policy. This is to be done by effectively interacting with new educational technologies, benefiting from experiences of others, specifying required skills to be learned by students at every educational level, linking information with general life, developing critical thinking methods, and developing required skills and essentials for productive work (Ministry of Education: Saudi Arabia, 2004). Regardless of all these efforts to improve the Saudi curriculum, classroom practices still haven't shown noticeable departure from traditional teaching and achievement tests are still focusing on low level skills (Aba-AlKhail, 2011; Al-Aklobi, 2008; Al-Harthi, 2007; Al-Nefaie, 2010; Al-Saadi, 2007).

As many factors in the educational field, the Saudi community, and the world around us have been dramatically changed in the last 20 years, Saudi schools can't operate as they have used to and reform become essential. Initiatives that have been tried to improve the Saudi curriculum were criticized by academics, educational experts and authorities, and community members (R. AL-Abdulkareem, 2009; Al-Nazeer, 2011; Al-Sayegh, 2009; Al-Trairy, 2009). Rashid Al-Abdulkareem, a former general manager of the Public Administration for Education Supervision department in the Ministry of Education asserted that "many indicators show that our schools face a crisis, since they are below the ambitions of those in charge of these schools, and fall short from the expectations of those benefiting from them" (R. AL-Abdulkareem, 2009, p. 2).

In 2010, the Saudi Council of Ministers, which sets national policies, approved the country's latest five-year development plan. The plan stressed the nation concern about the quality of education "One of the main issues of concern to many people in the kingdom, whether engaged in education or interested in it, for assuring quality of education ensures outputs that can contribute actively to development" (Al Bawaba, 2011, para. 35). The plan also calls for spending about $200-billion on expanding access to schools and universities, and for increasing vocational training by 2014 (Lindsey, 2010).

The U.S.-Saudi Business Opportunities Forum in Chicago held a panel featured education in Saudi Arabia explored past successes, current challenges, and future goals for the Kingdom's education system (*Chicago forum: Private sector to help reform Saudi education system,* 2012). One of the speakers was Dr. Khaled Al-Sabti, Vice Minister of Education, asserted that Saudi young graduate "need to be trained to work competitively in a knowledge and technology-based society… Now the focus is to improve the quality of education" (*Chicago forum: Private sector to help reform Saudi education system,* 2012. para. 6). Dr. Al-Sabti further mentioned the importance role that the private sector can play in education development process and the implementation of performance-based system.

King Abdullah bin Abdulaziz Education Development Project (Tatweer)

In reaction to the increasing criticism to the Saudi curricula and continues calls from stakeholders to improve the whole educational system in the country, the Saudi Council of Ministers launched King Abdullah bin Abdulaziz Public Education Development Project (Tatweer) at the beginning of 2007. Tatweer is an Arabic term, simply means reform. Taking into account the weaknesses of the previous reform programs, Tatweer aims to "achieve comprehensive educational development in public schools in The Kingdom of Saudi Arabia" (Hakami, 2010, p. 11). The project includes curriculum development, teacher requalification, and school system reform. Dr. Ali Al-Hakami, General Manager of Tatweer, further declared the aim of Tatweer is "to make students proficient in subjects such as math, science, and computer skills. This program will encourage young Saudi students to acquire better communication skills and learn to be more flexible and innovative, as well as teaching environmental literacy" (*Chicago forum: Private sector to help reform Saudi education system,* 2012, para. 8). Tatweer projected budget is $ 2.4 billion and its projected duration is six years (2007-2013). The project is independent of the Ministry of Education and will be directly supervised and reported to the king, which gives it a strong authority and independence.

Saudi education system used to be highly centralized; Tatweer main strategy adopts decentralizing the Saudi education by giving more authorities to schools and education directorates. Tatweer focal point focuses on learner needs and adopts learner-centered approach. Unlike the previous reform initiatives, Tatweer adopts a comprehensive systemic change in the Saudi education system. In addition to curriculum development, others educational aspects are addressed, including developing educational standards and assessment to fit the 21st century needs, improving professional development, and enhancing school environment to promote learning (Hakami, 2010, p. 12). In general, Schools are considered as the building block for reforming the Saudi education in Tatweer project.

International Society for Technology in Education National Educational Technology Standards

The International Society for Technology in Education (ISTE) is the premier membership organization for educators and education leaders (*About ISTE,* 2011). ISTE promotes professional development, innovation, and advancing the effective use of technology PK-12. More than 100,000 members come from across the globe. ISTE is the home of the National Educational Technology Standards (NETS), the Center for Applied Research in Educational Technology (CARET), and the National Educational Computing Conference (NECC).

National Educational Technology Standards (NETS) have served as a guide lines since 1998 for improved learning and teaching through the proper technology integration (*Standards for global learning in the digital age,* 2011). NETS have been widely adopted by U.S. educators and increasingly advocated in countries worldwide. Aiming to integrate technology across all curricula, NETS are used to help technology planning and curriculum development across primary and secondary school settings. ISTE recently led an international project involving thousands of educators and education leaders to update the NETS. The project resulted in updated standards:

- National Educational Technology Standards for Students (NETS.S): The skills and knowledge students need to learn effectively and live productively in a digital world (*NEST for students,* 2007).
- National Educational Technology Standards for Teachers (NETS.T): The skills and knowledge educators need to change the way they teach, the way they work, and the way

they learn in an increasingly connected global and digital society (*NETS for teachers,* 2008).

- National Educational Technology Standards for Administrators (NETS.A): The skills and knowledge school administrators and leaders need to lead and sustain a culture that supports digital-age learning, builds a vision for technology infusion, and transforms the instructional landscape. (*Standards for global learning in the digital age,* 2011, para. 2)

The National Educational Technology Standards for Teachers (NETS.T) has been around for more than a decade. However, little research is found in the literature about teacher use of technology in light of NTES.T. Sam (2011) examined how urban middle school teachers described their competence in the 2008 NETS.T and how they describe their use of technology to support teaching and learning. Participants included 45 teachers responded to the quantitative survey instruments and 18 teachers participated in the three focus interview groups representing three (private, charter, and public) middle schools. Urban middle school teachers in this study were found not aware of the important role technology can play in preparing students for the 21st century. In addition, teachers were "not fully competent in the NETS.T, nor have they used them as a basis to design 21st century lessons. The data show that among the three classifications of schools, urban public school teachers were less aware of the NETS.T" (Sam, 2011, p. 114). The researchers suggested further studies are needed to investigate high and elementary school teacher competence NETS.T and their use of technology to support teaching and learning.

Using multi-stage cluster sampling of all K-12 public school teachers in New Jersey, Bergacs (2008) studied teacher perceptions of the alignment of their practices in using technology with NETS.T. Results found that 144 participating teachers' technology use was adhering to NETS.T (Bergacs, 2008). While no differences were found between different teaching experience groups, differences were found significant between different subject area groups in the adherence of teacher use of technology to NETS.T. Results indicated that there were significant differences between grade level groups in their technology use in light of NETS.T, with lower grades had lower mean scores than higher grades. The research found a significant difference between respondent groups who knew about, read, and understand the standards before the survey and those who did not.

While the National Education Technology Standards for Teachers developed by International Society for Technology in Education (ISTE) has worked as a guide for teachers in technology implementation, lack of research that relates technology use to the National Education Technology Standards for Teachers is apparent in the literature. More precisely, no study could be found in the literature that examined teacher use of technology to support PBL in light of the National Education Technology Standards for Teachers in Saudi Arabia.

Theoretical Framework-Constructivism

The term "constructivism" describes student-centered, process-driven, and highly interactive instructional practices (Prawat, 1996; von Glasersfeld, 1995). Constructivism is a theory of learning based on the belief that learners construct their own knowledge and meaning from their past experience (Phillips, 2000; B. Wilson, 1996). Essentially, Vygotsky (1978) proposed that learning is a social phenomenon, in which the learner first learns by listening and observing others and with the help of others, then begins to internalize in order to be able to apply the knowledge without being helped. Hence, the knowledge becomes fully internalized, and the learner can function by herself or himself. In this fashion, learning takes place when instruction is designed to assist the learner to enter and progress across the zone of proximal development (ZPD) (Newman, Griffin, & Cole, 1989). According to Vygotsky, the ZPD is the range of activities beyond the capabilities of the learner alone but that can be accomplished in collaboration with more capable individuals.

Constructivist theory supports a learner-centered approach through the active participation of the learner in learning process while dealing with authentic situations (Krajcik, Blumenfeld, Marx, & Soloway, 1994). Rather than acquiring knowledge, constructivism suggests that learners construct knowledge based on their personal experiences and culture because learning is an active process (*Constructivism,* 2011). In such an environment, teachers act as facilitators who design engaging learning activities that help learners build new knowledge through the connection of concepts (Leder, 1993). Active participation of learner and facilitation role of teacher also improves knowledge transferability (de Kock, Sleegers, & Voeten, 2004; Dewey, 1944).

Project-Based Learning

Project-based learning (PBL) is rooted in constructivism theory, because learners are engaged in an investigation process, working on an authentic, non-trivial problem that requires them to use higher-order skills to synthesis new information into their previous experiences (Abdal-Haqq, 1998; Krajcik et al., 1994; Marx, Blumenfeld, Krajcik, & Soloway, 1997; Moursund, 2003). In addition, in PBL environment, teachers are facilitators who construct challenging driving questions, plan project activities with the help of students, monitor students' progress, offer materials, and give feedback (Markham, Larmer, & Ravitz, 2003). Furthermore, PBL enhances knowledge construction and transferability as students work on real-life situations and use cognitive tools to create tangible (physical or digital) artifacts that represent their understanding and that can be shared with real audiences (Krajcik, Czerniak, & Berger, 2003; Markham et al., 2003; Marx et al., 1997; Moursund, 2003).

Working in groups is a key characteristic of PBL, and social negotiation is essential to explore and understand a particular topic (McDowell, 2009). Therefore, PBL offers excellent opportunities for constructivist learning to occur. Small groups, peer reviews, and networking are some instructional activities that can help to create a community of learning during the project; knowledge is shared and built cooperatively (Barron et al., 1998). Moreover, learners can present their findings to real audiences such as community members to get valuable feedback and encouragement (Barron et al., 1998).

PBL's uses as a viable approach to attain educational goals has now entered the public education policy debate in the United States. High Tech High Schools, Edvision Schools, Envision Schools, and New Tech Network (previously known as New Tech High) all use PBL (Ravitz, 2008a). The Buck Institute for Education, which conducts research, provides in-services and a range of materials on PBL, stated what PBL is about:

> Students go through an extended process of inquiry in response to a complex question, problem, or challenge. While allowing for some degree of student "voice and choice," rigorous projects are carefully planned, managed, and assessed to help students learn key academic content, practice 21st Century Skills (such as collaboration, communication & critical thinking), and create high-quality, authentic products & presentations. (*What is PBL,* 2011, para. 1)

Figure 2. Project-Based Learning Elements.

Adapted from "What is PBL", (2011), by Buck Institute of Education (BIE)
http://www.bie.org/about/what_is_pbl/

In addition to constructivism, PBL also supports John Dewey's theory of active learning, which advocated teaching strategies that supported active engagement in learning topics related to their lives (Krajcik et al., 2003). PBL engages students in an investigation process to answer a driving question that addresses a real-life problem and guides and organizes project instructional activities (Krajcik et al., 2003). The project is designed around an authentic problem that allows multiple perspectives and enhances high-order thinking skills, including critical thinking, problem-solving, decision-making, self-direction, and communication skills.

Learning is a partly social activity (Markham et al., 2003), so working on project tasks requires students to form a learning community with knowledgeable members from school, such as peers and teachers, and non-school members, such as experts, parents, and other community members (Krajcik et al., 2003). Teachers in PBL are facilitators who provide the framework for learning and who design novel project tasks that insure learning transferability into situations that differ from that used for the learning itself (Capraro & Slough, 2009). Upon finishing tasks and achieving project goals, students create physical or digital artifacts to show how their understanding has developed over time and to represent their findings, sharing those findings with authentic audiences. As PBL engages students in highly complex tasks, technology helps ease accomplishing project goals.

Technology-Assisted Project-Based Learning

Proper use of technology supports successful implementation of PBL, because it helps in constructing more authentic projects. Technology facilitates searching for real data, communicating with real people, and sharing information with real audiences through the creation of appealing artifacts. Therefore, when used as a "cognitive tool" (D. H. Jonassen & Reeves, 1996; D. Jonassen, 2000) rather than an aid, technology not only increases student motivation during the project (Blumenfeld et al., 1991), but also involves students in a high-level cognitive process that leads to gaining 21st century skills, such as cooperation, problem solving, and decision making. Technology helps to create more motivating, engaging, and interactive learning materials that ensure the active participation of learners. Technology achieves the goal of student-centered learning by giving learners control over the type of information they access, the order in which topics are covered, the format of data presentation, and the pace of learning (Dror, 2008).

Various wireless technologies, such as tablets and handheld devices, such as mobile phones, allow students to access data sources and communicate with peers and experts as they work on problems (D. Jonassen, Howland, Marra, & Crismond, 2008). Moreover, technology use enhances the authenticity of the project tasks through accessing real data sources and communicating with project team synchronously or asynchronously. Motivation and project authenticity also increase through virtual tours and "field trips" (e.g., Google Earth, webcams, etc.) (Prensky, 2010).

Student engagement increases as students create digital artifacts that represent their understanding: websites, digital portfolio, or attractive multimedia products. Technology advances make it easier to build a learning community while working on projects through collaboration and sharing. For example, wikis and Google Docs allow learners to build knowledge collectively, while blogs help students express their ideas and reflect on their learning (Boss & Krauss, 2007).

Therefore, technology can enhance PBL in different ways; as Capraro and Slough (2009) asserted, "With the help of technology, students can confidently embark on projects requiring them to investigate, experiment, write, model scientific and mathematical phenomena, collaborate, express, design, and visualize" (p.123). In studying the impact of online tools on PBL, Ravitz (2010) found that, "the more teachers used online features the more prepared they felt and the better they were able to handle PBL-related challenges" (p. 5).

Project-based learning is effective both for student achievement and the acquisition of 21^{st} century skills (Liu, 2003; McMahon, 2008; Mishra & Girod, 2006; V. Wilson, 2000; Wright, 2009). Ravitz (2008b) studied PBL as a catalyst in high school reform. Though the study had only a 36% response rate, about 400 teachers nationwide responded to the web-based survey. The study concluded that, "PBL and high school reform are most likely mutually reinforcing, with PBL helping to engage students in the community and to personalize their learning, and an emphasis on these reforms potentially leading teachers to try more PBL" (Ravitz, 2008b, p. 12). Buck Institute for Education (BIE) researchers found several gaps in the literature on PBL, including "…[the] need to know more about how expert PBL teachers create and manage projects…We need to learn more about the ways technology can add value and extend learning in PBL" (Mergendoller, Markham, Ravitz, & Larmer, 2006).

PBL is being adopted more widely, especially with increased calls from educators and stakeholders for school reform to adequately prepare students for work and life. In addition to its use in reform schools in the United States, like New Tec Network (NTN), have adopted technology-assisted PBL as the norm instructional strategy. These schools are considered exemplary for both PBL and technology integration (Ravitz, 2008b). Based on the results of the PBL nationwide survey (Ravitz, 2008b), Ravitz (2008 a) compared the responses of teachers in the four small high school reform models – New Tech High, High Tech High, Envision Schools and Edvision Schools – with traditional schools in the study. The researcher found that reform schools were designed to support PBL implementation and that teachers in reform model schools were significantly better in their PBL practices than teachers in other traditional schools. For example, "63% of teachers in the reform model schools said students spent ¾ or more of their time conducting projects, compared to 14% of teachers in the other schools" (Ravitz, 2008b, p. 2). More specifically, 68% of NTN teachers indicated that their students spent ¾ or more of their time conducting projects.

In a case study, Freshwater (2009) investigated one New Tech Network school in North Carolina. The study focused on the challenges of implementing PBL. The study also examined how the school addressed these challenges and the impact of PBL on academic achievement. Technology was used for conducting research and creating digital artifacts and presentations. Participants included administrators, staff, teachers, and ninth and tenth grade students. The four participating teachers were classified as highly qualified teachers by the North Carolina Department of Public Instruction. Qualitative data were collected through interviews, direct observations, and school documentations.

Resource availability (e.g., computer and reliable internet access) and curriculum related issues (e.g., methods, team teaching, collaboration, and assessment) were found the most challenges for school stakeholders. While seeking grants and business partnership were planned to address some challenges, curriculum related issues were perceived as hard to be changed in the near future. Participants perceived technology-assisted PBL as having improved student technology, collaboration, research, and writing skills and as having increased their motivation to learn science especially as they used technology. Since standardized tests results indicated that students did not outperform students from other schools at the district or state level, Freshwater (2009) suggested future studies include a qualitative approach to student learning at the higher levels of Blooms' Taxonomy—analysis, synthesis and evaluation, since standardized tests do not emphasize these levels of learning, as well as draw from larger populations and include schools from other geographic regions. He added that "future studies are needed to investigate exemplary practices using this approach [technology-assisted PBL] to examine strategies that other educators have used to overcome challenges to implementation" (Freshwater, 2009, p. 120). Therefore, the current study will examine teacher PBL practices in Tatweer schools in which the learning environment has been designed to support learner-centered strategies that support higher levels of learning through PBL.

Luehmann (2001) studied factors affecting secondary science teacher adoption of technology-rich project-based learning in Indiana. Using convenience sampling through email invitation to participate in the study, 30 teachers participated during the two phases of the study. In the first phase, qualitative data were gathered, including teacher comments in the form of 'think alouds' and classroom observations during teacher implementation of an internet-based science program: Web-Based Inquiry Science Environment (WISE). During this phase, six implicit factors were identified: *trust* (teachers' perceptions of the quality of the program), *teacher identities* (their characteristics related to innovation), *self-efficacy* (primarily in terms of technology and content), *teacher intentions related to process goals*, *situational constraints* (e.g., limited technology), and *contextual idiosyncrasies* (fire drills, behavioral problems of students, and technological challenges). These six implicit factors indicated that not only curricular and academic factors affect technology-assisted PBL adoption, but personal factors also do. In the second phase, factors emerged during teacher semi structured interviews were analyzed and rated, quantitatively, by teachers in terms of their importance in influencing teachers' adoption of WISE-water quality program.

Ratings ranged from -3 to +3, in which the negative score indicating the factor influencing non-adoption and the positive indicating teacher decision to adopt. Zero indicated that factor has no influence at all. Participants were asked to response to two work sheets to rate factors affect their adoption of WISE PBL program and adoption of innovation curriculum in general. Teachers identified 26 factors. Fifteen participants indicated concern about national or state standards and school curricular expectations as the most commonly listed factor affected teachers' adoption of new program like PBL. The second and third factors ranked by teachers that affected their adoption were student interest (n=13) and ease of use for students (n=12) respectively. Cost and assessment were ranked by 11 participants while 10 participants indicated concern for whether or not the program allowed for classroom customization. About one quarter of the participants identified time needed to prepare the program, content coverage, the alignment of the new program with the current curriculum, the use of technology and other supplies, and other teacher support as important factors in adopting a new program. Only four teachers indicated that technology access and reliability were important factors, also. Clustering of the 26 identified factors yielded five clusters of teacher profiles: logistically focused, subject-matter focused, scaffolded optimists, accountability focused, and pedagogically savvy.

Since the study used convenience sampling, under-representation or over-representation of the population within the sample may have occurred, which made it difficult to describe the sample population and affected generalizability (Gay, Mills, & Airasian, 2009). The researcher indicated this problem with the sample size and choosing participants in discussing the results:

> Lack of predictive power may be associated with the statistically challenging circumstances of this study, such as unequal cell sizes and a relatively small sample size. It also might be explained by the sample bias inherent in the investigation of participants who volunteered to consider an innovative curricular option. (Luehmann, 2001, p. 114)

In addition, some teachers proudly indicated their abundance of technology, while others were frustrated at the lack of technology access, which influenced their adoption of technology-enhanced PBL. Luehmann (2001) suggested that future studies were required to measure the robustness of the identified clusters in this study and to "identify influential factors in a variety of disciplines with a variety of participants" (p. 137). In future research, researcher also suggested to investigate the subjective realities by involving all teachers from two or three schools. Therefore, the current study will focus on a more homogeneous population, with a large enough sample size and use the stratified sampling technique to investigate teacher PBL practices and technology uses in Tatweer elementary, intermediate, and high schools.

In another study on PBL, a comparison of high school math, science, social studies, English, and foreign language teacher knowledge and implementation of teaching practices associated with individualized instruction, constructivist learning, PBL, and differentiated instruction was conducted in a one-to-one computing environment (Short, 2011). Short purposively surveyed a sample of 209 teachers. Participants were ISTE-registered and taught in one-to-one computing high school throughout the U.S. With an 81% response rate, *t*-test results indicated that there were significant differences between teachers' knowledge (M= 44.15) and implementation (M= 38.62) of individualized instruction, constructive learning, PBL, and differentiated instruction. For example, the mean and standard deviation for PBL knowledge were (M = 34.02, SD= 8.61) while PBL implementation was (M= 30.74, SD= 9.29). This means that though they taught in different disciplines, teachers were knowledgeable about PBL and sometimes implemented PBL in the one-to-one computing environment.

One-way ANOVA results indicated that there were no significant differences between math, science, social studies, English, and foreign language teacher knowledge of using technology, though they differed in their perceptions regarding their knowledge of one-to-one teaching practices associated with individualized instruction, constructivist learning, PBL, and differentiated instruction and their ability to implement these teaching practices in a one-to-one environment. Results also indicated there were no significant differences between teacher knowledge by discipline on individualized instruction, constructivist learning, and differentiated instruction, even though they significantly differed in PBL knowledge ($F(4,163) = 3.73$, p=<.01).

A *post hoc* Dunnett T3 test was conducted for PBL knowledge to evaluate pair-wise differences among the means. Descriptive analysis (FREQUENCY) was also conducted to examine the distribution of responses of participants to determine if there were unique in any one item regarding math and social studies PBL knowledge. Seventeen percent of math teachers indicated that they were "not at all" to "only slightly knowledgeable" on how to use laptops in their class to help promote PBL activities. Also, 15.4% of math teachers reported they were “not” or “only slightly knowledgeable” with regard to using the internet to find educational resources to provide instruction for student-assigned PBL activities.

The results of a one-way ANOVA indicated that there was a statistically significant difference for the implementation of individualized instruction, constructivist learning, PBL, and differentiated instruction among the disciplines. A *post hoc* Dunnett T3 test was conducted for all variables, including PBL, to evaluate pair-wise differences among the disciplines. A descriptive analysis (FREQUENCY) was also conducted to examine the distribution of responses of participants to determine if there were unique and important differences in any one item regarding different disciplines PBL implementation. For example, 58% or greater English teachers reported that they “frequently to almost always implement resources” for PBL while students use their laptops whereas a percentage of math teachers reported that they almost never to seldom.

The study discussed the differences among the disciplines in knowledge and implementation related to these four teaching practices to the “existing pedagogical beliefs about teaching and learning within specific disciplines that differ according to the content area” (Short, 2011, p. 110). To resolve this problem, the study emphasized the importance of providing classroom-embedded professional development opportunities to support these teaching practices implementation. In addition, the study recommended that teachers collaborate within their content areas to create best teaching practices and “understand the relationship between technology and its usefulness in improving the processes of teaching and learning” (Short, 2011, p. 118). Furthermore, the study recommended that teachers should understand the usefulness of technology in supporting these teaching practices including PBL. While Short (2011) study examined more than one learning strategy and only four subjects high school teachers, current study focuses on understating how Tatweer teachers (in all subjects and all levels) use technology to support PBL in light of the National Educational Technology Standards for teachers (NETS.T) and to examine their PBL practices, especially the school framework and the new curriculum emphasis to use more learner-centered teaching strategies supported with technology.

Project-Based Learning in Saudi Arabia

Saudi classrooms still favor traditional teaching methods (Aba-AlKhail, 2011; Al-Aklobi, 2008; Al-Harthi, 2007; Al-Nefaie, 2010; Al-Saadi, 2007). In over 2000 subject supervisor reports, teachers indicated that traditional teaching, like lecturing, was the norm at nationwide schools. In reaction to these reports, the Ministry of Education launched a program called "teach me how to learn" aimed to improve teaching methods to be more learner-centered, such as inquiry-based learning (*Teaching strategies development: Teach me how to learn,* 2010).

Thirteen emerging teaching methods, such as cooperative learning, inquiry-based learning, and role playing, have been adopted by the program. The program document clarified learner role as active participant who participates in designing learning activities, works in groups and supports peer learning, and engages in investigation process to search for and find creative solutions for real-life problems (*Teaching strategies development: Teach me how to learn,* 2010). Teacher role has been identified to be a facilitator to offer a learning environment that allows learners to safely express their ideas and opinions. Teachers design learning activities to help learners construct new knowledge based on their prior experiences. Teachers are also required to encourage learners to participate actively in group assignments like an authentic project (*Teaching strategies development: Teach me how to learn,* 2010). Clearly, student and teacher roles identified by "teach me how to learn" program coincide with PBL student and teacher roles.

The formal educational system in Saudi Arabia is relatively new. The first education collage was established in 1950 (Mutairi, 2009). As a result, there is a lack in dissertation data bases, which makes it hard to look for dissertations conducted in Saudi universities. Recently some universities have started to build such data bases, like King Abdullah Digital Library and King Fahad National Library. However, only recently published titles and some abstracts are available for the public. One good source is ProQuest data base, which helps in finding dissertations related to Saudi education that have been conducted in non-Saudi universities. Most of the dissertations conducted on topics related to applying new learning strategies in the Saudi universities were experimental studies where the focus was on examining the impact of using the new strategy on student achievement and skills (Al-Aklobi, 2008; Al-Saiari, 2010).

Yaseen and Bakhsh (2008) examined types of teaching strategies, like lecturing, demonstration, active learning, programmed learning, and inquiry-based, problem-based, project-based, and collaborative learning, that were used in Makkah middle and high girl schools. Participants included 20 science supervisors and 44 teachers. Using closed-ended questioner, researchers found that teacher-centered strategies, like lecturing and demonstration, were the most used (M= 2.30, SD= .42). Learner-centered strategies, like PBL and programed learning, (M= 2.18, SD= .41) and teacher-student interaction strategies, like discussion and exploration, (M= 2.16, SD= .37) were less used (Yaseen & Bakhsh, 2008). The significance of the differences between the uses of the three teaching strategies, as identified in the study, was not reported, which reveal no clear conclusion about what type of teaching strategies were used by intermediate and high school teachers in Makkah. The sample size was also so small to reach a strong conclusion about the population. However, general feeling might be concluded that traditional teaching methods are still pervasive in girl middle and high schools in Makkah.

In a more recent study, Al-Khalaf (2011) examined science teacher skills and applying active learning strategies. Participants included 65 female science teachers selected randomly from Riyadh girl intermediate schools. Data were collected through observation based on pre-specified criteria. Results indicated that teachers were lack of planning and preparing lesson skills associated with active learning strategies (M= 1.40), while, surprisingly, their practices were found moderately (M=1.68) fit with active learning strategies (Al-Khalaf, 2011).

Few studies were found in the literature about active learning and new learning strategies like PBL, in Saudi Arabia. One study was only found in the literature studied PBL in Saudi schools. This experimental study, which will be discussed in details in chapter II, found that technology-assisted PBL was effective in teaching 11th computer science unit in a private girl high school in Jeddah (Al-Saiari, 2010). The researcher recommended to avoid traditional teaching methods (e.g., lecturing) at high schools, which emphasize on abstraction and passive role of learners. Also, she emphasized to adopt more learner-centered methods like PBL. In addition, the study recommended examining the impact of PBL on teaching other subjects especially when supported with web technologies like Wikis. This study showed the positive impact of web-based-PBL on high school student achievement and skill. However, the study sample was very small (21 students) and the nature of the experimental design did not allow for investigating the real status of PBL adoption in Saudi Arabian schools. In addition, teacher perspectives, practices, and factors affecting technology-assisted PBL implementation haven't been examined yet in Saudi Arabian education environment.

In a mixed methods study, S. Al-Abdulkareem (2004) investigated the Saudi teacher beliefs about science and science teaching. Participants included 298 science teachers and 31 science supervisors. Participants were sampled from boys elementary, intermediate, and high schools in Riyadh. Results indicated that participant beliefs were slightly in favor of inquiry-based learning (M= 3.54 in a 5 pints scale) more than objective approach in teaching science, while their teaching practices did not reflect this view (S. AL-Abdulkareem, 2004). In their responses to open-ended questions, participants referred their less inquiry-based learning classroom practices to different factors such as class size, amount of information needed to be covered, supervision methods, and difficulty to conduct outdoor activities, like field trips. In their responses to enabling factors that would enable their work in teaching science, all participants "strongly agreed" or "agreed" on statements included: having support from other teachers (coaching, advice…), team planning time with other teachers, a decrease in course teaching load to give more time for planning, a reduction in the amount of content to be taught, using various assessment strategies, and teacher input and decision making participation. When asked how likely these factors occur in their schools, 76.60% of participants indicated that they believed these factors might occur in their schools. When asked about physical environment factors that support science teaching, 92.09 % believed technology (computers, software, and internet) would enable science teaching, while only 53.8% believed technology availability might be improved in their schools.

When it came to the student role, in general, participants indicated slight favor for active role in the learning process, while some practices had some controversial among participants. For example, statements "Student should help the teacher to plan what they are going to learn" and "Student should help the teacher to decide which activities are best for them" only about less than third of participants rated them as “almost always” or “often”. Most of participants (93.31%), “strongly agreed” or “agreed” that “professional development, workshops, conferences, etc.” would enable science teaching, while only 58.97 % believed that professional development is likely to occur in their schools. Most of Participants (more than 90%) “strongly agreed” or “agreed” on all statement of missing points in science curriculum, such as involvement of community members, scientists, academics, and parents, and administrative and supervisors support.

This study gave a great insight about beliefs and expectations of science teachers and supervisors in all school levels about inquiry-based learning. It also pointed out to enabling factors as believed by teachers and the likelihood these factors to occur in the future. While participants showed favor to adopt inquiry-based learning, different factors had hindered them. Therefore, it is important to examine teacher practices and the current situation of schools and school readiness to support new strategies, like PBL, especially Ministry of Education is supporting this type of learning strategies. Also this study only examined male science teachers. Therefore, female teacher perspectives and differences between male and female perspectives should also be examined. More important, perspectives of teachers in different disciplines needed to be investigated also.

In conclusion, curriculum reform initiatives in Saudi Arabia have adopted leaner-centered approach. However, recent studies have indicated that traditional teaching strategies are still dominant. While these studies found teachers had positive attitudes toward this type of learning, many factors were mentioned had hindered them practicing more learner-center strategies. Inquiry-based learning in general and PBL in specific have been adopted by the new curriculum started two years ago in Saudi Arabia. Therefore, it is important to examine to what extent teacher practices and school environment reflect PBL enabling factors, especially Tatweer schools model supports PBL nature.

Project-Based Learning and Technology Integration in the United States and Saudi Arabia

With the lack of studies found in the literature related to PBL and technology integration in Saudi Arabia, learner-centered methods, like PBL, adoption and technology integration studies in the U.S. and Saudi Arabia have common findings in general. With this lack, S. Al-Abdulkareem (2004) study provided good insight to some needs that should be addressed in the adoption of PBL in the Saudi schools. Similar factors affecting teacher adoption PBL or more general inquiry-based leaning in both U.S. and Saudi schools as found in S. Al-Abdulkareem (2004), Freshwater (2009), and Luhmann (2001) studies. General teacher characteristics (gender, content area, level, types of degree, and years of teaching experience) have been found to influence teacher PBL practices and technology integration in studies conducted in the U.S. and Saudi Arabia. Difference in the type of degree earned (education collage or non-education college) was found significant in teacher use of technology in teaching intermediate mathematics (Al-Qurashi, 2008) and high school English (Alshumaim & Alhassan, n.d.). While difference in years of teaching experience was found significant in using technology to teach intermediate mathematics (Al-Qurashi, 2008), It was not significant in examining the alignment of technology uses with the National Educational Technology Standards for teachers (NETS.T) (Bergacs, 2008). Also Toolin (2004) in a qualitative study of six teachers to examine what influences PBL implementation in middle and high school science classes in New York City, found more experienced teachers were more eager to apply PBL. Difference in content area was found significant in teacher knowledge and implementation of PBL and other learner-centered instructional strategies (Short, 2011). While S. Al-Abdulkareem (2004) study population included teachers from all levels, the study did not aim to compare teacher practices in inquiry-based learning in science teaching among different levels (elementary, intermediate, and high). Grade level difference was significant in examining the alignment of technology uses with the National Educational Technology Standards for Teachers (NETS.T) (Bergacs, 2008). As schools in Saudi Arabia are segregated, most of the studies are conducted on either boys or girls schools. AlZahrani (2004) examined the attitudes of Saudi high school mathematics teachers regarding using calculators in teaching mathematics, the actual use of calculators in mathematics classrooms, and the factors influenced the use of calculators in mathematics classrooms. Participants in this quantitative study included 210 male and female mathematics teachers in Jeddah high schools. Valid responses of the closed-ended survey were 149 (74 male and 75 female). The study found types of degree earned (education college or science college) were significantly affected mathematics teacher attitude towards using calculators (F (3, 143) = 18.748, P < .001) (Alzahrani, 2004). It is also found that male and female teachers do not differ significantly in their attitudes toward calculators (F (3, 143) =.972, p= .408), while they differed in identifying the factors affecting teachers in using calculators (No F value was reported) (Alzahrani, 2004). The *Education Development Report* prepared by the Ministry of Education in 2004 indicated that girls' education has outperformed boys' education in several aspects; therefore, it might be important to examine differences between male and female teachers in PBL practices and technology uses.

Saudi Arabia's Tatweer Schools Model

In 2007, the Ministry of Education signed a partnership contract with Intel to participate in Intel Education for Future Program, which is "an informal education program serving youth ages 8-16. Through this program, young people gain access to technology and learn critical thinking and collaboration skills using an engaging, project-centered approach" (*The world ahead starts here,* 2006, p. 4). The project aims to prepare teachers to plan, design, and assess lessons based on PBL. It provides teachers with professional development training modules, curriculum materials and other resources that support 21st century skills (e.g., critical thinking, problem-solving) through effective use of technology (*Intel education project,* 2011). Starting 2007-2008, the project targeted to train 120 subject supervisors as coaches from different educational regions in the country. Those coaches will train 1200 supervisors in their educational regions who will train all teachers by the end of the 2008-2009 school year (*Intel education project,* 2011). Even though, this project launched since a while, very little information is known about its real classroom implementation. Neither formal nor informal study has been conducted to examine its reality and effectiveness.

The General Project for Curriculum Development and Tatweer have put student needs and active participation as their focal point. Tatweer adopts active learning strategies, like inquiry-based, problem-based, project-based, and collaborative learning, as the norm learning strategy in Tatweer schools model and the new curriculum (*Project-based learning,* 2010). Tatweer schools new curriculum emphasizes using new educational technologies to support student collaboration work with community involvement to help them possess 21st century skills (Tatweer, n.d.). In 2010 Ministry of Education and Tatweer signed a contract with Microsoft worldwide program "Partner in Learning" to train teachers in integrating technology in PBL environment also (E. Herzallah, personal communication, March 10, 2012).

Tatweer adopts incremental change, therefore, Tatweer schools started in 2007 with 50 pilot schools nationwide (one boys school and one girls school in selected education directorates) and was expanded last year to include 30 schools (15 boys and 15 girls schools) in each seven education directorates (Riyadh, Jeddah, Madenah, Qaseem, Tabuk, Eastern region, and Sabia). Tatweer schools model aims to "Prepare schools to be appropriate place to educate and support students and help them to reach high achievement levels in a healthy, safe, and supportive environment that prepare students to be active and responsible citizens" (Tatweer, n.d.). Comparing to the old schools, Tatweer schools have more authorities and responsibilities to plan, execute, and evaluate the whole learning process.

Table 3 *Old and future Saudi Schools*

Old Saudi School	Future Saudi School
Highly dependent on Ministry of Education	Has more independency and authorities:
Works on reactions bases.	Plans, implements, and evaluates.
Principal role: mainly execution and routine bases tasks.	Principal role: leads the whole learning process.
Individuality is pervasive.	Collaborative work is the norm.
Lack of incentive system for extraordinary work of students, teachers, and staff.	Students, teachers, and school staffs are incentivized for creativity and excellence.
External (out of school) supervision system has inefficient support for teachers.	Internal supervision system leaded by school principal and department heads to offer continues support for teachers.
Less community engagement.	Wide community engagement

Note. Adapted from "General features of the strategic plan of public education in Saudi Arabia," by A. Hakami, (n.d.), http://www.tatweer.edu.sa/Ar/SFV/Documents, p. 26

With the adoption of active learning strategies supported by emerging technologies, Tatweer schools model curriculum emphasizes collaboration among learners with more community involvement where content is related to student real-life issues and problems to help them gain long-life skills (Tatweer, n.d.). In such learning environment, teachers act as facilitators who design learning activities that require using high-ordered thinking skills. School environment also allows for negotiation where diverse opinions are welcomed. Tatweer schools model also encourages using non-traditional assessments that assess both student content mastery and skills possession (Hakami, 2010). The Saudi community looks forward to Tatweer and Saudis are eager to see its effects on changing the status quo of the Saudi education and improving learning outcomes. Based on the previous studies conducted on technology-assisted PBL, to prevent Tatweer schools from a range of possible problems in technology-assisted PBL adoption, it would be beneficial to examine how PBL-enabling factors are practiced at Tatweer schools. Also it is important to investigate how technology is used in relation to the International Society for Technology in Education (ISTE) National Educational Technology Standards for Teachers (NETS.T) widely accepted technology standards.

Statement of the Problem

Project-based learning has been gaining increasing attention by educators in Saudi Arabia. While only one research conducted in Saudi Arabia examined the effectiveness of PBL on student achievement and skills, no study found in the literature investigated teacher practices related to PBL enabling factors, especially in schools that support learner-centered approach and technology integration, like Tatweer schools. Research is still needed to understand how technology is utilized to support PBL classrooms in light of ISTE NETS.T, widely accepted technology integration standards, which will serve to determine how teachers use a standards-based approach to technology use with PBL.

Purpose of the Study

This study investigated teacher practices of enabling factors in the implementation of technology-assisted PBL, in Tatweer schools in Jeddah, Saudi Arabia, which have been designed to support more learner-centered learning with technology integration. This study also explored how the International Society for Technology in Education (ISTE) National Education Technology Standards for Teachers (NETS.T) were used in Tatweer classrooms and for what purposes technology was used to support PBL in the Tatweer schools. The study was driven by the important role that PBL can play in supporting 21st century skills being adopted by the recent Saudi educational reform initiatives and the need to examine the readiness of Saudi schools to apply this type of learning.

Significance of the Study

Through examining teacher real practices of PBL enabling factors and the use of technology, this study provides information to stakeholders in the Saudi education system, particularly since Tatweer schools are an indicator of the readiness of Saudi schools to implement progressive education that supports learner-centered approach. Also, with the increase in the use of emerging technologies in PBL, this study provides a better understanding of how technology can support PBL, as well as hot to assist in making modifications in the school environment and to develop better professional development for teachers based on a formal needs assessment. No study could be located that examined technology-assisted PBL in light of the International Society for Technology in Education (ISTE) National Educational Technology Standards for Teachers (NETS.T). Such information could serve in determining how teachers use a standards-based approach to technology use in PBL.

Research Questions

This study had three research questions:

1. Is there a significant difference between Tatweer teacher general characteristics (gender, types of degree, educational degree, years of teaching experience, school level, and content area) and their project-based learning practices?
2. How are the International Society for Technology in Education National Education Technology Standards for Teachers used in Tatweer classrooms?
3. For what purposes do Tatweer teachers use technology in PBL project?

Limitations of the Study

Data from this study provides information on teacher practices in technology-assisted PBL implementation in Jeddah Tatweer schools, only. Thus, further investigation on PBL practices and technology uses to support PBL are required for other types of Saudi schools, due to differences in learning and teaching that vary by school setting.

Definition of Terms

Animoto: A video slideshow maker with music (*Animoto,* 2012).

Bachelor Degree Types: In Saudi Arabia teachers may either graduate from an education collage or non-education college, such as a Science College. Non-education graduates are allowed to teach without a teaching license.

Google Docs: "… an easy-to-use online word processor, spreadsheet and presentation editor that enables you and your students to create, store and share instantly and securely, and collaborate online in real time" (*Google for educators,* 2011, para. 1).

Higher-Order Thinking Skills: "Thinking that is complex, effortful self-regulated and judgmental" (Grabe & Grabe, 2007, p. 406).

Moodle: "A free, open-source course management system" (Solomon & Schrum, 2007, p. 66).

Multimedia: "Communication format integrating several media (text, audio, visual); most commonly implemented with a computer" (Grabe & Grabe, 2007, p. 407).

Prezi: "A cloud-based presentation software that opens up a new world between whiteboards and slides. The zoomable canvas makes it fun to explore ideas and the connections between them. The result: visually captivating presentations that lead your audience down a path of discovery" (*About prezi,* 2012, para. 1).

Subject Supervisor (Consultant): A supervisor is an out of school expert (usually a teacher with more than 10 years of experience) who visits teachers in their classrooms to evaluate their teaching performance and provides need training and other supports.

Virtual Reality: "The simulation of an environment that can be experienced visually as having width, height, and depth and in some cases can allow interaction or manipulation" (Grabe & Grabe, 2007, p. 409).

Weblog (Blog): "A web publishing method in which participants use a standard browser to add comments to a self-expanding webpage" (Grabe & Grabe, 2007, p. 403).

Wikis: "… a collaborative Web space where anyone can add content and anyone can edit content that has already been published" (Richardson, 2006, p. 8).

Chapter 2 - REVIEW OF THE LITERATURE

Chapter Overview

This chapter comprises a literature review of topics related to this study. Initially, a brief summary of the Saudi Arabia education is given followed by discussing of Saudi Arabia curriculum reform initiatives and their goals. Constructivism theory as framework for this study is described. Next, project-based learning is explained including its definition, common characteristics, and effectiveness. Then, the alignment of PBL characteristics, with the theoretical background, is summarized. After that, PBL effectiveness is discussed. The chapter then, explains how technology assists project-based learning in both U.S. and Saudi Arabia. Finally, several factors that affect project-based implementation are addressed.

Saudi Arabia Education

The Kingdom of Saudi Arabia is largest country in the Arab peninsula and covers an area of 2,149,690 sq. km and surrounded by Red Sea (West), Arabian Gulf and Kuwait, Qatar, United Arab Emirates (East), Yemen and Oman (South), and Iraq and Jordan (North) (*Royal embassy of Saudi Arabia,* 2011). The modern Saudi state was founded in 1932. Saudi Arabia is the birthplace of Islam and home to Islam's two holiest shrines in Makkah and Medina (*The world fact book,* n.d.). According to 2010 census, total population was about 27 million, including about 8.4 million expatriates (*Central department of statistics and information,* 2012).

The Ministry of Education was established in 1953 and took the responsibility for supervising public education sectors including public and private sectors including, primary, intermediate, and secondary schools (Ministry of Education: Saudi Arabia, 2004). Saudi Arabia offers free education through all stages for citizens and expatriates. The administration of the

Saudi education system is highly centralized. All educational policies are controlled by the government and supervised by the Supreme Council of Education. Curricula, syllabi and textbooks are uniform throughout the Kingdom. The Ministry of Education is responsible for building schools and equipping them with materials and other facilities, hiring teachers and paying their salaries, and in general planning for and supervising the whole educational process in the country. The Ministry includes 44 regional education divisions (Education directorates), which are responsible for schools and their region (Ministry of Education: Saudi Arabia, 2004). Educational regions vary in sizes and the number of districts each one includes. The larger ones called the general educational regions that are located in large cities like Makkah, Riyadh, Jeddah, and Dammam (Eastern Region). While boys and girls schools are segregated, each division is divided into three levels: elementary (6 years), intermediate (3 years), and secondary (3 years). Educational aims for any country reflect its beliefs and cultural values. "The objectives of Saudi educational policy are to ensure that education becomes more efficient, to meet the religious, economic and social needs of the country and to eradicate illiteracy among Saudi adults" (*Education,* 2011b, para. 1). After finishing the first high school year (10^{th} grade), students are given more freedom to pursue their study either in Art or Science track where the cumulative GPA started at this year (11^{th} grade), which determines student high school diploma final GPA. To give students more choices, especially at the secondary level, other school types are available, like vocational and Qur'anic schools, with much less percentage when compared to the dominated general high schools (*Education,* 2011b).

Even schools are segregated by gender, Saudi Arabia education epimerizes giving both boys and girls equal educational opportunities. Saudi Arabia has been able to eliminate gender discrimination in both elementary and high school levels before 2015, the recommended period assigned by UNISCO (*Education,* 2011b). According to 2010-2011 statistics, boys and girls had almost equal enrollment (see Appendix F for 2010-2011Saudi Arabia Education Statistics). Both sectors have about the same curriculum except for some subjects. For example, 10th grade common subjects for boys and girls include Islamic studies, Arabic language, mathematics, science, English language, social studies, and computer science. According to the Ministry of Education report to UNISCO, the girls education in Saudi Arabia "has outweighed in many aspects education of boys" (*Education,* 2011b, p. 16).

The school year is divided into two semesters, each of 15 weeks for instruction and two more weeks devoted for final exams. With some variation according to different levels, the school day starts at 7:00 am and ends at about 1:30 pm including seven periods, where each period lasts for 45 minutes. Except for the elementary level, students are required to pass the final exams to be promoted to the next grade or the next level. Those who failed the exam are given one more opportunity to retake the exam in the subject(s) thy failed to pass or they need to repeat the same grade. At the elementary level, comprehensive assessment is applied where students are evaluated on their performance and acquiring skills specified for each subject.

Formal Saudi education has done a great job since its establishment. While over 90% of the population was estimated illiterate in 1950 just couple years before the establishment of the Ministry of Education (Al-Romi, 2001), the literacy rate was 86.1% in 2011 (*International human development indicators,* 2011). However, it is time now to focus on quality of education, as Dr. Khaled Al-Sabti, Vice Minister of Education emphasized (*Chicago forum: Private sector to help reform Saudi education system,* 2012).

Saudi Arabia Curriculum Reform Initiatives

Curriculum development in Saudi Arabia is continues process to improve learning outcomes. Several initiatives have tried many programs that have been established and applied in a pilot small number of schools to examine their effectiveness. At the secondary level, new programs started with the *Developed Secondary Education* in 1975, followed by the *Comprehensive Secondary Education*, then *the Pioneering Schools*, and ended with the *Flexible Secondary Education*, which is being applied in an increasing number of schools today. All these types of programs have aimed to improve student readiness to college and labor market by giving students more freedom to choose appropriate curriculum they need and be responsible about their learning (Al-Romi, 2001). At the elementary level also several programs have been applied, like the *Primary Classes System* and the *Ongoing Evaluation System* (R. AL-Abdulkareem, 2009). The two main significant reforms have recently taken place in the country are the Educational Ten years Plan (The General Project of Curricular Development) and Tatweer. Both reforms look at students as the focal point and have some overlaps.

The Educational Ten Years Plan (2004-2014)

The General Project of Curricular Development established in 2004, as a part of the Educational Ten Years Plan (2004-2014), has aimed to develop school curricula with placing students at the center of the project. The Plan emphasized "Developing School Curricula according to Islamic values and with the aim of building the character of students and providing them with knowledge and systemic thinking skills, in addition to the skill of continuing self-education" (Ministry of Education: Saudi Arabia, 2004, p. 18). Several goals in this project focused on student acquisition of life-long skills such as social, managerial, and productivity skills that meet the need of labor market. Also this project emphasized on the integration of modern technologies in the new curricula “Developing the infrastructure of information technology and communications and using it in the process of teaching and learning (Ministry of Education: Saudi Arabia, 2004, p. 18). As a result of the General Project of Curricular Development many commissions have been assigned to develop subject curricula through different levels. Also different programs have been established, such as *Thinking Skills*, *The Program of Especial Education for the Gifted*, *The Cultural Activities Program*, *The Social Activities Program*, and *The Program of Sports Activities* (Ministry of Education: Saudi Arabia, 2004) Even though each program has different focus, all of them aimed to improve student learning and educational outcomes in general. However, less emphasis on life skills is still noticeable in the Saudi curricula, especially with continues use of traditional teaching strategies and more emphasis on low level learning objectives (Aba-AlKhail, 2011; Al-Aklobi, 2008; Al-Nefaie, 2010; Al-Saadi, 2007).

Despite the great political and financial support for the education in Saudi Arabia (about 20% of the budget is allocated for education), Those different programs that have been established in the country to develop the educational system and curriculum in particular have been criticized by academics and educational experts and authorities (R. AL-Abdulkareem, 2009; Al-Nazeer, 2011; Al-Sayegh, 2009; Al-Trairy, 2009) . R. Al-Abdulkareem (2009) mentioned several problems associated with these reform initiatives that have affected their success. For example, education lacks of a clear theoretical framework and definite vision that policymakers agreed upon in designing curriculum development. This leaded to unclear criteria when decisions were made to terminate some new programs, like the *Developed Secondary Education* and the *Pioneering Schools*, after a while from their establishment. Hiring unqualified teachers has also been considered an obstacle for education reform effort success.

Teaching license is not required to hire a teacher at public schools, therefore, uncertified teachers, like the ones graduated from a non-education collage can teach even they lack of pedagogical knowledge. The quality of educational college graduates is also a controversial issue (Al-Trairy, 2009). One dilemma in the Saudi education is the school buildings. Due to the inflation in population and lack of appropriate planning, the Ministry of Education has been forced to rent residential buildings and use them as schools, which causes several deficiencies in educational facilities and activities. In addition, the governmental school building design has been criticized for not offering appropriate educational environment (R. AL-Abdulkareem, 2009). While the average number of students in the classroom is reasonable (25 students), this number has become a problem in the rented residential building schools, where class size is very small, and in the urban secondary schools where the number of student reaches up to 35-40 students. This also hinders teachers from applying new teaching strategies in such crowded classes (S. AL-Abdulkareem, 2004; Basamh, 2002). As the educational system in Saudi Arabia adopts a top-down administration approach, school principals have very limited authorities, which have limited their roles to executing instructional activities and running daily school routine. Finally, there are no clear criteria to measure the fulfillment of the educational system goals, which have made it hard to evaluate school performance or new programs effectiveness (R. AL-Abdulkareem, 2009).

King Abdullah bin Abdulaziz Education Development Project (Tatweer)

Based on many challenges facing the Saudi education including globalization, global competitive economy, and knowledge rapid expansion, Tatweer aims to create a comprehensive reform in the educational system (Hakami, n.d.). The project put a strategic plan for developing country public education. The strategic plan mentioned several challenges facing the Saudi education, like high population growth, spread geographical area, large number of schools (30,400 schools), and large economy depends on time-limited resources (Hakami, 2010). Based on these factors and challenges the project stated a future vision for the Saudi Education:

- Lerner is the focal point of the learning process: working to achieve excellence in learning for all learners, according to their abilities.
- Ministry of Education role is to focus on educational planning, guiding the educational process, development of educational standards, and building quality and motivation systems.
- Decentralizing the educational process administration and giving more authorities to educational regions and schools.
- Building capacity and equipment in schools to develop the educational process and direct all its plans and programs to improve learning.
- Building human and technical capacities at educational regions to guide the development process at their schools and achieve high quality performance. (*Strategic plan for public education development in the Kingdom of Saudi Arabia,* 2011, para. 3)

The main goals for Tatweer project includes:

- Developing a system of education standards, assessment, and accountability which will fit for the 21st Century.
- Implementing the Tatweer major development programs:
    - Developing curriculum and learning materials to meet current and future skill needs.
    - Enhancing the school environment to promote learning.

- Continuing Professional Development for leaders, managers.
- Extended School Services in partnership with the wider community. (Hakami, 2010, p. 12)

Looking for excellence for all students with emphasis on quality of learning outcomes, Tatweer strategy adopts incremental change to develop systemic and sustainable educational development. Tatweer strategy highly emphasizes benefiting from international best practices with open eyes to the Saudi context (Hakami, 2010).

Figure 3. Tatweer Strategy Integrated Model.
Adapted from "King Abdullah bin Abdulaziz public education development project: Tatweer" *by* A. Hakami, 2010, P. 15.

Moving from a highly centralized system where most authorities are held by the Ministry of Education toward balanced system by giving schools more authorities, Tatweer strategy greatly focuses on a comprehensive change starts by developing schools according to clear standards and performance targets.

Tatweer Schools

The new vision of the school tends to decentralize the educational system and give schools more independency and authorities, which will help in supporting the curriculum reform initiatives. The new model that being applied at 210 Tatweer schools spread nationwide includes nine aspects. Brief summary of some of these aspects will be given to get better understanding about Tatweer schools model (Tatweer, n.d.).

Leadership and school administration emphasize that school should have its own clear vision, mission, and development plan that are built with whole school members participation. With the participation of all school members in making important decisions, clear organizational structure became essential, so each school member knows his/her rights and responsibilities. Leadership also requires creating effective communication system. Tatweer schools model adopts learner-centered learning that is supported by appropriate integration of emerging technologies. School should also offer the required equipment, instruments, and resources like computers, projectors, internet connection, and science laboratory equipment. While the school offers safe internet uses, school intranet and school website should be built to improve school members' communication and the communication with community. The school environment allows for diverse perspectives where learners are encouraged to negate and accept different opinions, which leads to building the community of learners among school members. Tatweer schools model curriculum emphasizes collaborative learning that relates content with student real-life issues and problems to help them gain long-life skills. With the appropriate use of emerging technologies and digital resources, learning activities should be designed to support using high-ordered thinking skills. In general the school building should offer supportive environment for curricular and extracurricular activities. Teachers are also required to utilize community resources to improve student learning. Tatweer schools assessment adopts "assessment for learning" rather than "assessment of learning". Therefore, teachers should use appropriate assessments that fit the intended outcomes and focus on both achievement and skills.

Student affairs department at Tatweer schools is responsible for planning special activities for gifted and low achieving students. Student behavior and disciplines are closely watched to maintain safe and quite learning environment. Finally, Tatweer schools encourage teachers to update their content and pedagogical knowledge through attending professional development offered by the school, exchanging experiences with collogues or through other resources like the internet.

King Abdullah bin Abdulaziz public Education Development Project (Tatweer) has tried to avoid previous reform initiatives weaknesses. Unlike the previous reform programs, Tatweer has a very clear vision for the development, which includes the whole educational system rather than focusing on one aspect like high school curriculum. Tatweer also created standards and performance targets that can be continually evaluated and revised. More important, with giving schools more independency and authorities, clear criteria have been set to evaluate school performances in regular bases. Therefore, community at its different levels is eager to see all these plans to become real and reflected on student learning and education outcomes.

Constructivism

Constructivism theory, which is "perhaps the most current psychology of learning" (Fosnot, 1996, p. 8), originated in the work of Lev Vygotsky (1978) and others. Constructivism theory is based on the premise that learners, when actively engaged in the learning process, construct knowledge by synthesizing the new information into their previous experiences (Fosnot, 1996; Phillips, 2000; B. Wilson, 1996; Yew & Schmidt, 2009). By relating new information to what is already known, learners will build strong "connected networks of concepts" (Marx et al., 1997, p. 342). Dewey insisted that "students, as active organism, must be involved in the establishment of objectives for their own learning" (Noddings, 2007, p. 29).

In a constructivist learning environment, learners deal with real-life situations with the help and use of different resources, such as cognitive strategies and tools (Krajcik et al., 1994). Dewey (1944) asserted that "The fact that they [students] are socially representative gives a quality to the skill and knowledge gained which makes them transferable to out-of-school situations" (Dewey, 1944, p. 205). Constructivism supports collaboration among learners to become a community of learners (Abdal-Haqq, 1998). While an inquiry approach is adopted, reaching a correct solution or answer is not the goal in constructivist learning (Abdal-Haqq, 1998). Rather, what is more important is the learning process itself (de Kock et al., 2004).

As a learner-centered approach, constructivism adopts the position that teachers act as facilitators who formulate challenging activities that encourage learners to construct knowledge and meaning from their experiences (Abdal-Haqq, 1998; Leder, 1993). This facilitation helps to improve knowledge transfer (de Kock et al., 2004). It also develops long-meaning construction that requires understanding both wholes and parts where parts are understood in the context of wholes (Naseema & Sasikumar, 2007). (Naseema & Sasikumar, 2007)Most constructivist advocators claim that, "the most important goals of learning in the school context are problem-solving, reasoning, and critical-thinking skills-the active and reflective use of knowledge, and self-regulation skills" (de Kock et al., 2004, p. 146).

Within constructivism theory, there are several conditions for learning. Learning is an active process that involves interaction among learners and requires engaging learners with real and complex topics and ideas to construct knowledge. Thus, social negotiation is considered a vital part of learning where multiple perspectives are encouraged and reflection is a key point to construct knowledge. While higher-order skills like problem-solving, meta-cognition and self-regulation are given great consideration during learning activities and assessment, effective learning needs time to occur since new information needs to be revisited, pondered, tried, and applied (Brown & Green, 2006; Mason & Rennie, 2006; Tynjala, Pirhonen, Vartiainen, & Helle, 2009)

One important contributor to constructivism is Vygotsky (1978), a Russian psychologist, who emphasized that knowledge construction is the result of thinking and doing in a social context. Learners construct meaning in a social context through their interpretation of their environment and interaction with others (Barron et al., 1998; Blumenfeld et al., 1991; Krajcik et al., 2003). One important concept proposed by Vygotsky is the Zone of Proximal Development (ZPD), which represents the distance between learner ability to learn independently and/or with help of others like teachers or peers (Vygotsky & Cole, 1978). Therefore, constructivism supports building a community of learners where not only school members (students, teachers, and administrators) but also all community members (parents, organizations, agencies, and corporations) can be part of the learning network and active shareholders in the learning process where "the schools served as a place where teams of people from throughout the community could build, not with bricks but with ideas, an environment that had the learners as the center of attention" (C. Rogers & Freiberg, 1994, p. 183). In such a learning environment cooperative learning is more prominent than competitive approach.

The ZPD can serve as a guide for curricular and lesson planning. Therefore, educators should construct learning activities that promote collaboration and interaction among learners and other members of society, such as parents and academics (Barron et al., 1998; Naseema & Sasikumar, 2007). Small groups, peer reviews, and networking are some examples of opportunities to create a community of learning, wherein knowledge is shared and built cooperatively (Barron et al., 1998). Moreover, learners can present their findings and ideas to community members outside the school boundaries to get valuable feedback and encouragement (Barron et al., 1998). Hence, learners should be given opportunities to deal with and solve real-life complex problems related to their society (Blumenfeld et al., 1991).

Revolutionary learning theories, like constructivism, which tied knowledge construction not only to thinking, but also doing in social contexts, paved the way for new instructional practices that support learner-centered learning, such as project-based learning (PBL) (Markham et al., 2003) . PBL helps 21st century learners not only learn abstract knowledge, but also gain important skills, such as problem solving, decision making, and communication, to prepare them to "learn civic responsibility and master their new roles as global citizens" (Markham et al., 2003, p. 4).

Project-Based Learning

Project-based learning (PBL) is an instructional strategy that engages students in acquiring knowledge and gaining skills through an inquiry process designed to answer real-world driving questions or problems and creating authentic artifacts that represent students understanding (Harada, Kirio, & Yamamoto, 2008; Markham et al., 2003; Marx et al., 1997; Moursund, 2003). As opposed to "banking education," wherein teachers pour information into students' minds (Freire, 1993), PBL is a type of "progressive learning" introduced by John Dewey, the father of progressive learning (Krajcik et al., 2003). PBL is a learner-centered approach that encourages active participation of learners in real-life situations (Harada et al., 2008; Krajcik et al., 2003; Markham et al., 2003; Marx et al., 1997). PBL is gaining more attention from educators in recent years, especially because it increases knowledge retention and encourages higher-order thinking skills among students (Krajcik et al., 1994).

Both project-based learning and problem-based learning are important, progressive instructional strategies that promote applying knowledge in social contexts (Barron et al., 1998), yet each has its own learning goals. While problem-based learning emphasizes finding solution(s) to a specific problem, project-based learning is a broader approach. The "project" may address a problem, but it also covers areas that are not problems (Barron et al., 1998; Capraro & Slough, 2009; Moursund, 2003). Moursund (2003) explained, "A key characteristic of project-based learning is that the project does not focus on learning about something. It focuses on doing something. It is action oriented" (p. 11).

In experiential learning environments, learners are required to interact and communicate with different resources like peers, teachers, and other community members, to address issues related to their real life. Blumenfeld et al. (1991) emphasized, "Projects can serve to build bridges between phenomena in the classroom and real-life experiences" (p. 372). Higher-order thinking skills, such as problem-solving and critical thinking, are enhanced because learners plan their projects, search for solutions, evaluate and defend their findings, and present them to the whole class and, at times beyond their schools' boundaries (Blumenfeld et al., 1991; Capraro & Slough, 2009; Marx et al., 1997; Moursund, 2003).

In the PBL environment, teachers facilitate learning and encourage active participation of learners by creating authentic content that reflects learner's real lives (Krajcik et al., 1994; Moursund, 2003). This facilitation role of teachers includes several tasks as explained in the *Handbook of PBL* (Markham et al., 2003). After orienting students to project goals at the beginning of, and frequently throughout the project, the teacher groups students appropriately to create a successful, collaborative learning environment. Then, he/she organizes the project as it progresses by reminding students about the required tasks and deadlines, collecting their products, and giving feedback to keep them on track to finish the project successfully. PBL teacher should train his/her students to be independent learners gradually. The teacher should also be close to students to guide them to make any required modifications throughout the project and to immediately clarify any concern or unclear points before the final evaluation of their work to help students recognize what they have learned.

An important aspect in PBL is assessing student achievement using appropriate tools that fit the authentic content, since trivial questions or standardized tests may not fit (Marx et al., 1997). Therefore, authentic "performance" assessments, such as student portfolios, products, performance, research papers, and presentations that capture both the learning process and the result, are suggested (Markham et al., 2003; Moursund, 2003). This type of assessment should also reflect students' understanding and learning transferability (Moursund, 2003).

Characteristics of PBL

While literature has reported several characteristics of PBL, the following are the most common ones (Barron et al., 1998; Blumenfeld et al., 1991; Krajcik et al., 2003; Marx et al., 1997):

1- Driving questions

2- Engaging learners in investigations

3- Creating communities of learners through collaboration

4- Using cognitive tools to create artifacts

Driving Question

A driving question is "a rich, open-ended question that uses everyday language to make connections with students' authentic interests and curiosities" (Weizman, Yael, & Fortus, 2008,

p. 1). The driving question is the first step in PBL and plays an important role in the subsequent steps. Since "a good driving question makes a project intriguing, complex, and problematic" (Markham et al., 2003, p. 37), it helps learners to understand what they will learn as well as directing their investigation (Barron et al., 1998). Therefore, it should be constructed carefully because it "requires multiple activities and the synthesis of different types of information before it can be answered" (Markham et al., 2003, p. 37).

Driving questions can be generated either by teachers or students (Krajcik et al., 2003). For example, "Do you support/not support the use of foam cups that is made of synthetic polymers to drink hot beverages?" is a good driving question because it meets the criteria mentioned by Krajacik et al. (2003) and Marx et al. (1997). A driving question is *feasible;* students can plan an investigation to answer it (either as a whole or as parts) through available resources like the school library and the internet (Krajcik et al., 2003). A driving question is also *worthwhile;* it is consistent with the current curricular framework and meets the standards at different levels (Krajcik et al., 2003; Marx et al., 1997). Moreover, it is *contextualized*; it encompasses real-life issues that engage learners and sustain them to continue working until the project is finished (Krajcik et al., 2003; Marx et al., 1997).

Engaging Learners in Investigations

PBL exposes learners to challenging problems (questions), since "If the central activities of the project represent no difficulty to the student or can be carried out with the application of already-learned information or skills, the project is an exercise, not a PBL project" (Thomas, 2000, p. 3). Authentic investigations, such as designing experiments, creating a web page, planning a field trip, observing natural phenomena, searching for information in different resources, collecting data outside school and analyzing them, drawing conclusions, and making decisions and defending them (Marx et al., 1997), require learners to use higher-order thinking skills to construct and transform knowledge (Thomas, 2000). Such investigative activities also require learners to examine their previous knowledge and experiences (Harada et al., 2008). In the example (using foam cups to hold hot beverages), learners must plan their investigation to make an appropriate decision by breaking the main question into sub-questions or subtasks:

- Defining polymers;
- Explaining what synthetic polymers are;
- Finding examples of different polymers in student's life;
- Relating polymers' uses to their characteristics;
- Comparing polymer usefulness and harmfulness; and finally,
- Making a decision about using foam cups based on benefits and risks.

After reviewing what they already knew about synthetic polymers, students needed to search different resources to find information on these subtasks and judge the validity of these resources with the help of their teacher. After analyzing the collected data, students can make a decision, defend it, and then present it to class peers or even post their decision on a website to be accessed community members. Such a project cannot be done individually; it requires a team effort.

Creating Communities of Learners through Collaboration

Learning occurs in a social context (Krajcik et al., 2003), and project-based learning involves different tasks during the investigation process and artifact creation. Therefore, PBL requires collaboration among different society members for learning to occur (Krajcik et al., 2003; Marx et al., 1997; Moursund, 2003). The PBL environment encourages creating a community of learners, giving opportunities for students to communicate with their peers and teacher to exchange ideas, make sense of information, extend their thinking, draw conclusions, and make decisions (Krajcik et al., 2003; Marx et al., 1997). Students may also benefit from local community members who may be experts on the phenomena under investigation. Moreover, students may present findings to community members who are actually affected by these findings. In addition, internet facilities allow students to collaborate with learners, experts, and others from all over the world who share the same project (Krajcik et al., 2003; Marx et al., 1997). Barron et al. (1998) asserted the idea of community of learners:

> Connections with other communities are an important part of what makes our work meaningful, and they almost always offer new opportunities for learning. Not only do we learn from the varieties of feedback given from audiences with different concerns such as principals, parents, and fellow academics, but we also learn about more effective ways to communicate our ideas. (p. 286)

In the example, students may conduct a brief survey of people in the school's neighborhood to explore their perceptions on using foam cups. They also can communicate with industries that make these cups and learn from them about the pros and cons; they could make a field trip to these factories. In addition, they may contact chemists from all over the world and learn about their perceptions of using foam cups. Finally, students can create a flyer on their findings and suggestions and send it to homes or post their findings on the school website.

Using Cognitive Tools to Create Artifacts

The PBL process assesses student learning and understanding through creating artifacts or products (Krajcik et al., 2003; Marx et al., 1997; Moursund, 2003). While constructing artifacts, students go through several cognitive processes: incorporating new information and integrating it into previous knowledge, connecting ideas and concepts, and reconstructing understanding if the current conceptual framework is contradicted (Laffey, Tupper, Musser, & Wedman, 1998). Students exhibit their achievements in tangible physical or digital artifacts that "can be shared and critiqued by other members of the learning community in a manner similar to the way that scientists share their work within research communities"(Marx et al., 1997, p. 345). PBL allows learners the freedom to create their own artifacts, since "it is through this process of generation that students construct their knowledge-the doing and the learning are inextricable" (Blumenfeld et al., 1991, p. 372).

Technological tools, such as computers and internet facilities, enable learners to present their artifacts in different formats including text, graphic, video, and audio, as emphasized by Marx et al. (1997):

> These technologies facilitate real-time data collection, visualization, and modeling; expand collaboration possibilities beyond the confines of a classroom; and support the construction of sophisticated artifacts. As well, the multimodal, multi-representational, and multimedia capabilities of technology not only enhance the physical accessibility of information, they facilitate its intellectual accessibility as well. (p. 346)

Computer programs, digital presentation, video documentation, multimedia, podcasting, and digital reports are just a few examples of artifacts or products that students can design to address driving questions and show what they have learned (Krajcik et al., 2003; Marx et al., 1997). Students are highly motivated by such presentations to their peers and community members (Krajcik et al., 2003). Moreover, getting feedback from experts strengthens student understanding and allows them to reflect on their learning (Krajcik et al., 2003). Through interaction with different community members, learners autonomously construct a meaningful learning experience that can be presented in the form of authentic artifacts that have applications in society. John Dewey advocated "projects as a means of learning by doing based on student self-interest and a constructivist approach" (Fallik, Eylon, & Rosenfeld, 2008, p. 566).

Alignment of PBL with Constructivism

The following table summarizes how PBL characteristics align with constructivism theory.

Table 4. *Alignment of PBL with the Theoretical Framework Background*

Project-Based Learning Characteristics	Constructivism Theory Premises
Driving Question • Authentic nontrivial problem • Generated by teachers or students • Feasible • Worthwhile • Contextualized (real-life) (Krajcik et al., 2003; Markham et al., 2003)	• Learners deal with real-life authentic problems (Krajcik et al., 1994) • Learners are actively engaged in constructing knowledge autonomously (Dewey, 1944; Noddings, 2007) • Teachers are facilitators (Leder, 1993)
Engaging in investigation: • Authentic • Using higher-order thinking skills • Examining previous knowledge • Includes knowledge construction and transformation (Blumenfeld et al., 1991; Krajcik et al., 2003; Marx et al., 1997; Moursund, 2003)	• Learners deal with real-life authentic problems (Krajcik et al., 1994) • Learners are actively engaged in constructing knowledge autonomously (Abdal-Haqq, 1998) • Knowledge is constructed by synthesizing the new information into learners previous experiences (Brown & Green, 2006; Fosnot, 1996) • Higher-order skills such as problem-solving, meta-cognition and self-regulation are given great consideration during learning activities and assessment (de Kock et al., 2004)
Creating communities of learners through collaboration with: Peers, Teachers, Parents, and Community members (Krajcik et al., 2003; Marx et al., 1997; Moursund, 2003)	• Learners construct meaning in social context through their interpretation of their environment and interaction with others (Vygotsky & Cole, 1978)
Using cognitive tools to create artifacts: • Tangible • Shared and critiqued by community members • Using technology to enhance physical and intellectual access to information and support different types of artifacts representations • Requires students to reflect on their learning (Krajcik et al., 2003; Markham et al., 2003; Marx et al., 1997; Moursund, 2003)	• Apply information in real-life situations by transforming knowledge (Dewey, 1944) • Use of authentic/performance assessment (Marx et al., 1997)

All these promising characteristics encourage educators to use PBL widely to create an effective learning environment.

Effectiveness of Project-Based Learning in Student Learning

Since achievement is related to thinking skills (cognitive strategies), using different types of thinking skills will result in different types of learning outcomes and achievement levels (Greene, Miller, Crowson, Duke, & Akey, 2004). Using deep cognitive strategies that connect new information with existing knowledge leads to a richer, more elaborative, and more coherent mental representation that consequently enhances achievement (Greene et al., 2004). Furthermore, student motivation to learn affects their choice of the cognitive strategy that they will use in their learning. Constructivist learning strategies, such as PBL, adopt such an engaging learning environment that motivates learners to use higher-order thinking skills, such as problem-solving and decision making (Blumenfeld et al., 1991; Harada et al., 2008).

Researchers have argued that PBL occurs in a social context. Learning based on contextualized knowledge, wherein learners are actively engaged in solving real-life, complex problems using cognitive tools, is a highly motivating learning experience (Blumenfeld et al., 1991). PBL also prepares students for their future working environments by focusing on important social skills such as communicating, collaborating, and negotiating with others (Tynjala et al., 2009).

In a study of ninth grade science students using a personal narrative case study, Adamson (1999) examined the effects of PBL on science education and its effects on student attitudes toward science. The researcher gathered data through teacher and student reflections, interviews, direct observations, and researcher's own personal reflections. The researcher summarized how PBL improved deeper understanding of concepts. "I have come to believe that when given opportunities, students will take charge of their own learning and pursue concepts or issues at a much deeper level than I anticipated" (Adamson, 1999, p. 95). He referred to these factors:

- Student ownership of the problem
- Opportunities to collaborate with peers and experts
- Use of technology to communicate with people outside the school community (Adamson, 1999, p. 95).

Moreover, students indicated that PBL environments, wherein they were allowed to share meaning with others, engage in investigating a problem and find solutions, enhanced their motivation and helped them to create positive attitudes toward science (Adamson, 1999).

Mishra and Girod (2006) conducted a case study of a high school science teacher and his 40 students as they designed a project on life during the Mesozoic era. With little guidance from their teacher, students worked for ten weeks to show their understanding of that era to community members, including a local newspaper, a television station, and elementary school students. To reach that goal, each student prepared himself/herself, during the investigation, to be an expert in a specific area in that era. The group prepared products that fit different audiences who attended the show. As a result of participating in such a project, students were more engaged and motivated to learn the topic. "Students surely gained a deep understanding of the core ideas of deep-time and evolutionary biology" (Mishra & Girod, 2006, p. 47) the teacher found.

Kucharski, Rust, and Ring (2005) studied the effectiveness of PBL in an elementary school where the Ecological, Futures, and Global (EFG) science curriculum, a comprehensive project-based approach to instruction, was used. Using an experimental design, the EFG curriculum was compared to traditional learning with 461 students participating in the study.

Results of standardized tests for both experimental and control groups were compared. Students were also asked to respond to the Student Satisfaction Survey (SSS). Thirty teachers also participated and responded to the Teacher Satisfaction Survey (TSS). The study results showed that students in the experimental group had more positive attitudes toward school and learning. The standardized achievement test results indicated that "the EFG curriculum may have long-term effects on academic leaning" (Kucharski, Rust, & Ring, 2005, p. 659).

Chen and McGrath (2003) studied high school science student engagement in PBL to create hypermedia documents to represent student understanding of concepts of a sub-unit on water. Quantitative and qualitative data were collected, including a questionnaire, observations, teacher and student interviews, and documents and assignments related to the project. Researchers concluded that students had shown high engagement during the project. This engagement was "important for the cognitive process of transforming information into knowledge" (Chen & McGrath, 2003, p. 416). Moreover, the study found that students achieved more organized and elaborated structures on their conceptual framework (Chen & McGrath, 2003).

In their report on implementing PBL in the Davidson County, North Carolina, school district, McGrath and Sands (2004) indicated the positive impact on student engagement and achievement in several subjects, particularly English and chemistry. Implementing PBL in a ninth grade honor English class was particularly successful. The project's driving question was "What was life like during the Vietnam War?" To address this question, students searched the literature, interviewed people who were at least 18 years old during the war, and produced a video to represent their understanding. The teacher stated that her students were highly engaged and learned much more than what they used to when using a traditional approach. She added, “My English I scores this year at East are the highest ever in ninth grade…I believe PBL was a contributor to our success” (McGrath & Sands, 2004, p. 54). Moreover, she mentioned that the teaching load was less, which allowed her to help individuals who needed assistance while others worked on designing the video (McGrath & Sands, 2004).

McMahon (2008) studied the effects of ongoing formative assessment on student achievement in high school history class using PBL approach. McMahon’s class included 12 students who responded to a pre- and post- treatment survey questionnaire to measure their attitudes toward PBL. Formative and summative assessments measured student understanding of the unit content. Results indicated that student achievement and PBL correlated positively (McMahon, 2008).

Wright (2009), in a mixed-methods study, examined the effectiveness of the Intel Essentials model of project-based learning based on the Florida Comprehensive Assessment test (FCAT) reading scores of students. Thirty-two teachers who participated in the study were divided equally into experimental and control groups. The study concentrated on middle and high school students. Results showed that students from the experimental group had significantly higher scores on the FCAT than the ones in the control group.

While traditional learning involves low order cognitive skills such as recalling and listing, PBL concentrates on high order skills that include collecting data, analyzing information, drawing conclusions, brain-storming, evaluating, problem solving, planning, making decisions, and self-reflection (Liu, 2003; V. Wilson, 2000). Several studies showed the effectiveness of PBL in enhancing higher order thinking skills.

Liu (2003) conducted a study for several years on elementary, middle, and high school students to examine the acquisition of high ordered thinking skills in technology supported PBL.

Both quantitative and qualitative data were collected. The project included a questionnaire that was developed to explain how students used design skills during the project. The cognitive skills addressed in the questionnaire included planning, searching for and presenting information, connecting ideas, audience, collaboration, mental effort and involvement, interest, and individualization (Liu, 2003). Qualitative data included using a rubric to evaluate students multimedia products and interviewing students, teachers, and in some cases, parents to explore different aspects of the project process. Results indicated that students acquired and internalized several cognitive skills including planning, searching for information, connecting ideas, importance of audience, and collaboration (Liu, 2003).

In a case study of a Hong Kong primary school, Chu (2009) studied the effectiveness of PBL in a 4^{th} grade class. The project involved a collaboration of three types of teachers, general study, language, and information technology, and the librarian. Eleven teachers, 141 students, and 27 parents participated in the study. A survey questionnaire, a semi-structured interview, and a project evaluation were the data collection methods. The PBL group got better grades on project evaluation than the traditional group. As a result of participating in this project, students showed improvement in their "academic abilities, including research skills, problem-solving skills, IT capabilities, reading and writing abilities, as well as interpersonal and communication skills" (Chu, 2009, p. 1682).

In a case study of a high school astronomy class, Petrosino (2004) explored the benefits and hurdles of incorporating advanced technology into a PBL environment and how technology affects classroom practices including curriculum, instruction, and assessment. Data came from intensive interviews of the teacher and five students, email, classroom observations, and artifact evaluation. According to the teacher, students developed a deeper understanding of the content.

In addition, stronger relationships between students and with the teacher were built, which resulted in important intellectual growth and development for students. Since students used email and web facilities to contact experts outside of the school and other students using the same program, they gained collaboration skills and built a community of learners. Moreover, the teacher used cyclic instruction and distributed of his expertise, allowing every student to be more engaged and contribute effectively to the overall class effort (Petrosino, 2004).

Karaman and Celik (2008) examined the perspectives of 29 prospective teachers who experienced PBL by designing projects to create course material related to their subjects (English, chemistry, and biology). Qualitative data were collected using an open-ended questionnaire. Participants pointed out several benefits of PBL that they encountered, including gaining lifelong skills, which cannot be taught in a traditional classroom situation, increasing self-confidence, and being more engaged during the course (Karaman & Celik, 2008).

In a study to investigate the effectiveness of PBL with the assistance of information technology for middle school science, Eskrootchi (2001) designed a science project incorporating internet facilities and simulation software. The researcher developed a questionnaire using both closed and open-ended items to measure content knowledge, student understanding and attitudes toward the project, and their computer background. In addition, more data were collected through direct observation. Results indicated no significant differences between experimental and control groups in content knowledge. In subject comprehension, the experimental group had significantly higher scores than the control group. Finally, students developed positive attitudes towards the project and its components (Eskrootchi, 2001).

In a longitudinal study, Doppelt (2009) followed and observed 128 high school students during the MECHATRONICS course. The MECHATRONICS curriculum integrates several engineering and scientific topics; 12th grade students created a capstone graduation project. Students were given the opportunity to choose an authentic project topic, plan and construct it, investigate it, and assess the findings. Projects were assessed by a university professor, who attended students' presentations and determined their final grades. In this qualitative study, data were collected via researcher observations, evaluating student portfolios, and the results of a matriculation examination prepared and evaluated by the university professor.

Research results indicated that students developed "awareness of their internal thinking processes and learn to direct their own thinking and document it" (Doppelt, 2009, p. 62). Furthermore, students showed that they could plan, design, construct and manage the project. Finally, student portfolios showed that they reached a high level of achievement (Doppelt, 2009).

PBL has also benefited students at risk. Carr and Jitendra (2000) studied the effectiveness of PBL on nine 10th-grade students who had significant educational and emotional problems and were considered potential drop outs. PBL motivated them to be active learners, providing them the opportunity to choose their own ways of learning about real problems and collaborating with others to propose solutions. Students searched several resources, including the internet, to gather information and evaluate the validity of their results. At the end of the project, students presented their findings to peers, faculty, the school principal, and the superintendent. Observing students during their work, conducting informal interviews with them, and evaluating their artifacts indicated that they had used higher order thinking skills, such as problem solving, planning, and reflecting. In addition, students had a feeling of success, accomplishment, and increased self-confidence and self-esteem. More importantly, they showed positive attitudes towards school (Carr & Jitendra, 2000).

All these studies show the effectiveness of PBL in improving learning outcomes. Well-designed PBL helps to create engaging learning environments that increase learner motivation, improve their attitudes towards learning and allow learners to use higher-order thinking skills. Chen and McGrath (2004) summarized the benefits of PBL:

> Like many other educators, we believe PBL offers positive effects in cognitive, metacognitive, affective, and social domains. Good outcomes seem to occur almost without special effort: increased student involvement, persistence, and motivation: opening up a new conceptual space for students who begin to see themselves as learners; and benefits in understanding. (p. 54)

In recent years, all these benefits of PBL found in the literature have been supported by technological advances to widen its implementation.

Technology-Assisted Project Based Learning

One of the most difficult problems teachers face in their classrooms is student boredom and lack of motivation (Nastu, 2010). Designing multimedia-rich curriculum presents an important solution; especially audio, video, and simulation content create interactive and more attractive learning materials (Nastu, 2010). In recent years, more advanced educational technology helps greatly in implementing PBL and has helped overcome some PBL challenges, especially when teachers are well prepared. Ravitz (2010) emphasized that "Teachers' development of PBL-related knowledge and the availability of implementation scaffolds are critical to the implementation and effective use of PBL" (p. 3). Technology enhances the ability to achieve key learning goals, including information acquisition, long term retention, and applications (Dror, 2008; D. H. Jonassen & Reeves, 1996; D. Jonassen, 2000). Human cognitive abilities are limited, so instructors should reduce the cognitive load by focusing on the most valuable, critical, and relevant information through the appropriate use of technology like color and animation (e.g., PowerPoint) to create meaningful and engaging learning (Dror, 2008; D. H. Jonassen & Reeves, 1996). Technology helps in creating motivating, engaging, and interactive learning materials that ensure active participation of learners, which "activates and correctly taps the cognitive mechanisms of learning, such as attention, depth of processing, and other cognitive processes" (Dror, 2008, p. 219). Giving learners freedom to choose what is more appropriate for their learning through meta-cognition by helping learners *know what they know* and *know what they need to know* is important in constructivist learning. Technology achieves the goal of student freedom by giving learners control over the order in which topics should be covered and the format of presentation (e.g., visual or auditory, texts or images) (Dror, 2008). In addition, technology supports a student-centered approach, giving learners control over the pace of their learning (e.g., repeat material, skip material and come back to it, or move forward) (Dror, 2008). Furthermore, technology helps in designing authentic projects through communication with real people, reaching real databases, and creating digital products for students to share their findings with their community, possibly through the a school website (Means & Olson, 1995).

Technology allows students to more easily search for and analyze data, communicate to foster cooperative learning even beyond school time and boundaries, and create unique artifacts to represent and share their findings with audiences in and outside school (D. H. Jonassen & Reeves, 1996). Students can search for and keep up with the latest information in various large data sources, such as data bases, virtual libraries, and virtual museums. Data analysis is easier and more accurate using statistical packages and databases like MS Excel (D. H. Jonassen & Reeves, 1996). Moreover, technological advances have made communicating with others, either synchronically (e.g., Skype or Adobe Connect) or asynchronically (e.g., email, texting), far easier. Collective knowledge construction and sharing of data among learning community members also have become quite easy using emerging social media tools like blogs, wikis, Google plus, Facebook, and Twitter. Students can join groups on Facebook or Yammer studying the same topic, follow an expert on Twitter, or even create a virtual study environment (Lockergnome, 2011). YouTube provides materials that explain topics in different and potentially easier ways. Technology helps teachers to communicate easily with other teachers, to work in groups, and to collaborate in creating units and projects. This collaboration helps overcome time issues about which teachers complain when applying PBL (McGrath & Sands, 2004). Creating hypermedia artifacts not only increases student motivation, but more importantly, it involves a higher-order thinking process that leads to improved knowledge retention and application (Chen & McGrath, 2003) "We don't combine random media elements, we make multimedia that communicate something" (Simkins, Cole, Tavalin, & Means, 2002, p. 33). Multimedia product creation helps students make a connection with the real world by designing a presentation to share knowledge with real audiences on topics that concern the students (Simkins et al., 2002). Students can use multimodal presentations to present their findings using several technological tools such as PowerPoint, animoto, digital video cameras, podcasting, Prezi, and many other tools. Furthermore, technology also helps teachers to easily perform managerial tasks (e.g., Moodle, 4teachers.com, Google calendar, eportfolios) (Blumenfeld et al., 1991; Helic, Krottmaier, Maurer, & Scerbakov, 2005) and enrich their instruction (project) through different resources that fit students learning styles (e.g., Molecular Workbench at http://molo.concord.org, Open Source Physics at www.opensourcephysics.org).

Ravitz (2010) examined how much online technologies can help using PBL. Three hundred thirty-three high school teachers nationwide were surveyed in 2007. They taught math, science, English, or social studies and confirmed using PBL in teaching these subjects (Ravitz, 2010). The study focused on using online technologies to support PBL for planning and managing projects, giving feedback, collaborating, finding examples of projects and resources, and linking with experts (Ravitz, 2010). The study found that teachers felt more prepared and could successfully implement PBL.

Marco, S. Maneira, Ribeiro, and M. Maneira (2009) studied the effect of implementing synchronous and asynchronous technology tools on a PBL college course in applied optics physic. The course included both face-to- face and online cooperative work, supported by the Learning Management System (LMS) Blackboard-Horizon Wimba to facilitate synchronous and asynchronous activities. Several educational technologies were implemented. For example, electronic conceptual maps were used to summarize project tasks. Simulation supported a virtual laboratory with virtual experimental activities. Moreover, two web forums were created to support communication and interaction among students, peer tutoring, and communication with course instructors, which leading to constructivist community of learning (Marco, Maneira, Ribeiro, & Maneira, 2009). Responses of students to an open-ended and closed-ended questionnaire indicated that they were motivated and that knowledge acquisition was supported through project development (Marco et al., 2009). In addition, participants indicated that the high quality of the LMS course content, including resources and interfaces, matched their learning needs and that the synchronous activities helped maintain their attention during the course. The researchers found that the professors also highly valued the impact of online synchronous activities (Marco et al., 2009).

In a case study that included observations and interviews of 17 teachers in their classrooms, technologies like word processing software, spreadsheet software, and documentary videos were used to support PBL implementation (Means & Olson, 1995). Teachers reported different results on regarding the impact of technology-supported PBL on students. Sixteen teachers indicated an increase in student motivation, and 11 teachers indicated improved student self-esteem (Means & Olson, 1995). Fifteen teachers found technology helped improve technical skills among students and helped students accomplish more complex tasks, and ten teachers indicated that technology increased student use of outside resources (Means & Olson, 1995). Moreover, nine teachers found technology enhanced student creativity, and seven of them found it helpful in improving student presentation skills (Means & Olson, 1995).

In a study of a software engineering college course, where Web-based PBL was implemented, several technologies were used, such as LMS, discussion forum, and multimedia authoring tools (Helic et al., 2005). After the course, teachers and more than 200 participating students were given a simple form to evaluate the use of these tools in supporting PBL implementation. Teachers found that incorporating technology helped them manage the course more easily and reduced the time required for course preparation and evaluation of student work (Helic et al., 2005). Eighty percent of students found using communication tools helpful, with an advantage over in-class work (Helic et al., 2005). Finally, most students indicated that the web-based project helped them acquire more skills than what they would have acquired in a traditional project setting. Students indicated that the tools allowed them to communicate with teachers and students, discuss results, and share ideas with others (Helic et al., 2005).

In a dissertation research study, Perera (2008) considered how teachers integrated computer-related technology to support constructivist instructional methods, like PBL, at five private high schools. In this mixed methods study, 84 teachers responded to the closed-ended questionnaire; among the respondents, 23 were interviewed, and 21 were observed in their classrooms. The researcher found that technology was used in several ways to support constructivist instructional approaches. For example, teachers used technology like SMART boards to introduce and clarify lesson themes and display multimedia content, which helped increase student motivation and encouraged them to be more focused (Perera, 2008). In addition, technology helped build students prior knowledge through reading assignments on teachers' websites and other online resources. Documentary movies, voice recorded material, animation, virtual laboratories, and concept maps helped to introduce new concepts, enhance student understanding, and increase authenticity. Furthermore, video conferencing tools allowed students to communicate with experts at a distance. Purposeful internet searches and information evaluation and synthesis were important knowledge construction activities during projects. To demonstrate their findings, students created different digital artifacts, including websites using *Dreamweaver*, multimedia products where video and audio editing software were used, and Microsoft Word to write research papers. A SMART board was used to display student products and allowed peer critique. Students gained many social and computer skills through interaction with teachers and peers and using different technologies. The researcher concluded, "Teachers facilitate[ed] student use of technology for communication with others, designing/creating/innovating skills, and thinking critically about real-world problems" (Perera, 2008, p. 118) .

WebQuest is a compelling web-based and inquiry-oriented learning approach that has become popular in recent years (Oliver, 2010). It was first developed in 1995 by Bernie Dodge at San Diego State University (Dodge, 2007). WebQuest uses web resources and steps suggested by teachers to perform project tasks and are described as scaffolded (Grabe & Grabe, 2007) . WebQuest supports a constructivist approach and enhances critical thinking skills because it requires students to cover authentic topics and break projects into meaningful tasks (Grabe & Grabe, 2007; Oliver, 2010). Oliver (2010) investigated the impact of WebQuest activities, delivered through multimedia, on 5th graders science content knowledge and higher-order thinking skills development. In this quasi-experimental design, 117 students and four teachers participated. While the traditional group and WebQuest group scores were similar on a pre-test, the treatment group scored higher on a post-test. However, the higher post-test results were not statistically significant, so the researcher concluded that the WebQuest activities had no effect on student content knowledge. Teachers' responses to a closed- and open-ended questionnaire indicated that teachers perceived WebQuest as beneficial in supporting student higher-order thinking and social skills, such as problem-solving and collaboration (Oliver, 2010).

Technology advances in recent years make it easy to bring teachers and students with different backgrounds from different countries together in collaborative projects focused on real global issues; "digital tools make it easy for students to share their work and exchange ideas with diverse audiences, including family members and peers, local community members, and even much wider world" (Boss & Krauss, 2007, p. 127). Students can communicate with experts from all over the world using different technologies and ask questions related to the phenomena under investigation. For example, a ninth-grade biology teacher arranged for his students to interact with marine scientists at the University of Delaware who were conducting a deep-sea expedition (Boss & Krauss, 2007). Students from all over the world had a chance to communicate with the researchers in this project and ask real-time questions via video conferencing tools. More than being exposed to an authentic situation, students experienced a deep cognitive learning opportunity through preparing rich questions that reflected their understanding of the oceanography unit that they were studying.

Union (2011) examined the effects of using Web 2.0 tools on student relationships related to ethnocentrism in a cross-cultural global learning environment. Data came from interviewing classroom coordinators, student responses to open-ended questions about working with people from other countries, and online wiki discussions among more than 300 high school students representing ten classrooms from countries including the United States, Canada, Qatar, Pakistan, and South Korea for the Net Generation Education Project in 2009-2010 (Union, 2011). Students were assembled in heterogeneous groups with each group assigned a coordinator and a facilitator. While the wiki was used for sharing and discussing ideas among groups, videos were developed by different groups to present findings. The researcher concluded that:

> Working patterns related to ethnocentrism were positive when using Web 2.0 technologies. Moreover, I found that students were willing to work and socialize with students from other countries. Finally, the positive working relationships outweighed the negative working relationships during these global collaborations, and ethnocentrism was deemed minimal in most cases. (Union, 2011, p. 111)

Recent technology advances, especially when used as cognitive tools, are helpful for successfully implementing PBL because they increase project authenticity. In addition, technology has made it easier to find data, communicate with real people, and share information with real audiences through the project final product. Using technology to support PBL increases student motivation and involves them in a high-level cognitive processes that lead to gaining 21st century skills such as cooperation, problem solving, and decision making.

Technology- Assisted Project-Based Learning in Saudi Arabia

Several initiatives have been applied toward applying more student-centered strategies to improve the Saudi education and student outcomes. However, very few studies were found in the literature about the new learning strategies like inquiry-based leaning and PBL. Most of the studies found used experimental design to examine the impact of using the new teaching strategy on student achievement and skills. Only one study was found in the literature focused on the effectiveness of PBL in a Saudi school.

In a quasi-experimental study Al-Saiari (2010) examined the impact of web-based PBL on improving problem-solving skills and achievement of 11^{th} graders at a private girl high school located in Jeddah, Saudi Arabia. Based on PBL characteristics, the researcher designed a website to teach a Visual Basic unit. The researcher designed an achievement test and a test to examine student problem-solving skills. Pre and post tests were conducted for 21 participants and significance of differences were examined using *t*-test. Results of problem-solving skills test indicated that there is a significant difference between pre and post test results in favor for pretest (t (21) = 5.46). Post-test mean and standard deviation were (M= 9.48, SD= 4.26), while they were (M= 4.38, SD= 2.67) for pre-test. Results indicated that there was a significant difference between pre and post achievement tests also (t (21) = 5.718) where post-test was better. Mean and standard deviation were: post-test (M= 13.38, SD= 4.99), pre-test (M= 7.90, SD= 3.30) (Al-Saiari, 2010).

Al-Awad (2007) studied the impact of teacher using high cogitative-ordered questions in teaching sixth grade science at an elementary school in Asser region. Students were divided into two groups; experimental (64 students) and control (62 students). Experimental group was taught the electromagnetic unit using a strategy uses high cognitive questions, while the control group was taught the same unite using traditional method. Pre and post achievement tests and instrument to test the use of inferential thinking skills were applied. Results indicated that experimental group was better in post-test results in both achievement and inferential thinking skills tests at a significance level of .05 (Al-Awad, 2007).

Aba-Alkhail (2011) examined barriers of using new teaching strategies in teaching home economics at Riyadh girl intermediate schools. Participants included 116 female teachers and 89 supervisors. Data collected using closed-ended questionnaire. With about 40% response rate, the study found that collaborative learning was the most modern strategy used by participants (30%). Several barriers were mentioned, such as lack of supportive learning environment at schools, large number of students per classroom, and the time needed for modern teaching strategies (Aba-AlKhail, 2011).

Al-Saadi (2007) studied the effectiveness of problem-based learning in improving student achievement and critical thinking skills. Participants were 10th grade biology students in Besha city. Students were divided into experimental group (60 students) and control group (65 students). Results indicated that experimental group students were better in achievement test and critical thinking skills test scores (Al-Saadi, 2007).

Basamh (2002) investigated the principal and teacher attitudes toward cooperative learning implementation in girls' private middle schools in Jeddah. Participants included 30 principals and 225 teachers. In this study a closed-ended survey was utilized to collect data where response rate reached 98%. Attitudes of most principals (83%) towards cooperative learning were positive with willingness to support its implementation in their schools. Eighty three percent of principals believed that teachers at their schools would implement cooperative learning. The study identified four types of cooperative leaning: Student Team Achievement (STAD), Jigsaw II, Group Investigation, and Numbered Heads Together. On a scale ranges 1-4, most of teacher responses indicted positive attitude towards all cooperative leaning identified in the study (M= 2.85, SD= .72). Teachers identified amount of curriculum to be covered, limited class time (45 minutes), number of students per class, classroom size and physical arrangement of students in the classroom, and student lack of skills as obstacles to apply cooperative learning (Basamh, 2002).

Regardless of the difficulty to find the full text of these studies, reviewing their abstracts could give an idea about the current use of modern teaching (learning) strategies, such as PBL, problem-based learning, and cooperative learning. The nature of experimental studies does not help to get wider understanding about the extent of applying these strategies the Saudi education environment, teacher attitudes toward applying such strategies, and the readiness of the Saudi schools for applying more learner-centered strategies. However, these studies could conclude that these strategies are effective at different levels in Saudi Arabia schools since these studies found the new strategies have helped in improving student achievement and skills.

Factors That Affect Project-Based Learning Implementations

Despite its positive effects on student learning, PBL is still not widely implemented (Kramer, Walker, & Brill, 2007). Applying PBL requires changes in both teacher and student practices; these changes can present challenges that may decrease the chances that teachers will adopt and apply PBL widely in their classrooms. This section concentrates on discussing what affects PBL implementation, including teacher beliefs about learning and teaching, content and pedagogical knowledge, time, curriculum, school culture, professional development, technology skills, and technology access.

Teacher Beliefs about Teaching and Learning

Teacher beliefs about curriculum, content, instructional strategies, student engagement and success, and the evaluation system vastly affect attitudes toward new educational initiatives, like integrating technology or implementing inquiry learning such as (PBL) (M. Rogers, Cross, Gresalfi, Trauth-Nare, & Buck, 2010). Marx et al. (1997) asserted, "If the innovation is derived from theory that is divergent from that which underlies the teacher's established practices, then the teacher's beliefs and assumptions about learning might also need reexamination" (p. 347). For example, it's very difficult for a teacher who adopts teacher-centered learning to allow students to take responsibility for their own learning through self-investigation and/or planning to build their own new knowledge.

Rosenfeld and Rosenfeld (2006) investigated the relationship between teacher response to a constructivist learning environment and his/her own individual learning differences (ILDs). The study included 16 middle-school science teachers wherein ILDs were measured by two style inventories. Data from the results of the two style inventories, questionnaires, field notes, and interviews, were collected and analyzed. The study found that teachers who preferred "the right answers" and to teach science facts "thinking-watching," assimilator style teachers, were more tied to traditional teaching rather than PBL environment. On the other hand, teachers who preferred "thinking-doing and applying" to teach science, converger style teachers, preferred teaching science in a PBL environment rather than the traditional one (Rosenfeld & Rosenfeld, 2006).

In a multiple case study, M. Rogers et al. (2010) studied one mathematics and two science teachers' experiences in their first year of using PBL at the high school level. One participating teacher believed that covering content is more important than gaining 21st century skills and that the teacher is the subject while students are objects who learn by repetition; this teacher, was very uncomfortable with using PBL. On the other hand, a participant who advocated PBL believed in the importance of helping students to participate actively and gain 21st century skills under the guidance of their teacher. Researchers concluded, "The teachers' orientations served as the guiding force in their decision to be a part of the PBL team, as well as the degree of fidelity with which they implemented PBL" (M. Rogers et al., 2010, p. 16).

Another important issue related to teacher beliefs is the type of evaluation and assessment system he/she adopts in the PBL environment. PBL outcomes cannot be assessed by the traditional evaluation system, which requires recalling or applying information that has been poured into students' minds by teachers. PBL requires teachers to adopt a mastery evaluation system (Blumenfeld et al., 1991), which assesses student acquisition of the intended skills during the whole project, especially during the artifacts creation step.

Content Knowledge

Teachers who have less experience with different forms of instruction will manage PBL features poorly (Krajcik et al., 1994). This problem grows if teachers lack content knowledge, which affects the teacher ability to select appropriate driving questions and construct suitable motivating PBL activities (Blumenfeld et al., 1991; Feldman, Konold, & Coulter, 2000; Krajcik et al., 1994; Krajcik et al., 2003). Blumenfeld et al. (1991) stressed,

> Project-based instruction affords exciting opportunities for teachers and students to explore problems in depth and to draw on concepts across subjects. However, these opportunities assume that teachers possess knowledge of content included in projects, understand how to explain or illustrate content and teach learning strategies, and hold

belief systems compatible with a constructivist approach to teaching and learning. These requirements are not easily met. (p. 382)

Six teachers were observed in a qualitative study to examine what influences PBL implementation in middle and high school science classes in New York City (Toolin, 2004). Among the teachers who were observed, the two least experienced ones rejected to implement PBL. The researcher emphasized the importance of teacher experience in accepting and implementing PBL. "Most new teachers focused on classroom management, lesson and unit planning, and New York State Regents examination preparation. More experienced teachers focused on refining cooperative grouping strategies, integrating literacy strategies, and developing science projects" (Toolin, 2004, p. 181). The researcher concluded that what caused these two first year teachers to reject PBL was their lack of experience and not attending the PBL workshop (Toolin, 2004).

Therefore, to insure student motivation during the project process, project topics should be selected very carefully (Blumenfeld et al., 1991). Also, teachers should be trained to design the driving question accurately and precisely to help them properly scaffold question generation skills to their students (Krajcik et al., 1998) and make sure that students completely understand the goals of the project. This requires that teachers possess deep content knowledge to link different concepts addressed by the project (Blumenfeld et al., 1991). To expand and be more confident in their content knowledge, teachers can use each project as a good opportunity to read more and find information related to the project topic in different resources including books, magazines, and internet resources. Furthermore, teachers can ensure that their content knowledge is current by joining a professional development organization and attending its workshops and conferences (Krajcik et al., 2003).

Pedagogical Knowledge

Teachers with weak pedagogical knowledge tend to narrow motivation to "developing positive attitudes rather than enhancing cognitive engagement" (Blumenfeld et al., 1991, p. 382). Teacher experience also affects their ability to control the unstructured activities required by PBL and to balance the level of scaffolding they will give to support their students learning (not too low modeling, not too much independence) (Marx et al., 1997). Therefore, teachers should also have sufficient pedagogical knowledge to help them understand how to support students learning, engage them in high level cognitive activities, create a learning environment that fits learner needs and styles with the appropriate use of technology, and manage the classroom in accordance with PBL requirements. Teachers must also be very familiar with carrying out an investigation to properly guide students in their observations, manipulation of variables, data search and analysis, and conclusions drawn during the project (Krajcik et al., 2003). "Like a master craftsman, the teacher should scaffold instruction by breaking down tasks, use modeling and coaching to teach strategies for thinking, provide feedback, and gradually release responsibility to the learner" (Marx et al., 1997, p. 343).

Teachers can improve their pedagogical knowledge by attending sessions that focus on inquiry learning. They also can observe teachers who apply PBL effectively or invite an expert to observe them while applying PBL (Krajcik et al., 2003). Furthermore, the World Wide Web has professional development resources that can help teachers improve their implementation of inquiry learning.

Time

Compared with traditional learning, PBL requires more time to achieve its goals, so time is important factor in implementing PBL (Hung, Bailey, & Jonassen, 2003; Laffey et al., 1998;

Marx et al., 1997). In a PBL environment, students usually need more time to finish the required activities, which is a problem with a 45 minute class period limit (Luehmann, 2001). In addition, this problem becomes more critical when associated with district guidelines to cover specific curriculum content (Marx et al., 1997). McGrath and Sands (2004) emphasized, "The hardest thing for high school teachers is the pressure they feel from end-of-course exams" (p. 52). In Basamh (2002) study, 84% teachers believed amount of content to be covered was identified as an obstacle in cooperative learning while 81% identified limited class time (45 minutes) also. In their response of open-ended questions, teachers in S. Al-Abdulkareem (2004) study, mentioned class size and amount of content to be covered would hinder their inquiry-based leaning implementation. Of course, engaging in a collaborative investigation process, which includes planning, searching, analyzing, making decisions, and creating artifacts to present project findings, is time consuming and affects curriculum content coverage. Since knowledge is endless, no curriculum content can provide learners with full understanding of content's breadth (Hung et al., 2003). Therefore, it is more important to provide learners with skills that allow them to take responsibility for building their own knowledge in an age where knowledge is easily obtained.

One-fourth of the thirty participants in Luehman (2001) study indicated that time and the quality and quantity of the content coverage were among the factors that concerned them in implementing PBL in their classrooms. Toolin(2004) mentioned that one of the six participating teachers resisted PBL because of lack of time: "limited amount of time that she had to 'cover' the Regents syllabus for chemistry and biology and to prepare her students for the comprehensive Regents examinations administered in June" (p. 184). Among the four participating teachers in Freshwater (2009) study, only one mentioned that technology-enhanced PBL needs more planning and assessing than the traditional approach.

Curriculum

Even though lack of time creates a problem with content coverage, the literature discusses other concerns related to curriculum. As students in PBL spend more time studying a specific area of the content, they may not be able to cover a wider range of information or acquire factual knowledge that is stipulated in the curriculum (Hung et al., 2003; Krajcik et al., 2003; Marx et al., 1997). Another curriculum-related problem is how teachers can effectively sustain a balance between PBL, which requires students to move, talk, and do different tasks freely, and the need to keep order in the class (Marx et al., 1997). Standardized tests, national standards, and state standards also concern teachers when implementing PBL (Marx et al., 1997). Objective tests cannot assess PBL outcomes properly, because such tests concentrate on assessing factual knowledge. Therefore, teacher commitment to prepare students for state assessments hinders them from applying authentic assessment, which is more appropriate to PBL outcomes. In addition, authentic assessment usually requires more effort to be prepared and scored. Insufficient student investigative skills, questions, planning, analyzing data, and drawing conclusions, are some of the other deterrents to implementing PBL (Edelson, Gordin, & Pea, 1999). Furthermore, students usually resist new learning environments that require more effort than memorizing and answering questions at the end of the chapter (Krajcik et al., 2003). Blumenfeld et al. (1991) asserted, “Students often are resistant to tasks that involve high-level cognitive processing” (p. 374). Fifty nine percent of participating teachers in Basamh (2002) study, indicated number of students per classroom would hinder them from implementing cooperative learning while 40% reported student lack of skills would hinder them also.

In the Freshwater study (2009) of the New Tech High school in North Carolina, curriculum issues were mentioned most frequently by the four participating teachers. The teachers claimed that because all students were placed in college prep classes, their previous work did not prepare them well study for hands on work. Teachers added the students lacked cooperative skills essential to complete project tasks (Freshwater, 2009). Students themselves identified curriculum as the second most important challenge in their experience with PBL. They mentioned that students must do more work while teachers are not doing enough. From observations, the researcher noted, “Balancing the amount of facilitation necessary for students to achieve expected goals was another challenge” (Freshwater, 2009, p. 78). Furthermore, students needed closer monitoring to ensure that they achieved the intended goals of the project.

In Luehmann study (2001), half of the 30 participating teachers voiced concerns about national or state standards and school curricular expectations in adopting new programs like PBL. Moreover, about one-third of the participants indicated that assessment and hands-on activities were other curriculum-related concerns.

In a case study, Krajcik et al. (1998) studied eight middle school students while they worked on two science projects over seven months. Students were intensively observed and interviewed. In addition, the project outcomes and documents were analyzed. The study showed that, during their investigation, students generated weak or inappropriate driving questions that concentrated on factual knowledge only. Students’ lack of experience with PBL or inappropriate scaffolding exacerbated this problem. In planning their investigation, students showed great work, but precision, especially in determining appropriate measures to be used, was lacking. During the investigation, students had trouble focusing on the main problem and managing their time to perform complex tasks with which they were unfamiliar. Finally, researchers found that students “have had limited experience organizing data, examining patterns from data, determining what the patterns mean, and justifying what they have concluded from the data” (Krajcik et al., 1998, p. 347).

Edelson, Gordin, and Pea (1999) explored the challenges of applying inquiry PBL in teaching a geosciences climate class using different types of scientific technologies. The team designing the curriculum included faculty in the Education and Computer Science departments, teachers, professional programmers, and graduate students. Data collection included observation, interviews, and journals of teachers and students. Because students usually ask for more information to complete the required tasks, one concern teachers mentioned was managing the instructional needs of an individual group as opposed to the whole class. In addition, researchers noticed that “teachers struggled to present the curriculum to their students as a coherent whole. In several cases, teachers chose to focus on the structured investigations, treating them like a traditional curriculum unit organized around a topic, not a controversy” (Edelson et al., 1999, p. 423). They also found that teachers had problems in controlling unstructured activities (Edelson et al., 1999).

M. Rogers et al. (2010) found that, although the three participant teachers considered PBL as a great way to engage students, two teachers pointed out their concerns about students mastering basic concepts of math and biology. Moreover, the biology teacher added that he needed to prepare students for exams in a PBL environment (M. Rogers et al., 2010). Furthermore, the two science teachers mentioned their concern about the high level of thinking that PBL requires, for which ninth grade students are not prepared; they also were concerned with the less structured nature of PBL activities that conflict with a rigid school schedule (M. Rogers et al., 2010).

In a Delphi study of barriers encountered by teachers implementing ICT-supported PBL in North America, Europe, and Africa, Kramer, Walker, and Brill (2007) found that only 16 of 51 barriers were statistically significant. Participating teachers ranked curriculum-related barriers fourth, after cost, teacher training and technical and internet connectivity. Curriculum factors included several items, such as time needed for students to complete PBL tasks, PBL requiring more preparation and planning time, teachers needing to devote time to preparing students for national and local tests, and students giving low priority to PBL requirements over time devoted for traditional classroom tasks (Kramer et al., 2007).

School Culture

The current status of schools, including the division of knowledge into subjects, isolation from real-life problems, requirements of the current evaluation system, and time limitations, represent another important factor in PBL implementation (Laffey, Tupper, Tusser, & Wedman, 1998). Moreover, external support, including availability of resources, principal and other staff support, and community involvement, are other aspects of the school system that affect implementation (Edelson et al., 1999; Krajcik et al., 1994; Kramer et al., 2007; Toolin, 2004).

In a qualitative study, Laffey et al. (1998) described the implementation of PBL supported by technology in teaching high school science as a part of the Missouri Supporting Teachers (MOST) Project. The study included two stages, spanning two years. In the first year, 31 students participated from one school. In the second year, more than 100 students representing three schools participated and data collected through classroom observation, teacher and student interviews, and artifact reviews. Researchers concluded that teachers were interested in implementing PBL in their classrooms, especially if it helped increase the authenticity of learning. However, "the very structure of schooling-the short periods for classes, isolated subject matters, and lone teachers in a classroom-hinder project-based learning efforts" (Laffey et al., 1998, p. 85).

Freshwater (2009) found that students ranked limited resources as the first barrier, and teachers ranked this as the second highest barrier to implementing PBL. Several resources were mentioned as important to ensure successful PBL implementation; these resources included a library, a laboratory, equipment, support staff, and involvement of community members. Furthermore, researcher observations indicated not enough budgeted to hire elective teachers, to update computers, and to have enough printers. With about 30 students in each class, physical space for group work and to store completed projects was also a problem (Freshwater, 2009).

Rosenfeld and Rosenfeld (2006) indicated that the support of the principal and other staff was vital to teachers' responses to PBL. Researchers noticed that participants were less reactive in the study when a new principal provided less support for PBL than the previous principal. Luehmann (2001) found that one-fourth of the 30 participating teachers considered the lack of external support a challenge in implementing PBL supported by technology. Examples the teachers gave of external support included: having someone to help or guide in or outside the class; finding pre-prepared instructional materials such as kits and worksheets; and participating in professional workshops (Luehmann, 2001).

To successfully implement PBL, the school system and curriculum must undergo significant reform, including administrative personnel, curriculum, learner knowledge, class structure, instructional strategies and activities, and assessment. School principals can help by giving teachers the opportunity to consult PBL coaches and technology experts and enable them to communicate with other teachers to construct cross curricular projects (M. Rogers et al., 2010); they can also offer the required materials for the project. In such reform, professional development is also important.

Professional Development

Lacking of the necessary experience and skills to implement PBL properly also hinders teachers from adopting it. In the Delphi study conducted by Kramer et al. (2007), teacher training was rated by teachers as the most significant barrier in implementing ICT PBL. This challenge included how to practice PBL implementation and use ICT and computers.

Therefore, professional development is a core element in any successful educational reform and innovation. The Southeastern Wisconsin Cooperative Educational Service Agency (CESA) No. 1 revamped the educational system in 45 Milwaukee public schools. The innovation aimed to equip students with 21^{st} century skills and to prepare them to compete and succeed in the global workplace (Devaney, 2010). One focal point in this transformation included moving from teacher-led face-to-face instruction to more student-directed, electronic, digitally blended instructional approaches. Tim Gavigan, CESA executive director, mentioned, “Educator practices, and professional development to guide educators along the way, are two of the most important components in the transformation” (Devaney, 2010). Gavigan added, “You can tinker with systems [and] funding methodologies, but if something substantial is not changed with regard to the teacher-student interaction, we have not accomplished the transformation” (Devaney, 2010). Moreover, Stephanie Hirsh, the Executive Director of the National Staff Development Council, who guided the writing of the *Status Report on Teacher Development in the U.S. and Abroad*, asserted that:

> Improving professional learning for educators is a crucial step in transforming schools and improving academic achievement. To meet federal requirements and public expectations for school and student performance, the nation needs to bolster teacher skills and knowledge to ensure that every teacher is able to teach increasingly diverse learners, knowledgeable about student learning, competent in complex core academic content, and skillful at the craft of teaching. (WEI, Darling-Hammond, ANDREE, Richardson, & Orphanos, 2009, p. 1)

Effective professional development both improves teacher knowledge and enhances instructional practices and student learning (WEI et al., 2009). Instead of giving teachers abstract knowledge on teaching, effective professional development should concentrate more on practical ways to apply specific pedagogical skills in their classes. In addition, successful professional development should be aligned with whole school system reform, including curriculum, assessment, and standards (WEI et al., 2009). As Marx et al. (1997) emphasized, "Effective teacher professional development needs to be based on a clear model of teacher growth and development that acknowledges the complexities of classroom, school, and community as settings and contexts for teachers' work" (p. 350).

Research also found that creating collaborative professional development, by involving teachers from the same grade level or school departments and experts, enhances the effectiveness of the professional development and supports learning communities both inside and outside school boundaries. Furthermore, collaborative professional development increases teacher confidence in applying the new initiative because it allows teachers to take risks while discussing problems with peers and being observed by experts (Blumenfeld, Krajcik, & Marx, 1994; WEI et al., 2009). Different collegiate activities can enhance professional communities. Teachers visit each other's classes to observe, critique, and give feedback on implementing new instructional strategies. They also can analyze student work collectively to gain a common understanding of what fits student needs in their school environment. Moreover, teachers of the same grade level or in the same department can create study groups to learn together about new pedagogical knowledge to improve their teaching (WEI et al., 2009). In S. Al-Abdulkareem (2004) study, all participants "strongly agreed" or "agreed" that having support from other teachers (coaching, advice…) and team planning time with other teachers would support their inquiry-based learning implementation.

One very effective strategy to create successful professional development is to engage teachers in the learning cycle that students would go through in their classes (Blumenfeld et al., 1994; WEI et al., 2009). This modeling type of learning allows teachers to try out the new strategy under the guidance of expert trainers, reflect on their learning, and get valuable feedback before they apply the strategy in their classes. In a national survey, researchers found, "When teachers have an opportunity to do 'hands-on' work which enhances their knowledge of the content to be taught to students and how to teach it, and it is aligned with the curriculum and local policies, they report a greater sense of efficacy" (WEI et al., 2009, p. 16). Finally, effective professional development is usually tied to time and content. The more focused content on the topic and the more time allowed for the professional activities, then the better the outcomes (WEI et al., 2009).

Toolin (2004) mentioned that two teachers changed from favoring traditional teaching to advocating PBL as a result of participating in discussions during the weekly science staff meeting and having the support of a botanist from the American Museum of the Natural History. Four participants were first or second year teachers. The two who adopted PBL in their teaching attended the quarterly PBL workshops and held a higher degree in education, while those who rejected PBL did not attend these workshops and only held a Bachelor degree (Toolin, 2004). In addition, the teacher who had ten years of teaching experience, a Ph.D. in Biochemistry, and a MS in Education, showed resistance to PBL in the beginning but embraced it later as a result of attending the four training workshops and the encouragement she felt from observing her colleagues' successes in implementing PBL (Toolin, 2004). Rosenfeld and Rosenfeld (2006) noticed that as a result of participating in the professional development workshop, the conflict between PBL coordinators and teachers decreased. Their participation caused the teachers to have a positive attitude towards PBL.

Krajcik et al. (1994) explained their work with ten middle school teachers and one elementary science teacher in iterative cycles of collaboration, enactment, and reflection as a development method to create a positive change on teachers' understanding and implementation of PBL. Collaboration between researchers and teachers allowed sharing and critique as well as professional support as they built a common understanding of PBL. Researchers, consultants, and university personnel offered pedagogical information about PBL, including scientific knowledge, educational premises and features, technological support, and content knowledge that helps in properly designing a project. Teachers, relying on their professional experiences and beliefs, provided what can be applied and what cannot be, explained challenges, and were given opportunities to apply their new skills (Krajcik et al., 1994). Teachers enacted two 6-8 week science projects, prepared by the Technical Educational Research Center, in their classes to practice what they had learned and understand the full implications of PBL. Krajcik et al. (1994) insisted, "Essentially, knowledge is transformed by action such that teachers understanding of the new practice will not, indeed cannot, be formed until the practice is enacted" (p. 492).

Finally, teachers reflected on their experiences after enacting PBL, including the difficulties they faced and how they reacted to them, strategies they used, and supplementary activities they instituted. During these cycles, dialogue and discussion continued between researchers and teachers to develop consistent practices for PBL. Data were collected from the video tapes of teachers actually using PBL, reflection journals, case reports, interviews, and audio and video tapes of the collaborative work sessions. Results indicated that teachers' perceptions of PBL improved and their PBL knowledge was enriched. Researchers concluded, "We view the development of teachers' understanding and practice as an idiosyncratic evolution" (Krajcik et al., 1994, p. 492).

In Ldewski, Krajcik, and Harvey (1994) study, one teacher who that participated in the Krajcik et al. (1994) study was further scrutinized. Connie was a middle school science teacher with a Bachelor's degree in science education and a secondary teaching certification. When she first enacted PBL and participated in the study, Connie had four years of experience teaching in middle school. Before participating in the research, she believed that in teaching science, covering content was more important than student understanding. She also believed that the teacher was fully responsible for everything in the class, including maintaining order, conveying scientific knowledge, and directing class activities. She had very little knowledge of constructivism learning theory, how to carry out and guide students during the investigation process, and no experience with PBL.

Connie believed that learning science should be fun for students, which encouraged her to participate in Krajcik et al.'s (1994) research effort. She was also intrigued by certain PBL features, particularly investigation and hands-on activities, the use of computers and other technologies, and dealing with real-life issues. Before joining the research effort, she participated in training workshops designed to help teachers use the new computer laboratory in her school, which helped improve her own computer skills. She had limited classroom facilities and many students (33). She participated, with other teachers, in the work sessions prepared by researchers to introduce PBL and was actively involved in the dialogue among the research team.

Connie's enactment of the two projects prepared by the Technical Educational Research Center was videotaped and critiqued by researchers and other participating teachers during the monthly work sessions where clarification, content, pedagogical, and technical support was also given. Through the cycle of collaboration, reflection and enactment of the first project, W*hat is in our water?,* her perception of applying investigation and PBL in science learning showed only minor positive shifts. This lack of improvement was attributed to Connie's beliefs about teaching science. However, she was eager to adapt her teaching practices to the new teaching approach, and with the support of the research team members, she adopted a more constructivist approach in her teaching during the enactment of the second project, *Acid Rain.* The researchers emphasized this improvement: "As the Acid Rain project continued, we began to see changes in Connie's practice related to fostering investigation. Several work sessions during the Acid Rain project encouraged and supported these changes" (Ladewski, Krajcik, & Harvey, 1994, p. 510). The researchers concluded that this type of professional development, which includes collaboration of teachers and experts, enactment, and reflection, is effective. In addition, results indicated the significance of teachers' prior beliefs in enacting new constructivist initiatives, because their beliefs are important to accepting new approaches. One way to help create significant change is to allow teachers to enact the new approach and participate with peers and experts in learning opportunities that lead to developing new thought (Ladewski et al., 1994).

Schneider, Krajcik, and Blumenfeld (2005) examined the initial enactment of four middle school teachers, who were given pre-prepared physics unit materials to enact in their classrooms. While the science materials were prepared using PBL premises, professional development workshops were also offered. Teachers were allowed to make changes to fit their classes, and detailed lesson descriptions included content and pedagogy information and strategies. The study investigated how real enactment looks compared to what was intended with these materials. During the summer prior to enactment, teachers were introduced to the unit, *force and motion*, at a two week conference that included 20 hours explaining the content and another 20 hours introducing PBL features. During enactment, teachers were visited in their classrooms and participated in monthly professional development workshops, supervised by researchers to discuss difficulties in enactment and technology use.

Data were mainly collected via videotaped classroom enactments. Research findings indicated that appropriate use of materials can help teachers enact a new initiative like PBL. However, the materials should be supported by professional development to help teachers plan and reflect on their enactment. Moreover, systemic changes to the school context and practices are necessary (Schneider, Krajcik, & Blumenfeld, 2005).

In M. Rogers et al. (2010) study, two of the participating teachers were involved in summer professional development, where they widened their pedagogical knowledge, especially with the online project systems and to some extent, how to implement PBL. They also had a limited opportunity to practice building PBL projects in specific disciplines. In addition, they had some opportunity to consult a coach from the tech-based PBL program whenever they face a problem during their implementation year. This consultation included email communication, on-site visits to the teachers, or meeting with other teachers in the district to discuss their first PBL implementation (M. Rogers et al., 2010). Because teacher beliefs about learning are so important, this study found only minor changes in teachers' practices in the PBL curriculum; they lacked information on PBL, so researchers concluded that professional development was necessary to create a significant shift in teacher beliefs (M. Rogers et al., 2010).

Marshall, Petrosino, and Martin (2010) investigated the conception and PBL enactment of science and mathematics student teachers. Participants learned about PBL as a part of their teacher certification course. This mixed methods study aimed to explain what student teachers gained from the professional development program. Data were collected through interviews, classroom observations, and closed- and open-ended questionnaires conducted before and after PBL enactment during their apprentice teaching. Study results indicated including actual implementation of the new curriculum during the professional development program was an important part of creating the required change in thinking about reform curriculum (Marshall, Petrosino, & Martin, 2010).

Professional development is important in preparing teachers for proper PBL implementation and overcoming its challenges, especially challenges related to classroom practices and changing beliefs. Effective professional development should focus more on practical issues not the theoretical aspects of PBL. Participating in collaborative and collegiate activities, engaging in learning cycles and practical field experiences, and enacting new strategies are efficient approaches.

In Basamh (2002) study, 97% of the principals mentioned that school should offer training workshops in cooperative learning for teachers while 93% of them indicated that they would schedule time for teachers to discuss their experiences in the implementation of cooperative learning methods.

Technology Access

Freshwater's study (2009) included a principal's statement that the school could not afford the necessary technologies to support PBL properly. Other technology-related problems frustrated teachers, including not having enough computers or not having high speed internet connections at school (Freshwater, 2009; Luehmann, 2001). Waiting for a page to open or an image to download interferes with class flow, wastes limited class time, and decreases student productivity (Edelson et al., 1999). In the Kramer et al. (2007) study, technology and internet connectivity were ranked as the third barrier to ICT PBL implementation. The Delphi study included several dimensions related to technology: weak internet connectivity, lack of updated computers, not enough computers for students, lack of students with skills required to use computers, and the high cost of technology (Kramer et al., 2007). In a study investigating barriers to technology use by science teachers (105 male and 71 female teachers) in Yanbu city schools in Saudi Arabia, Al-Alwani (2005) found infrastructure to support technology was the most significant barrier to participants ($M= 2.06$, $P< .001$). In the Al-Qurashi (2008) study, teachers identified several obstacles that hindered them form using computer and internet in teaching. Lack of technology, like projectors, was the most rated obstacle (85.6%), followed by weakness in English language skills (84.4%) and lack of instructional technology materials in Arabic language (79.24%).

Technology Skills

Teachers often lack the necessary skills and experience using technology as a cognitive tool, not a demonstrative tool to support traditional teaching (Marx et al., 1997). Students may also lack the ability to use technology properly, which can also cause problems when implementing PBL (Edelson et al., 1999; Freshwater, 2009). Among the four participating teachers in the Freshwater (2009) study, one was the need for students to be technologically knowledgeable enough to be able to carry out PBL projects. In the Al-Alwani (2005) study, lack of technology related professional development was rated the second highest barrier by participants (M= 2.02, P< .001). It was found that teachers who received in-service training programs used technology more frequently than those who did not (t = 2.41, p = 0.017) (Al-Alwani, 2005). Teachers who received both pre-service and in-service training were also found to use technology more frequently than those who did not receive any training (t = 2.61, P = 0.01) (Al-Alwani, 2005). The researcher concluded that there was a need for offering more computers at schools and training for teachers in the use of technology. In the Al-Qurashi (2008) study, lack of appropriate professional development was also mentioned as an obstacle for using technology in teaching by 78.8% of mathematics teachers in Al-Taif intermediate boys schools. In the Alshumaim and Alhassan (n.d.) study, with a population that included male and female English teachers from five large educational regions in the Saudi Arabia, the greatest barrier mentioned by participants for using technology in their teaching was a lack of experience in using computers (M= 3.40, SD= 1.26).

The benefits of PBL outweigh the costs. Because PBL allows students to gain 21st century skills, educational stakeholders should support solutions to these PBL challenges. Several changes can help teachers overcome the obstacles to PBL and widen its implementation in our schools. Successful PBL implementation requires changing school and curriculum settings and teachers beliefs about teaching and learning, offering the required materials and providing teachers with appropriate professional development, and applying technology properly. Blumenfeld et al. (1991) asserted that

A quarter of a century of research and development has suggested that innovation in curriculum and instructional practice requires that considerable attention be paid to curricular content and organization, psychological factors associated with learners (e.g., individual and developmental differences in use of knowledge, motivational orientation, cognitive strategies, and metacognition), and professional practice issues of teachers (e.g., teacher efficacy, opportunities for professional development with colleagues, and organizational time and support for teacher reflection). (p. 373)

Chapter Summary

Education in Saudi Arabia has undergone several reform efforts. The most recent example of one such effort is the Tatweer Schools, which, unlike the preceding reform initiatives, aims to create a comprehensive change in the Saudi educational system. Students are put at the focal point of Tatweer and schools have been given more authority to guide the learning process. The Tatweer curriculum adopts learner-centered strategies, like PBL, use of technology, and community involvement is an important factor in preparing students for college and the labor market.

PBL is an inquiry-oriented, learner-centered learning strategy that helps learners construct knowledge and acquire skills by working on an authentic driving question and creating non-traditional physical or digital artifacts. Supported by constructivism theory, PBL involves students in high-level cognitive processes and helps them gain higher order thinking skills like problem solving, decision making, and critical thinking. During the process of investigating and creating artifacts, several tasks require collaboration among learning community members as they share ideas, knowledge, and experiences. Dealing with real-life problems under a teacher's facilitation, students construct new knowledge based on their previous experiences. Students participate in designing a driving question on topics about which they care, planning the project, searching for and analyzing data, and creating products to present findings to others. Several studies show the effectiveness of PBL in motivating students, increasing knowledge retention and transformation, and helping students acquire 21st century skills like problem solving, decision making, and communication.

As a constructivist learner-centered approach, PBL requires that teachers adopt more constructivist educational approaches, wherein students are important shareholders, authentic activities predominate, and educational initiatives are enabled through shareholder concerns, such technology-assisted PBL implementation. Teacher experience and pedagogical knowledge also affect the perception and enactment of PBL, especially since less experienced teachers concentrate more on covering content. Time is a major concern for teachers in PBL implementation, especially with the increase in standardized tests and the lack of school support for required materials, preparation time, technology access, and, more importantly, professional development.

In spite of all these obstacles, many options can aid progress toward successful implementation of PBL. The school system and curriculum can be modified to support the constructivist nature of PBL. Teacher beliefs about teaching and learning processes, as reflected in their classroom practices, can be changed to fit a constructivist approach through professional development that helps them understand the nature of PBL and gain the required skills to apply it. Effective professional development should concentrate on practical approaches more than abstract ones. Technology, when used appropriately as a cognitive tool, helps overcome some PBL challenges and create more meaningful learning activities. Technology supports project authenticity by reaching real people and real data sources easily. Emerging technologies support creation of a community of learning and knowledge sharing that helps teachers overcome time issues by creating and sharing units collectively. Furthermore, creating multimedia products increases student motivation while enhancing higher-level cognitive processes.

Chapter 3 - METHODOLOGY

Chapter Overview

The purpose of this study was to examine teacher practices of enabling factors in the implementation of technology-assisted PBL in Tatweer schools in Jeddah, Saudi Arabia. Additionally, this study explored how the International Society for Technology in Education National Educational Technology Standards for Teachers were used in Tatweer classrooms and how technology was used to support PBL in the Tatweer schools. The focus of the study was Tatweer teachers in Jeddah. The chapter will address the research questions, research design, research setting, data collection methods, data analysis methods, and reliability and validity issues.

Research Questions

1. Is there a significant difference between Tatweer teacher general characteristics (gender, types of degree, educational degree, years of teaching experience, school level, and content area) and their project-based learning practices?
2. How are the International Society for Technology in Education National Education Technology Standards for Teachers used in Tatweer classrooms?
3. For what purposes do Tatweer teachers use technology in PBL projects?

Based on research question #1 seven hypotheses were generated:

H_0 *1.1*: There are no statistically significant differences between Tatweer teacher's gender and their PBL practices.

H_0 *1.2*: There are no statistically significant differences between Tatweer teacher's types of degree and their PBL practices

H_0 *1.3*: There are no statistically significant differences between Tatweer teacher's educational degree and their PBL practices

H_0 *1.4*: There are no statistically significant differences between Tatweer teacher's years of teaching experience and their PBL practices

H_0 *1.5*: There are no statistically significant differences between Tatweer teacher's level of school and their PBL practices

H_0 *1.6*: There are no statistically significant differences between Tatweer teacher's content area and their PBL practices

H_0 *1.7*: There is no statistically significant interaction between independent variables (gender, types of degree, educational degree, years of teaching experience, school level, and content area) in the effect on Tatweer teacher's project-based learning practices

Research Design

This study used a mixed-methods research methodology, which is "a type of study that uses both quantitative and qualitative techniques for data collection and analysis, either concurrently or sequentially, to address the same or related research questions"(Gall, Gall, & Borg, 2010, p. 461). Using mixed methods allows researcher to use the strength of qualitative and quantitative methods together. This leads to a deeper understanding of the phenomenon under study and the ability to generalize study findings (Creswell, 2003; Gall et al., 2010; Hanson, Creswell, Plano Clark, Petska, & Creswell, 2005). Tashakkori and Teddlie (1998) asserted, "Triangulation of distinct methods provides greater opportunities for causal inference" (p. 42). In addition to triangulation, Hanson et al. (2005) added four more reasons to use a mixed methods approach:

- Complementarity: results from one method are used to elaborate results from the other one.

- Development: results from one method are used to develop or inform the other method.
- Initiation: results from one method are used to question the results from the other one.
- Expansion: different methods are used to extend the range or the breadth of the findings from the other method.

Research questions are important in selecting the appropriate research method (Gall et al., 2010). Thus, in this study, a mixed methods approach was used first for its complementary function to examine different facets of the phenomenon. Both quantitative and qualitative data collection methods were used to address the research questions. The mixed methods approach will also enable triangulation for convergence of the results of the quantitative and qualitative data to gain better understanding (Gall et al., 2010; Tashakkori & Teddlie, 1998).

Creswell and Clark (2011) discussed four mixed methods designs: explanatory, exploratory, embedded, and convergence. A convergent parallel mixed methods is the design that best fits this study because both quantitative and qualitative data will be collected and analyzed during the same phase of the research process, and the results of the two measures will be merged into the overall interpretation (Creswell & Plano Clark, 2011)

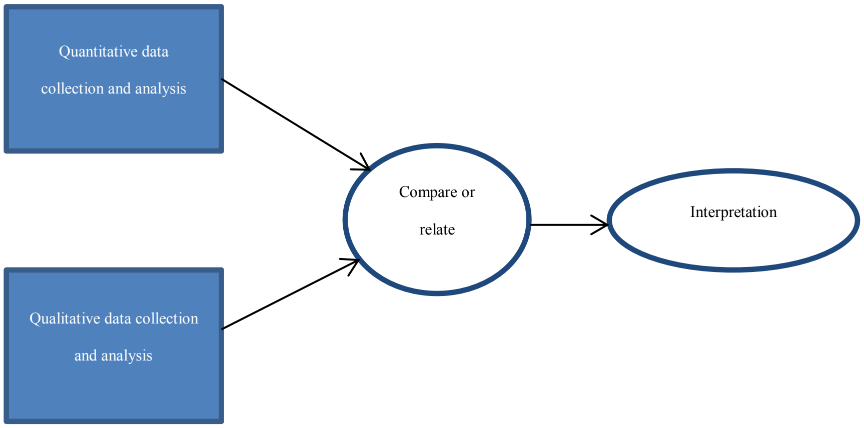

Figure 4. Convergence Parallel Method Design.
Adapted from "Designing and conducting mixed methods research" (2nd ed.) by Creswell, J., & Plano Clark, V., (2011). Washington DC: SAG.

In the current study, open-ended items were added at the end of each section of the questionnaire to give participants more freedom to add information and share ideas that had not been covered in closed-ended items, which will "provide the researcher with emergent themes and interesting quotes that can be used to validate and embellish the quantitative survey findings" (Creswell & Plano Clark, 2011, p. 81). Interviews are not conducted in Saudi Arabia, since it is not part of the educational culture to do so.

Research Setting

The Ministry of Education is the largest centralized system in the country. It was established in 1953 and has been responsible for all K-12 education in the country, and includes the planning and supervision of the entire learning process (Ministry of Education: Saudi Arabia, 2004). The curriculum has undergone several initiatives to improve learning outcomes. The most recent and promising reform has been the Tatweer school, which aim to create a comprehensive change in the educational system including curriculum. The Tatweer strategic plan is to create a systemic development in the Saudi educational system in order to facilitate the adoption of a more decentralized Saudi education system, thus giving schools more independence and responsibility to guide education reform. The Tatweer schools model adopts learner-centered approach to help student acquires 21st century skills with proficiency in mathematics, science, and technology, in order to prepare students for the college and labor market (Hakami, n.d.).

Tatweer schools started in 2007 with 50 pilot schools nationwide (one boys school and one girls school in selected education directorates) and was expanded last year to include 30 schools (15 boys and 15 girls schools) in seven education directorates (Riyadh, Jeddah, Madenah, Qaseem, Tabuk, Eastern region, and Sabia). The Tatweer schools model gives school principals more authority to guide the educational process through building the development team of school members (principal, staff, teachers, and students), with each shareholder being involved the school's improvement. The Tatweer curriculum adopts a learner-centered approach wherein the student is given more responsibility for learning under the guidance of teachers who build collaborative, authentic, and engaging learning activities supported with the proper use of internet and other technologies. Assessment in Tatweer schools aims to assess both student achievement and skills.

In Jeddah, Tatweer schools started in 2007, with two high schools (one boy and one girl) and expanded last year to include 30 schools equally divided according to levels (elementary, intermediate, high) and genders (15 boys' schools and 15 girls' schools). Each sector has five schools at each level. These schools were selected to be part of Tatweer schools because of their student high achievement results and availability of resources and facilities to support the educational process. For example, Iben-Khaldon high school students were ranked first nationwide in the Qiyas Test (similar to the SAT) results in 2009 and was so for six years in a row (*Tatweer educational forum,* 2009).

Participants

A basic step in the inquiry process was identifying participants who can provide necessary and valuable information related to the phenomenon under investigation (Creswell & Plano Clark, 2011; Weisberg, Krosnick, & Bowen, 1996). This study focused on teacher practices of enabling factors in the implementation of technology-assisted PBL in Jeddah, Saudi Arabia. Additionally, this study explored how the International Society for Technology in Education National Education Technology Standards for Teachers were used in classrooms and for what purposes technology was used to support PBL. Thus, finding groups of schools recognized as best environment to support PBL implementation supported with technology required much inquiry and approvals would need to be obtained by appropriate authorities for the purposes of this study. After contacting education officials in Jeddah, Tatweer schools were nominated as the best fit for the study goals, especially since the framework of the schools adopts a learner-centered approach with technology integration.

The population of this study included both male and female teachers in Jeddah Tatweer schools. Most of teachers hold a bachelor's degree either from an education college or a non-education college, like the Science College. A teaching license is not required for teachers in Saudi Arabia. Most of the subjects taught in boys and girls schools are the same, except for the practical subjects, such as family studies for girls and physical education for boys. Subjects include Islamic studies, Arabic studies, mathematics, science (chemistry, biology, physics, and earth science), computer, English language, social studies, practical (physical education, art, and family studies), and general topics (in first through third grades). Participants in the study included all Tatweer school teachers.

Population Sampling Issues

Identifying a reliable sample size is essential. Cohen (1988) defined the reliability of the sample size as "the closeness with which it can be expected to approximate the relevant population value" (Cohen, 1988, p. 6). Therefore, the reliability of the sample size is an estimated value in practice (Cohen, 1988). While reliability is always affected by the sample size, it may also be affected by the unit of measurement, the population value, and the shape of the population distribution, depending on the type of statistical test used for analysis (Cohen, 1988). Cohen (1988) asserted, "The larger the sample size, other things being equal, the smaller the error and the greater the reliability or precision of the results" (p. 7), and, consequently, the more power which can be achieved with the statistical results. In order to increase power, a larger sample size is needed, taking into account any other elements affecting power (level of significance and the effect size). For a MANOVA analysis, Tabachnick and Fidell (2007) emphasized that "it is important to have more cases than dependent variables in every cell" (p. 250).

The Tatweer schools in Jeddah consist of 30 schools divided into 15 boys and 15 girls schools. In each sector there were five schools at each level. All schools were located in urban areas. The total number of teachers in all schools was 1073 teachers (578 male and 495 female). It is important to have a large enough sample size, especially since several MANOVA problems, like unequal cell sizes, can be avoided by having larger size sample (Tabachnick & Fidell, 2007). Therefore the whole population was surveyed, given concerns for response rate and missing data.

Protection of Human Subjects

The Institutional Review Board (IRB) modules have been completed by the researcher and are on file with the IRB. To meet the requirements of the Kansas State University Committee for Research Involving Human Subjects, prior to the study for approval an application form was submitted to the Institutional Review Board (IRB) at Kansas State University by the researcher. A participant consent form was used, which gives participants enough information to make a decision as to whether or not to complete a survey (Fink, 2009). Upon approval by the IRB, subjects were informed that their identities and survey responses were confidential to the researcher. Subjects were also informed that the results of the study were available to them upon request. Attached is the individual consent form (Appendix B English and Appendix D Arabic), which was signed by each participant and returned to the researcher. To reduce the amount of discomfort as a result of participating in the study, no specific personal information was asked and each participant's identity was confidential. After collecting data from each Tatweer school unit in each sector, the data were collected by the researcher. Electronic data were entered into SPSS by the researcher. This data were kept on a secure home computer in the home of the researcher. All confidential identifying data were coded and kept on this computer for the remainder of the study.

Data Collection Methods

Data collection is very important in the inquiry process because the information collected addresses the research questions and affects subsequent steps (Creswell & Plano Clark, 2011). In a mixed methods research design, data is collected in two ways, quantitatively and qualitatively, and different types of instruments are used. The primary difference between quantitative and qualitative data collection is that quantitative data are obtained through closed-ended questions based on predetermined responses, whereas qualitative data are obtained through open-ended questions that do not restrict participant responses to specific choices (Creswell & Plano Clark, 2011). This study used a non-experimental, cross-sectional, closed and open-response electronic and paper and pencil survey. A survey, which includes both closed and open-ended questions, was used to collect both quantitative and qualitative data. Historically, Saudi educators are not accustomed to answering open-ended questions (Al Saif, 2005; AL-Sarrani, 2010; Alnujaidi, 2008). However, it was the decision of the researcher to provide that option.

Survey Preparation

Fink (2009) defined surveys as "information-collection methods used to describe, compare, or explain individual and societal knowledge, feelings, values, preferences, and behavior" (p. 1). Surveys can be used when the information needed comes directly from people and represents their feelings, perceptions, attitudes, values, habits, and demographic characteristics (Fink, 2009; Weisberg et al., 1996). This study used a web-based cross-sectional survey that occurs just once (Fink, 2009) and includes mainly closed-ended questions. However, the survey also included an open-ended item at the end of each section to give participants more freedom to add ideas and information not covered by the closed-ended items. Weisberg et al. (1996) asserted that open-ended questions "permit the analyst to study how the public thinks, rather than just what their opinions are" (p. 78).

The survey was administered online using Survey Monkey, which has an Arabic version, and is easily accessible from Jeddah, Saudi Arabia. The link for the survey (https://www.surveymonkey.com/s/HV88TTG) was emailed to participants in each Tatweer school unit in Jeddah education (boys and girls sectors). An appropriate survey was found for this study to collect data on PBL enabling factors as practiced by the teachers, how International Society for Technology in Education National Education Technology Standards for Teachers are used in the classrooms, and for what purposes technology is used to support PBL to improve student learning.

Due to the very low responses that were received, the researcher contacted the school principals for follow up. They suggested using a hard copy version of the survey, which was considered an easier way to follow and encourage teachers to participate. Therefore, a paper-and-pencil survey was used and distributed at the participating schools by the researcher.

Survey Elements

The entire survey is comprised of five sections (see Appendix A). The first portion of the questionnaire contains 39 items related to PBL-enabling factors. This section is divided into four parts. The first part consists of seven items related to teacher roles (six closed-ended items and one open-ended item). The second part consists of 10 items related to the school system (nine closed-ended items and one open-ended item). The third part consists of 13 items related to the learning environment (12 closed-ended items and one open-ended). Fourth part consists of nine items related to student assessment (eight closed-ended items and one open-ended). The second section contains 10 closed-ended items and one open-ended item representing using educational technology based on the International Society for Technology in Education National Education Technology Standards for Teachers. The third section contains 13 closed-ended items and one open-ended item asking about frequency of technology use for specific purposes to support PBL. The fourth section contains six closed-ended items and one open-ended item related to how frequently specific classroom technologies are used by Tatweer teachers. Finally, the fifth section includes six closed-ended items to collect participant's demographic information.

The items in the first section of the survey, which focuses on PBL enabling factors, were extracted from a revised survey that was previously prepared and administered by BIE. The survey was the *National Survey of High School Reform and Project Based Learning*, administered in 2007, with about 400 teachers participating nationwide (Ravitz, 2009). The survey results were presented in two articles (Ravitz, 2008b; Ravitz, 2008a). The survey items focused on different PBL schools, students, and teacher practices, and factors affecting PBL implementation. Most of the closed-ended questions on enabling factors were extracted from this survey, with some modifications to fit the context and the purposes of this study. Permission to use the survey was obtained from BIE (see Appendix E). The items in the second section of the survey came from the International Society for Technology in Education National Education Technology Standards for Teachers and its performance indicators (*NETS for teachers,* 2008).

The items in the third and fourth sections of the survey focus on different purposes for using technology to support PBL projects. These items were mainly constructed by the researcher, with guidance from the doctoral advisor. In designing these sections of the survey, the researcher has benefited greatly from reviewing different dissertations (Malcolm-Bell, 2009; Perera, 2008; Short, 2011), technology surveys (ISET, 2001; Schmidt, 2010), the BIE national survey (Ravitz, 2009), and the International Society for Technology in Education (ISTE) standards and performance indicators for teachers (*NETS for teachers,* 2008).

The survey in this study uses a 4-point Likert-type rating scale, ranging from “strongly agree” to “strongly disagree” in the first and second sections. In the third and fourth sections, a 4-point Likert-type rating scale ranging from “all of the time” to “never” is used to examine how often teachers use technology for PBL activities and how frequently specific technologies are used in Tatweer classrooms. The forced-choice was chosen to get more accurate responses from participants rather than choosing the middle uncertain choice (e. g., not sure, neutral) “Forced-choice questions are often useful when you want to divert the respondent from taking the path of least resistance by choosing the middle category” (Fink, 2009, p. 26).

Expert Review Panel

Tashakkori and Teddlie (1998) asserted that one way to establish content validity was “to ask ‘experts’ to help you judge the degree to which a particular measurement instrument seems to measure what it is supposed to measure” (p. 81). Initially, the survey was reviewed by the researcher’s doctoral advisor, who specializes in Educational Technology and teaches her courses using a PBL approach. The second reviewer was Dr. Timothy Frey, an Associate Professor of Special Education at Kansas State University, who has research and academic interests in using distance education technology for in-service teacher education and professional development, particularly project-based and web-based instructional designs. The survey items were modified after receiving responses from these experts.

One outside expert, Dr. Jason Ravitz, was consulted to review the survey content and individual items. Dr. Jason Ravitz, Director of Research at the Buck Institute for Education (BIE), was one of the three contributing authors to the second edition of *The Project Based Learning Handbook: A Guide to Standards-Focused Project Based Learning for Middle and High School Teachers* (2003) (see Appendix G for Dr. Ravitz vitae).

Once the survey was finalized in the English language version, it was then translated into Arabic, the language of participants, by the researcher. In order to ensure translation accuracy, the survey was reviewed by Saudi academics. One of them was Dr. Al-Matari, who recently earned his Ph.D. degree in Curriculum and Instruction from the University of Kansas and Mr. Faqehee, a Ph.D. candidate in Educational Technology at the University of Kansas. The survey was then emailed to four reviewers in Saudi Arabia to review its validity and appropriateness for the goals of the study in the Saudi school environment, especially for Tatweer schools in Jeddah. Also, they were asked to examine the survey's organization, design, and grammar. The first reviewer was Mr. Al-Zahrani, Director of School Supervision in Jeddah, who has a Master's degree in Educational Leadership. The second reviewer was Ms. Al-Hazmi, Director of the Tatweer Schools for Girls. She has a Bachelor's degree in Geography, a certificate in Quality Assurance and is a certified educational leadership coach and trainer. Ms. Al-Hazmi was the Director of Educational Assessment in Jeddah's education system until 2011. The third reviewer was Mr. Balkhyour, a high school Chemistry teacher at the Ibn-Khaldoun School (one of the Tatweer schools in Jeddah). He has a Master's degree in Chemistry and was the Vice Director of Teacher Affairs for three years and the Science Department head for four years in Eastern education. Mr. Balkhyour has offered many training sessions to teachers in using virtual classrooms (WiziQ) and is curently a judge for "the creativity program" at private schools in Jeddah. The fourth reviewer was Mr. Zuair, Director of the Jeddah Intel Project. His expertise is in Arabic language grammar. Mr. Zuair has a Master's degree in Educational Psychology (Learning and Teaching). He is also a Certified Trainer (HRD), a Certified Consultant in Decision Making and AutoDM™ Software, and a Certified Senior Trainer in the Intel Teach Program. Two items were added and some items were slightly modified, according to the Saudi reviewers' requests. Since one of the reviewers (Mr. Balkhyour) was a teacher at one of Tatweer schools (the study population), the validity of the study content and questions were enhanced through his examination. His comments were thoughtful and reflected his familiarity with the Tatweer schools environment. See Appendix C for the Arabic version of the survey (Note: Arabic language doesn't use abbreviations).

Data Collection Administration

After gaining the approval of the committee for the survey and the K-State I.R.B. (Appendix H), the Survey Monkey link for the web-based survey (Arabic version) was emailed to the Tatweer principals in schools (boys and girls sectors) in Jeddah, who sent them on to their teachers at each school on May, 12th 2012, along with the approval and support letter (Appendix I). One week after sending the survey, the first email reminder was sent. As it was found that very few responses were received, the researcher contacted all the 30 school principals, through phone calls, who suggested using a paper-and-pencil survey instead of the electronic version. At the end of the second week, the researcher distributed the survey at each male school and hired a female representative to distribute the survey at female schools. Follow-up phone calls or school visits were conducted by the researcher and his female representative at least once weekly in the following three weeks after distributing the hard copy version. Some schools were visited three times. At the end of the fourth week (June, 20th 2012) all responses were collected.

The survey included a consent form section at the beginning of the survey. The consent section of the form included a statement confirming the anonymity of the participants and the confidentiality of their answers. This section of the form had to be checked in the affirmative or participants were not allowed to continue with the survey. A statement insuring the participant's voluntary participation in the survey was included in the consent form, as well as the freedom to not answer any question. All principals were contacted about the importance of enabling each teacher to understand the nature of their consent before signing the form and returning it before the survey was sent.

Data Analysis

Mixed methods inquiry data analysis is divided into two parts: quantitative measures and qualitative measures (Creswell & Plano Clark, 2011). The process in both approaches follows the same procedure: preparing the data for analysis, exploring the data, representing the data analysis, interpreting the data, and validating the data (Creswell & Plano Clark, 2011).

Quantitative Measures

To prepare quantitative data for analysis, the data were coded by assigning numeric values and then recorded and computed with the help of the statistical program package, S.P.S.S. Data were entered into S.P.S.S. by the researcher. The survey used two types of an interval Likert-type scale, so participant responses were coded in the following two ways:

1) The 4-point Likert-type scale used for the first and second sections of the survey, participants' responses were coded as follows:

Strongly Agree = 4

Somewhat Agree= 3

Somewhat Disagree = 2

Strongly Disagree = 1

2) The 4-point Likert-type scale used for the third and fourth sections, participant responses were coded as follows:

All of the time= 4

Most of the time= 3

Some Time= 2

Never= 1

Next, the data were screened for normality, linearity, outliers, multicollinearity, and homogeneity of variance-covariance matrices. Then, data were analyzed using Descriptive Analysis and factorial MANOVA Analysis.

Independent and Dependent Variables

Variables are traits of research interest that can be measured and can vary over times and entities (Field, 2009; Fink, 2009). A research study considers two types of variables: independent and dependent. While the independent (predictor) variable value can be used to predict explain findings, the dependent variable (outcome) value depends on other variable values (Field, 2009; Fink, 2009). Variables used in this study are summarized in the following table.

Table 5. *Summary of Independent and Dependent variables and their scale types*

Independent Variables	Scale	Dependent Variable	Scale
Teacher general characteristics:		Teacher project-based learning practices	Interval
Gender	Nominal		
content area	Nominal		
School level	Nominal		
Types of degree	Nominal		
Educational degree	Nominal		
Teaching experience	Interval		
		Use of NETS.T in Tatweer classrooms	Interval
		Use of Technology to support PBL in Tatweer classrooms	Interval

Descriptive Analysis

Descriptive analysis is used in surveys to “provide[s] simple summaries about the sample and the responses to some or all questions” (Fink, 2009, p. 78). In this study, descriptive statistics were used to describe and summarize demographic data and technology uses by reporting frequencies, mean and mode to examine data central tendencies, and standard deviation to measure the variations in the data. Finding the frequencies of the International Society for Technology in Education National Education Technology Standards for Teachers gives an idea of how these standards were applied in Tatweer classrooms. Additionally, finding the frequencies of the technology uses in classroom showed the different purposes for which Tatweer teachers used technology. Results are summarized in both tables and charts in Chapter Four.

Inferential Analysis: Factorial MANOVA

While the descriptive analysis simply describes and summarizes the data, inferential statistics are used when the aim is to reach a conclusion about the population through the test of the significance of the hypotheses under certain conditions (e.g., $p < .05$) (Field, 2009; Tashakkori & Teddlie, 1998). Tashakkori and Teddlie (1998) insisted that "in inferential statistical analysis, tests of statistical significance provide information regarding the possibility that the results happened 'just by chance and random error' versus their occurrence due to some fundamental true relationship between variables" (p. 115).

Multivariate analysis of variance (MANOVA) is a type of multivariate analysis that can be used when several dependent variables (DVs) are involved in the study and it is desired to examine differences among them (Field, 2009; Tabachnick & Fidell, 2007). Analysis of variance (ANOVA) is used when the researcher examines differences with more than two conditions within only one dependent variable (Field, 2009). However, "MANOVA tests whether mean differences among groups on a combination of dependent variables are likely to have occurred by chance" (Tabachnick & Fidell, 2007, 243). As an extension of MANOVA, factorial MANOVA is useful when it is interested to examine the main effects of the independent variables and their interaction on a combination of dependent variables (Field, 2009; Tabachnick & Fidell, 2007).

MANOVA has several advantages over ANOVA (Tabachnick & Fidell, 2007). By examining the differences between more than one dependent variable, the chance of discovering the significant causes and their interactions increases, since the "ANOVA can tell us only weather groups differ along a single dimension whereas MANOVA has the power to detect whether groups differ along combination of dimensions" (Field, 2009, p. 586). In addition, for some cases, MANOVA can detect differences that can't be easily noticed in an ANOVA because "when responses to two DVs are considered in combination, group differences become apparent" (Tabachnick & Fidell, 2007, p. 244). One important advantage of conducting a MANOVA rather than several ANOVAs for each dependent variable, is to decrease the inflation of Type I error occurrence due to multiple tests. Field (2009) asserted that "the more dependent variables that have been measured, the more ANOVAs would need to be conducted and the greater the chance of making a Type I error"(p. 586).

Several statistics can be used to test the significance of main effects and interactions in MANOVA including Wilks' lambda, Hotelling's trace criterion, Pillai's criterion, and Roy's largest root criterion (Field, 2009; Tabachnick & Fidell, 2007). This study used the Pillai's trace (*V*), which is "the sum of the proportion of explained variance on the discriminant functions" (Field, 2009, p. 602). While in most research Wilk's lambda is reported, in some cases, especially when the assumption of homogeneity of variance-covariance matrices and equal cell sizes are violated, Pillai's trace is found to be more robust (Tabachnick & Fidell, 2007).

When MANOVA results indicated significant differences, a series of ANOVAs were conducted to determine values of significance (Field, 2009). Assumptions for ANOVA include homogeneity of variances (normal distribution) and independent observations (Field, 2009). If an ANOVA result was significant (*F*- value is significant), then *post hoc* tests were conducted to determine the exact differences between groups. *Post hoc* comparison is used to find between-group differences, which can be used when researcher "have no specific predictions about the data" (Field, 2009, p. 372).

MANOVA Assumptions

Several assumptions should be considered in conducting a MANOVA. MANOVA requires uncorrelated dependent variables, since highly correlated dependent variables measure similar facets of behavior. On the other hand, a MANOVA is useless if dependent variables are uncorrelated. Therefore, a MANOVA maintains greater power if dependent variables are somewhat different (Field, 2009). Tabachinck and Fidel (2007) asserted that the "MANOVA works best with highly negatively correlated DVs and acceptably well with moderately correlated DVs in either direction (about |.6|)" (p. 268). MANOVA also assumes absence of multicollinearity and singularity (Tabachnick & Fidell, 2007). Multicollinearity occurs when variables are highly correlated, which makes them measure the same attributes (Tabachnick & Fidell, 2007). Singularity represents redundant variables "when variables are multicollinear, they contain redundant information and they are not all needed in the same analysis (Tabachnick & Fidell, 2007, p. 89).

A MANOVA also requires having more cases than dependent variables in each cell (Tabachnick & Fidell, 2007). When fewer cases than dependent variables are found or only one or two more cases than dependent variables, the assumption of homogeneity is more likely to be rejected. Also, power will be lowered. Therefore, it is important to have a large enough sample size in each cell (Tabachnick & Fidell, 2007). Another assumption for the MANOVA is multivariate normality, which implies that all means of all dependent variables in each cell and all their linear combination are normally distributed (Tabachnick & Fidell, 2007). The limit theorem suggests the sampling distribution approaches normality even when raw scores do not if a large sample size is available in each cell (about 20 in the smallest cell) and has few dependent variables (Tabachnick & Fidell, 2007). MANOVA also is very sensitive to outliers. Homogeneity of variance-covariance matrices should be assumed, which means that the dependent variable maintains equal levels of variance across the independent variables (Field, 2009). However, Tabachinck and Fidel indicated that "if sample sizes are equal, robustness of significance test is expected" (p. 252). MANOVA also assumes linear relationships between all dependent variables pairs, since deviation from linearity reduces power (Tabachnick & Fidell, 2007).

Strength of Association (Effect Size)

While a test of significance reveals an important indication about the nature of the group differences, it doesn't give a clear picture of the degree of relationship between the independent variable and the dependent variable. To avoid publicizing results that are statistically significant, but realistically meaningless, the strength of association should be calculated (Tabachnick & Fidell, 2007). Strength of association or more popularly termed as "effect size" "measures how much association there is" and "reflects the proportion of variance in DV [dependent variable] that is associated with levels of an IV [independent variable]" (Tabachnick & Fidell, 2007, p. 54). Effect size can be estimated through η^2 (eta squared), which shows the proportion of variance in the DV (SS_{total}) attributable to the effect (SS_{effect}) (Tabachnick & Fidell, 2007). Since η^2 includes systematic variance (SS_{total}) for other effects (all effects, interactions, and errors), another form of η^2 is preferred, called partial η^2, which includes only variance attributable to the effect of interest and error (Tabachnick & Fidell, 2007). In ANOVA, effect size (η^2) value ranges from 0 to 1, while it as it might exceeds1 in MANOVA as DVs are recombined for each effect (Tabachnick & Fidell, 2007). Therefore, partial η^2 is recommended (Tabachnick & Fidell, 2007).

Missing Data

One very disturbing problem a researcher may face during quantitative data analysis is missing data, especially when it occurs in a non-random pattern (Tabachnick & Fidell, 2007). Several approaches can be used to treat missing data, such as deleting cases or variables, estimating missing data, and using a missing data correlation matrix. The current study used the deleting cases technique, especially since a reasonably good response rate was achieved. The researcher also used his prior knowledge and familiarity with the research environment to replace the very few missing values. Tabachinck and Fidell, 2007 suggested using prior knowledge to replace missing values if "the researcher has been working in the area for a while, and if the sample is large and the number of missing values is small" (p. 66), which apply for the situation of this study.

Reliability

Reliability "refers to the accuracy or precision of a measurement procedure" (Thorndike, 2005, p. 109). One way to measure survey reliability is to ensure that an individual's answers to survey items are consistent (Weisberg et al., 1996). This is the most appropriate check for a single administration survey and can be done by subdividing the test into two presumably equivalent halves (Thorndike, 2005). The correlation between the two separate halves is used to estimate the reliability of the whole test. This procedure is called the coefficient alpha or Cronbach's alpha (Fink, 2009; Thorndike, 2005; Weisberg et al., 1996). To improve survey reliability, the least consistent item can be removed (Field, 2009; Weisberg et al., 1996). The generally accepted range for the reliability coefficient is .7 to .8 (Field, 2009). However, some researchers consider .5 acceptable (Fink, 2009). As the items in this questionnaire were extracted from a revised survey or constructed by the researcher, a split-half reliability test (the coefficient alpha or Cronbach's alpha) was calculated. The overall (64 items) Cornobach's alpha value for this instrument was α= .97and reported. Table 7 summarizes the reliability values for different subscales used in the survey.

Table 6 *Cronbach's alpha of Survey Subscales*

Subscale	Number of Items	Cornobach's alpha
Teacher Roles in PBL	6	.82
PBL School System	9	.81
PBL Learning Environment	12	.93
PBL Assessment	8	.86
ISTE	10	.95
Technology and PBL	13	.96
Classroom Technology	6	.90

Validity

Validity is another important characteristic of survey research. It "refers to the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of test" (Thorndike, 2005, p. 145). Fink (2009) also emphasized that "a survey is valid if the information it provides is an accurate reflection of respondents' knowledge, attitudes, values, and behavior" (p. 43). Therefore, constructing a valid survey to measure personality, attitude, or interest is not easy; it is especially hard to identify appropriate domains of content (Thorndike, 2005). Most of the statements used to construct the survey were extracted from the aforementioned survey with some modifications. Therefore, it is essential to establish the content validity of this survey by asking experts to determine whether the items included in the survey accurately represent all the important factors (Creswell & Plano Clark, 2011; Fink, 2009; Thorndike, 2005).

Validity Threats

Campbell and Stanley (1963) identified several threats that can impact study validity. These threats are divided into internal and external validity. Internal validity (credibility) may be threatened in this study by the *selection of participants,* since participants vary in their teaching experiences, PBL implementation, technology use, and training. Another internal validity threat is attrition; this problem arises when busy or uninterested participants do not complete the survey (Campbell & Stanley, 1963).

External validity (generalizability) threats also may occur. One external validity threat is the *reactive effect.* This can happen as a result of a new intervention occurring just before or during the time of responding to the survey; a new intervention could participation in a workshop related to the factors being studied. Another external validity threat is the *Hawthorne effect,* which occurs when participants respond differently as a result of being a research participant (Campbell & Stanley, 1963).

Qualitative Measures

Survey Open-Ended Questions

Most of the data for this study were collected through quantitative methods (closed-ended items). However, data was also collected through responses to open-ended questions, since qualitative measures, alone, cannot provide an in-depth understanding of the phenomenon under investigation (Creswell & Plano Clark, 2011). In this study, the survey instrument had sufficient space for participants to answer seven open-ended questions. Therefore, qualitative methods were applied to analyze data collected from the seven open-ended questions in order to get more details on Tatweer school teacher PBL practices, how ISTE NETS.T were used, and how technology was used in PBL at Jeddah Tatweer schools. The foci of the seven open-ended questions were as follows:

Open-Ended Questions Related to Research Question 1:

- Survey question# 7: items related to the teacher's role in PBL practices
- Survey question# 17: items related to PBL school system support
- Survey question# 30: items related to the PBL learning environment
- Survey question# 39: items related PBL assessment

Open-Ended Questions Related to Research Question 2:

- Survey question# 50: items related to the use of ISTE NETS.T in Tatweer Schools

Open-Ended Questions Related to Research Question 3:

- Survey question# 64: items related to the use of technology in PBL projects
- Survey question# 71: items related to classroom technology use in Tatweer schools

Data Reduction

Qualitative data analysis includes preparing data for analysis, reducing the data into themes through coding, data presentation, and finally conclusion drawing (Creswell, 2007; Miles & Huberman, 1994). In preparing the qualitative data, open-ended answers were first translated into English and printed in Microsoft Office Word document. Skype and Google Docs were utilized to allow for distance collaboration between the researcher and the Major Professor in the coding process. The data was uploaded to Google Docs, coded, and then shared with the Major Professor, who made comments and corrections, as needed, before the researcher continued with pattern and theme analysis. The coded Google Docs file were then imported into Microsoft Excel, which was used for developing patterns and themes, interpretation, and record-keeping.

Data reduction is a continuous process of reducing data to manageable and meaningful elements through summarizing, coding, and theme formation, in order to help in understanding the phenomenon being studied (Miles & Huberman, 1994). In the current study, open-ended survey questions were coded based on the research questions to which they were related. Using the Miles and Huberman (1994) approach to coding, open-ended data were read thoroughly to get general ideas and to write first-thought codes and memos (Miles & Huberman, 1994). After codes were identified, categories and themes were established with the help of the quantitative data results. Coding is the most important step in analyzing qualitative data. Creswell and Plano Clark (2011) mentioned coding as "the process of grouping evidence and labeling ideas so that they reflect increasingly broader perspectives" (Creswell & Plano Clark, 2011, p. 209). Triangulation of the evidence was accomplished through comparing open- and closed-ended question answers, relying on expert panel members for clarification when responses seemed ambiguous or when the researcher could not understand the nature of the response.

Data Display

The next step in qualitative data analysis after data reduction is displaying data. According to Miles and Huberman (1994), data display involves organizing data for meaning. In the current study, data were displayed using appropriate words, charts, and tables, which help in summarizing and reading data easily.

Conclusion Drawing and Verification

Conclusion drawing needs to flow from data analysis (coding, categorizing, and exploring themes) and comply with the research literature, limitations, and questions (O'Leary, 2005). Therefore, the process of conclusion drawing starts concurrently with the coding process as the researcher begins to think about the phenomena that might be explored. This process can be repeated several times, since codes, categories, and themes are reexamined many times (Miles & Huberman, 1994). In the current study, the researcher, with the help of the Major Professor, analyzed the open-ended question responses several times and analyzed them by using a coding system to identify categories and the major themes. Results were verified through triangulation with the closed-ended findings and expert panel member checks. In addition, quotes from the qualitative responses were also included to allow the reader to judge findings and conclusions.

Grounded Theory

Grounded theory may be defined as "the discovery of theory from data systematically obtained from social research" (Glaser & Strauss 1967, p.2). It is ideal for exploring integral social relationships and the behavior of groups in which little exploration of the contextual factors that affect individual's lives were analyzed (Crooks, 2001). In Grounded Theory, the data is first coded and then grouped into concept for theory emergence. Coding is generated by word-by-word and line-by-line, since open-ended questions are the data to be explored. After open coding was completed then axial coding was used to relate codes (categories and concepts) to each other, via a combination of inductive and deductive thinking (Strauss & Corbin, 1990; Strauss & Corbin, 1998). During the axial coding process, causal relationships are emphasized, in order to build related categories, through combining different elements (Creswell, 2007). One element is to identify the core *phenomenon* or the outcome of interest. Another aspect to be evaluated is *casual conditions*, which represent the factors that caused the core phenomenon. *Action strategies* represent the actions taken in response to the phenomenon and its causes (Strauss & Corbin, 1990; Strauss & Corbin, 1998). Finally, the *consequences* of the action strategies are identified. Therefore, Grounded Theory, as a qualitative data analysis method, helps in developing a common understanding of a set of data, which leads to the development of a theory that "might help explain practice or provide a framework for further research" (Creswell, 2007, p. 63) in understanding the phenomenon under investigation (Strauss & Corbin, 1990).

Trustworthiness

Qualitative data validation focuses on "assessing whether the information obtained through the qualitative data collection is accurate" (Creswell & Plano Clark, 2011, p. 210). Guba and Lincoln suggested using a more appropriate terms for the naturalistic research like credibility, authenticity, transferability, dependability, and conformability (Guba & Lincoln, 1989).

Credibility

Credibility parallels internal validity in quantitative research (Guba & Lincoln, 1989). Credibility aims to find "isomorphism between constructed realities of respondents and the reconstructions attributed to them" (Guba & Lincoln, 1989, p. 237). Several methods, such a member checks, triangulation, and peer review, can be used to assure credibility of qualitative data and results (Creswell, 2007; Creswell & Plano Clark, 2011). In this study, expert panel member checks were used to get feedback about the accuracy of the data collected and their interpretation. In addition, triangulation was applied, meaning that qualitative and quantitative data were checked for convergence. "Typically, this process involves corroborating evidence from different sources to shed light on a theme or perspective" (Creswell, 2007, p. 208).

Transferability

Transferability in qualitative research parallels external validity (generalizability) in quantitative research (Guba & Lincoln, 1989). Transferability can be achieved through thick description of the participants and research setting (Creswell, 2007; Guba & Lincoln, 1989). Creswell (2007) asserted that "With such detailed description, the researcher enables readers to transfer information to other settings and to determine whether the finding can be transferred" (Creswell, 2007, p. 209).

Dependability

Dependability corresponds to reliability in the quantitative research that deals with the consistency of the data over the time (Guba & Lincoln, 1989). Qualitative research can be achieved through "external audits" by allowing an external consultant to "examine both the process and the product of the account, assessing their accuracy… whether or not the findings, interpretations, and conclusions are supported by the data" (Creswell, 2007, p. 209).

Confirmability

Confirmability parallels objectivity in the quantitative research, assuring that, similar to dependability, data, interpretations, and findings are rooted in contexts, not the researcher's subjectivity (Guba & Lincoln, 1989; Miles & Huberman, 1994). Guba and Lincoln (1989) declared that the confirmability of qualitative findings must be "rooted in the data themselves" (p. 243). Similar to dependability, confirmability is achieved through an external audit. Therefore, both can be checked by the same external reviewer (Guba & Lincoln, 1989).

Ethical Considerations

Novice researchers are advised to maintain humility and should not take themselves or their research so seriously as to disregard the fact that those whom they study have other and more important things in their lives (Miles & Huberman, 1994). Researchers have to consider important guidelines of ethics in research, which include: informed consent, establishing subjects' safeguards from harm, and ensuring confidentiality (Patton, 2002). These guidelines are considered to ensure that subjects participate in research projects voluntarily, understand the nature of the research and the risks and obligations that are involved, and are kept from exposure to risks which might be greater than gains derived (Patton, 2002).

Through each phase of the research study, the researcher followed the rules and guidelines of the Institutional Review Board (IRB) and Kansas State University (see Appendix H). The researcher completed the required IRB training for personnel proposing to conduct research involving human subjects. In this study the researcher tried to make all reasonable efforts to ensure the ethical treatment of the participants through establishing safeguards that will protect the rights of participants and include informed consent, protect participants from harm, and ensure confidentiality.

Participation in the study was completely voluntary, and participants had the option to withdraw at any time during the online survey, since the Survey Monkey questions were developed to allow participants to "opt out" of the study at any time during the survey's administration. The researcher took reasonable precautions to maintain confidentiality and anonymity for the participants in the study: (1) participation was strictly voluntary, (2) printed out surveys will be kept in a locked file cabinet and destroyed upon completion of the successful defense of the dissertation and (3) any statement that may identify a teacher was removed or changed.

Chapter Summary

In order to answer the research questions, this study utilized a convergent parallel mixed methods research methodology that included both quantitative and qualitative data collection and analysis. The study population included 1073 male (578) and female (495) teachers in Jeddah Tatweer schools. Tatweer schools in Jeddah included 30 schools: 15 boys and 15 girls schools (5 elementary, 5 intermediate, and 5 high schools) for each sector. To reach more reliable result, the whole population was surveyed. An online survey, including both closed and open-ended questions, was used to collect both quantitative and qualitative data. The first portion of the survey was prepared using a revised survey that was previously prepared and administered by the BIE. The second portion came from the International Society for Technology in Education National Education Technology Standards for Teachers and its performance indicators. The third portion constructed by the researcher, with guidance from the Major Professor. The quantitative data were analyzed using factorial MANOVA and descriptive analysis. The qualitative data were analyzed first based on the research questions that followed the Huberman and Miles (1994) approach, which used units, categories, and themes. Next Grounded Theory was applied using open coding, which was then followed by axial coding.

Chapter 4 - DATA ANALYSIS AND FINDINGS

Chapter Overview

The purpose of this study was to examine teacher practices of enabling factors in the implementation of technology-assisted PBL in Tatweer schools in Jeddah, Saudi Arabia. This study also aimed to explore how the International Society for Technology in Education (ISTE) National Education Technology Standards for Teachers (NETS.T) were used in Tatweer classrooms and for what purposes technology was used to support PBL in the Tatweer schools. Results of this study will provide insight for stakeholders in the Saudi education ministry, including Tatweer schools. Through information obtained by studying Tatweer schools, Tatweer administrators will gain a greater understanding of the readiness of these schools to implement a more learner-centered approach. In addition, this study provides a better understanding of how technology can support PBL. This information will help Tatweer school administrators to make required modifications in the school environment. These modifications can help to create better professional development for teachers based on this formal needs assessment.

This chapter presents data in four sections. The first section discusses data screening and MANOVA assumptions. The second section summarizes the descriptive analysis of participants' characteristics including gender, degree type, educational degree, teaching experience, school level, and content area. Findings are represented in tables and charts.

The third section presents the results of the quantitative measures. Using tables and charts, it displays the data from the factorial MANOVA results for research question one, which tested the difference between Tatweer teacher general characteristics (gender, types of degree, educational degree, years of teaching experience, school level, and content area) and project-based learning practices. If significance occurred, ANOVA and *post hoc* test results were also reported and summarized. Next, this section presents the descriptive analysis results of research question two by reporting frequencies, mean median, mode, and standard deviation of the use of the International Society for Technology in Education National Education Technology Standards for Teachers in Tatweer classrooms. Finally, results of research question three, which examined the purposes of using technology in PBL projects by Tatweer teachers, were summarized using frequencies, mean, media, mode, and standard deviation.

The fourth section reports the qualitative measures. The qualitative data were obtained from seven open-ended survey questions. A total of 177 responses were provided in the qualitative part of the study. These responses were first analyzed based on the research questions. Then, Grounded Theory was applied to code participant responses and obtain a deeper understanding of how technology-assisted PBL was applied in Tatweer schools. Qualitative analysis was conducted based on units, categories, and themes. Data were displayed in tables and charts for the major themes that emerged from the analysis of the responses of the seven open-ended survey questions.

Research Questions and Null Hypotheses

1. Is there a significant difference between Tatweer teacher general characteristics (gender, types of degree, educational degree, years of teaching experience, school level, and content area) and their project-based learning practices?
2. How are the International Society for Technology in Education National Education Technology Standards for Teachers used in Tatweer classrooms?
3. For what purposes do Tatweer teachers use technology in PBL projects?

Based on research question #1 seven hypotheses were generated:

H_0 1.1: There are no statistically significant differences between Tatweer teacher's gender and their PBL practices.

H_0 1.2: There are no statistically significant differences between Tatweer teacher's types of degree and their PBL practices.

H_0 1.3: There are no statistically significant differences between Tatweer teacher's educational degree and their PBL practices.

H_0 1.4: There are no statistically significant differences between Tatweer teacher's years of teaching experience and their PBL practices.

H_0 1.5: There are no statistically significant differences between Tatweer teacher's level of school and their PBL practices.

H_0 1.6: There are no statistically significant differences between Tatweer teacher's content area and their PBL practices

H_0 1.7: There is no statistically significant interaction between independent variables (gender, types of degree, educational degree, years of teaching experience, school level, and content area) in the effect on Tatweer teacher's project-based learning practices.

Data Screening

Prior to data analysis step, it is important for the researcher to spend sometimes in data screening (Tabachnick & Fidell, 2007). Data screening helps in resolving potential problems with data, such as data entry, missing values, extreme data, and assumptions needed for specific analysis (Warner, 2008). Therefore, any problem found in the data should be mentioned and resolved before data analysis starts.

Missing Data

The study's survey, including quantitative and qualitative data, was distributed among 1073 Tatweer school teachers. The returned survey number was 710, which represented a 66.2% response rate. Seventy respondents left most of the questions blank. Therefore, these responses were deleted, since it was difficult to apply any substitution technique. This deletion brought the valid survey number to 640 with 59.65% response rate. After this step frequency analysis was run, which indicated 67 scattered missing values in the remaining responses. These missing values were replaced using the researcher's prior knowledge, especially since the researcher had been working in Jeddah and had been working with Tatweer schools, which included weekly visitations for two months. Also, when the sample was large and the number of missing values was small (Tabachnick & Fidell, 2007).

Unequal Cell Sizes

Running a frequency analysis for the independent variables indicated unequal cell sizes, as shown in the following tables.

Table 7 *Number of Participants by Gender*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	326	50.9	50.9	50.9
	Female	314	49.1	49.1	100.0
	Total	640	100.0	100.0	

Number of the male participants (326) was slightly more than of the female participants (314).

Table 8 *Number of Participant by Types of Degree*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor	601	93.9	93.9	93.9
	Master's	34	5.3	5.3	99.2
	PhD	5	.8	.8	100.0
	Total	640	100.0	100.0	

Most of the participants had a bachelor degree (601), less had a Master's degree (34), and very few had a Ph.D. degree (5).

Table 9 *Number of Participants by Having Educational Degree or not*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	119	18.6	18.6	18.6
	Yes	521	81.4	81.4	100.0
	Total	640	100.0	100.0	

Most of the participants had an educational degree (521) while less had a non-educational degree (119).

Table 10 *Number of Participant by Years of Experience*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 yeas	56	8.8	8.8	8.8
	6-10 years	94	14.7	14.7	23.4
	11-15 years	156	24.4	24.4	47.8
	More than 15 years	334	52.2	52.2	100.0
	Total	640	100.0	100.0	

Most of the participants had more than 15 years of teaching experience (334). Among participants, 156 had 11-15 years, 94 had 6-10 years, and 56 had 1-5 years of teaching experience.

Table 11 *Number of Participants by School Level*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Elementary	190	29.7	29.7	29.7
	Intermediate	212	33.1	33.1	62.8
	High	238	37.2	37.2	100.0
	Total	640	100.0	100.0	

All school levels were represented almost equally in the study. Elementary participants were 190, intermediate school participants were 212, and high school participants were 238.

Table 12 *Number of Participants by School Level*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Islamic Studies	117	18.3	18.3	18.3
	Arabic Studies	109	17.0	17.0	35.3
	Science	102	15.9	15.9	61.6
	Math	85	13.3	13.3	74.8
	Social Studies	66	10.3	10.3	45.6
	Practical subjects	63	9.8	9.8	96.4
	English	47	7.3	7.3	82.2
	Computer Science	28	4.4	4.4	86.6
	General	23	3.6	3.6	100.0
	Total	640	100.0	100.0	

The greatest participants by content area were "Islamic Studies" teachers (117) while the least were "General" teachers (23) who teach first to third grades only.

Fortunately, unequal cell sizes was not a problem because there were more than 20 cases in the smallest cell and there were more cases than the number of dependent variables (four dependent variables only) included in the MANOVA analysis (Tabachnick & Fidell, 2007). The only independent variable that did not fulfill this assumption was degree types. Only five responses indicated a doctoral degree, which were excluded from the factorial MANOVA analysis. In addition, SPSS GLM (General Linear Model) allows the adjustment of the unequal cell size problem. Tabachinck and Fidell (2007) mentioned three methods that could be used for adjusting unequal cell sizes based on the research type (experimental or non-experimental). Method 2, which is used for survey non-experimental research, was applied in the current study. In this method main effects are given equal priority (Tabachnick & Fidell, 2007).

Multivariate Normality and Outliers

Running EXPLOR analysis and looking at the histograms showed no univariate outliers and all four dependent variables were normally distributed. Although some independent variables departed from normality, the large sample size made this not a concern. Tabachinck and Fidell (2007) asserted that "in a large sample, a variable with statistically significant skewness often does not deviate enough from normality to make a substantive difference in the analysis" (p. 80).

Multicollinearity and Singularity

Multicollinear variables represent highly correlated variables, which makes them measure the same attributes (Tabachnick & Fidell, 2007). Singularity represents redundant variables (Field, 2009; Tabachnick & Fidell, 2007). Multicollinearity and singularity were examined using the squared multiple correlation (SMC) of the variable or the tolerance (1-SMC) (Field, 2009; Tabachnick & Fidell, 2007). Too low a tolerance value (< 0.1) indicates multicollinearity and singularity. Also, multicollinearity and singularity can be detected using the condition index, which measures the tightness of one variable on other variables (Tabachnick & Fidell, 2007). A high condition index (> 30) indicates a collinearity problem (Tabachnick & Fidell, 2007). Table 13 shows the results of tolerance values for the dependent variables.

Table 13 *Tolerance Results*

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	166.565	42.486		3.920	.000		
	Teacher average	33.136	16.620	.104	1.994	.047	.554	1.804
	School system average	-19.022	21.321	-.054	-.892	.373	.409	2.447
	School environment average	29.796	17.954	.100	1.660	.097	.411	2.434
	Assessment average	30.246	18.698	.091	1.618	.106	.473	2.115

Results indicated that no multicollinearity problem existed, since all values were much higher than 0.1.

Homogeneity of Variance-Covariance Matrices

Homogeneity of Variance-Covariance Matrices indicates that groups represent the same population (the dependent variables are equal across groups). It can be examined using Box's test (Field, 2009; Tabachnick & Fidell, 2007; Warner, 2008). Box's test result was significant (p <.001, F= 1.53), which implied homogeneity violation. With a large sample size, significance of statistical tests is expected "as with any significance test, in large samples Box's test could be significant even when covariance matrices are relatively similar" (Field, 2009, p. 604). To fix this problem and avoid type I error inflation, especially when unequal cell sizes exist, Pillai's criterion should be used instead of Wilks' lambda because it is more robust (Field, 2009; Tabachnick & Fidell, 2007; Warner, 2008).

Characteristics of the Respondents

The characteristics of the respondents in this study were gender, degree type, educational degree, teaching experience, school level, and content area. Each of these characteristics are demonstrated in tables and charts for the number and percentage of the participants.

Gender

Table 14 and figure 6 show that participants were roughly equal: 50.9% male and 49.1% female.

Table 14 *Participant Gender*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	326	50.9	50.9	50.9
	Female	314	49.1	49.1	100.0
	Total	640	100.0	100.0	

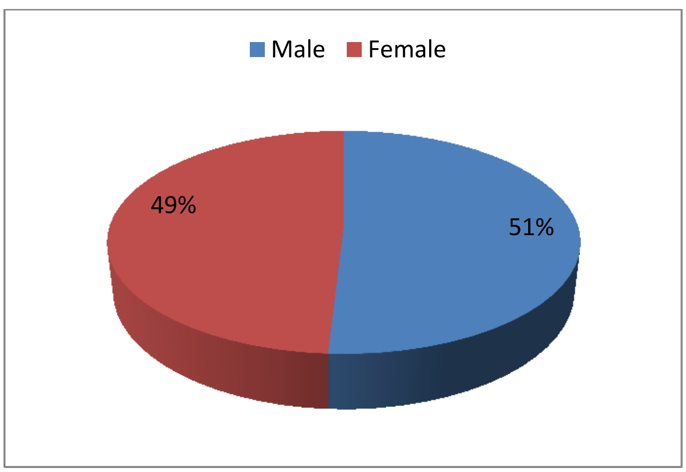

Figure 5. Percentage of Respondent Gender

Degree Type

Most of the participants (93.9%) had a Bachelor's degree, very few (5.3%) had a Master's degree, while only 0.8% had a Ph.D. Table 15 and figure 6 show the numbers and percentages of participant by their degree types.

Table 15 *Respondent Degree Types*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor	601	93.9	93.9	93.9
	Master's	34	5.3	5.3	99.2
	PhD	5	.8	.8	100.0
	Total	640	100.0	100.0	

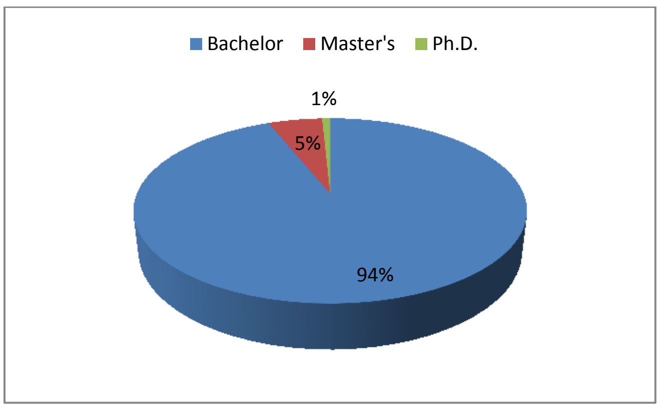

Figure 6. Percentage of Participant Degree Types

Educational Degree

Some teachers had degrees in Education and others did not. For example, some of them had degrees in Science, Islamic Studies, etc. Most of the Participants (81.4%) were found to have educational degree and less (18.6%) were not. Table 16 and figure 7 show summary of participant by educational degree.

Table 16 *Respondent Educational Degree*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	119	18.6	18.6	18.6
	Yes	521	81.4	81.4	100.0
	Total	640	100.0	100.0	

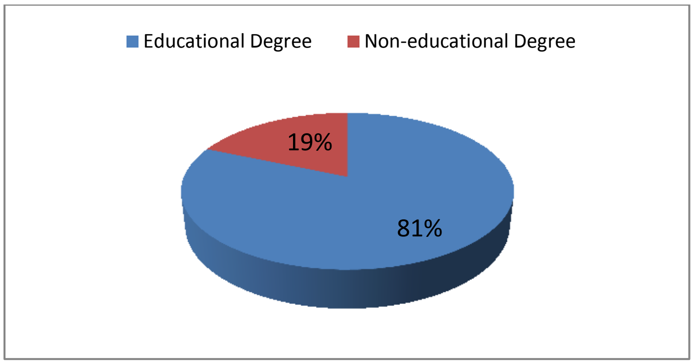

Figure 7. Percentage of Respondent Educational Degree

Teaching Experience

Table 16 and figure 8 show that 52.2% of participant had more than 15 years of teaching experience, 24.4% had 11-15 years of teaching experience, 14.7% had 6-10 years of teaching experience, and only 8.8% had 1-5 years of teaching experience.

Table 17 *Respondent Teaching Experience*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 years	56	8.8	8.8	8.8
	6-10 years	94	14.7	14.7	23.4
	11-15 years	156	24.4	24.4	47.8
	More than 15 years	334	52.2	52.2	100.0
	Total	640	100.0	100.0	

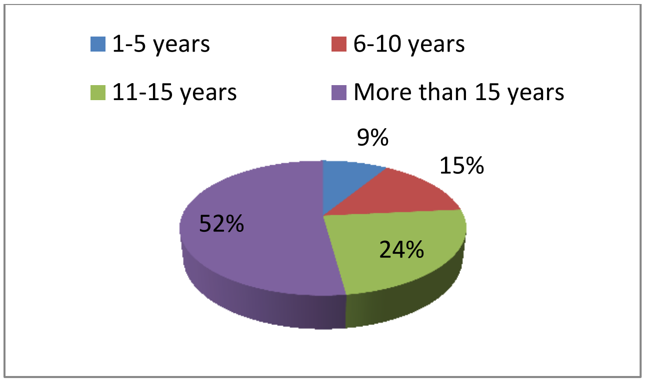

Figure 8. Percentage of Respondent Teaching Experience

School Level

School level means elementary, intermediate, and high school. Respondents were found to represent all school levels almost equally with high school participants were 37.2%, intermediate participants were 33.1%, and elementary participants were the least (29.7%).

Table 18 *Respondent School Level*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Elementary	190	29.7	29.7	29.7
	Intermediate	212	33.1	33.1	62.8
	High	238	37.2	37.2	100.0
	Total	640	100.0	100.0	

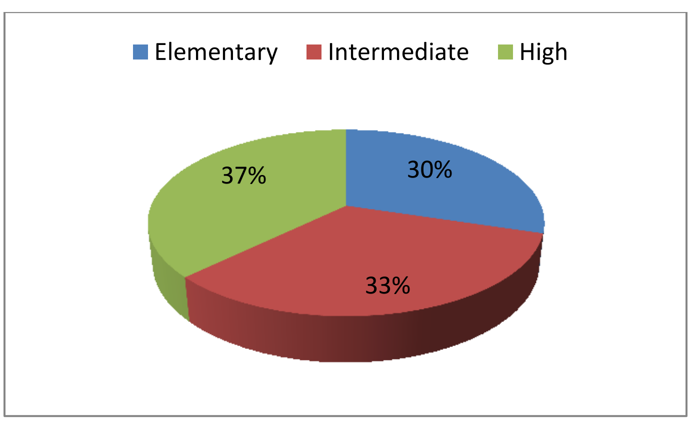

Figure 9. Percentage of Respondent School Level

Content Area

Table 19 and figure 10 display numbers and percentage of participants by content area. The greatest number of participants was Islamic Studies teachers (18.3%), while the smallest (3.6%) was general teachers who teach grades 1-3 only. The second greatest number of teachers who participated in the study was Arabic studies teachers (17.0%), followed by Science teachers (15.9%). Participants among other subjects were as follows: Mathematics 13.3%, Social Studies 10.3%, Practical Subjects 9.8%, English 7.3%, and Computer Science 4.4%.

Table 19 *Respondent Content Area*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Islamic Studies	117	18.3	18.3	18.3
	Arabic Studies	109	17.0	17.0	35.3
	Social Studies	66	10.3	10.3	45.6
	Science	102	15.9	15.9	61.6
	Math	85	13.3	13.3	74.8
	English	47	7.3	7.3	82.2
	Computer Science	28	4.4	4.4	86.6
	Practical subjects	63	9.8	9.8	96.4
	General	23	3.6	3.6	100.0
	Total	640	100.0	100.0	

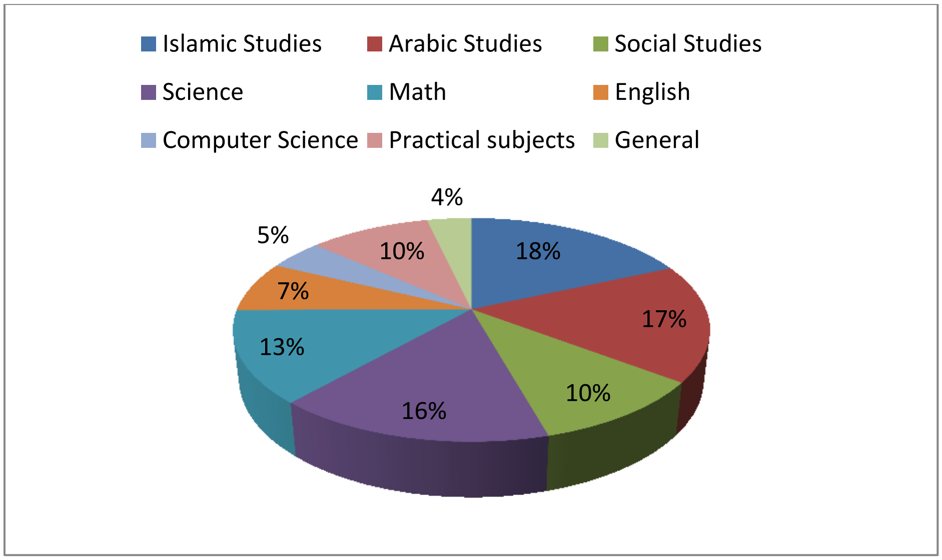

Figure 10. Percentage of Respondent Content Area

Quantitative Measures

Research Question #1

"Is there a significant difference between Tatweer teacher general characteristics (gender, types of degree, educational degree, years of teaching experience, school level, and content area) and their project-based learning practices?"

Teachers PBL practices were examined through the first section in the survey that consisted of 35 quantitative items related to PBL-enabling factors. This portion of the survey is divided into four parts. The first part consisted of six closed-ended items related to teacher roles. The second part consisted of nine closed-ended items related to the school system. The third part consisted of 12 closed-ended items related to the learning environment. The fourth part consisted of eight closed-ended items related to student assessment. Composite mean for each subscale (table 20 and chart 11) in this section was used to conduct the factorial MANOVA analysis.

Table 20 *Composite Means for PBL Practices subscales*

PBL Practices	N	Range	Mean	Std. Deviation
Teacher Role	640	3.00	2.94	.61
School system	640	3.00	2.67	.56
School environment	640	3.00	2.76	.66
Assessment	640	3.00	2.70	.59

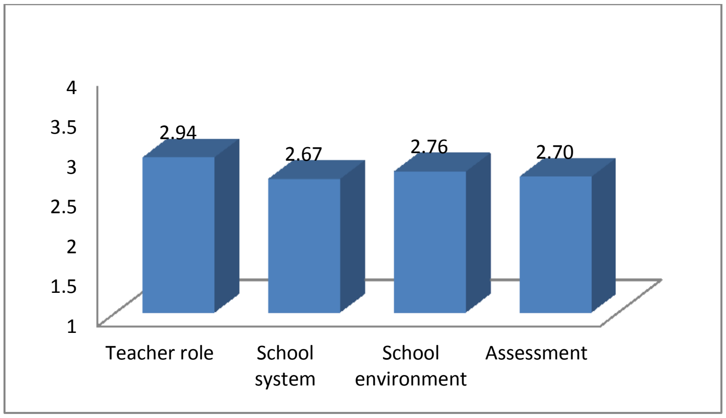

Figure 11. Composite Means for PBL Practices Subscales

Factorial multivariate analysis of variance (MANOVA) was performed to examine if there was a significant difference between Tatweer teacher general characteristics (gender, types of degree, educational degree, years of teaching experience, school level, and content area) and their PBL practices. Pillai's Trace test (*V*) values were reported for testing MANOVA significance because the assumption of homogeneity of variance-covariance matrices and equal cell sizes were violated (Tabachnick & Fidell, 2007). If the MANOVA was significant, then a univariate ANOVA was conducted, followed by *post hoc* tests to determine the exact differences between groups. Table 21 provides a summary of Pillai's Trace test results of MANOVA on Tatweer school teacher characteristics and their PBL practices. Pillai's test results showed that gender and school level were statistically significant at $p < .05$ while other teacher characteristics, including their interaction were not. This means that Tatweer school teacher PBL practices were affected by their gender and their school level only.

Table 21 *Pillai's Trace Values of MAOVA on Tatweer Teacher PBL Practices*

Independent Variables	Pillai's Trace Value	F	df	Error df	Sig.	Partial Eta Squared
Gender	.083	9.090	4.000	400.000	.000	.083
Degree types	.011	1.071	4.000	400.000	.370	.011
Educational degree	.006	.636[a]	4.000	400.000	.637	.006
Years of teaching experience	.049	1.674	12.000	1206.000	.067	.016
School level	.050	2.583	8.000	802.000	.009	.025
Content area	.087	1.118	32.000	1612.000	.298	.022
Interaction: Gender*Degree*Educational Deg*Experience*Level*Cont.	1.462	1.079	860.000	1612.000	.099	.365

Test Results of Null Hypotheses

H_0 1.1: There are no statistically significant differences between Tatweer teacher's gender and their PBL practices.

Finding

Pillai's test result indicated that the main effect of Tatweer teachers' gender was statistically significant (V= .083, F (4, 400) = 9.09, at p < .05) with partial η^2= .083. Thus, participants' PBL practices were influenced by their gender. Therefore, the *H_0 1.1* null hypothesis was rejected. To determine the exact differences between gender groups a univariate ANOVA test was conducted. Table 22 shows the significance values of PBL practices on gender.

Table 22 *ANOVA Results for Teacher PBL Practices by Gender*

Dependent Variables (PBL Practices)	Type II SS	Mean Square	F	df	Error df	Sig.	Partial Eta Squared
Teacher roles	5.84	5.84	17.767	1	403	.000	.042
School system	.023	.023	.077	1	403	.782	.000
Learning environment	4.577	4.577	10.826	1	403	.001	.026
Assessment	.483	.483	1.429	1	403	.233	.004

According to the ANOVA results, gender effects on PBL practices were found to be statistically significant on both teacher roles (F (1,403) = 17.77, partial η^2 = .042, p < .05) and learning environment (F (1, 403) = 10.83, partial η^2 = 026, p < .001). Since there is only one degree of freedom in gender, *post hoc* test couldn't be conducted. Therefore, a mean comparison was performed to determine the exact differences between gender groups. To compare the gender's means, a *t*-test was conducted. Tables 23 and 24 displays *t*-test results for male and female means of teacher roles and learning environment variables.

Table 23 *t-Test Results for Teacher Roles*

Gender	n	Mean	SD	T	df	Sig.
Male	321	3.056	.661	4.84	633	.000
Female	314	2.825	.534			

Table 24 *t-Test Results for Learning Environment*

Gender	n	Mean	SD	T	df	Sig.
Male	321	2.903	.674	5.553	633	.000
Female	314	2.619	.614			

t-Test results indicated that Tatweer male (M= 3.056, SD= .661) and female (M= 2.825, SD= .534) teachers significantly differed in their roles related to PBL practices ($t(633) = 4.84$, $p < .05$). Results also indicated that Tatweer male (M= 2.903, SD= .674) and female (M= 2.619, SD= .614) teachers had significantly different learning environments related to their PBL practices ($t(633) = 5.55$, $p < .05$).

H_0 *1.2*: There are no statistically significant differences between Tatweer teacher's types of degree and their PBL practices.

Finding:

Factorial MANOVA results (table 21) based on Pillai's test indicated that there were no significant differences between Tatweer teachers' degree types ($V= .011$, $F\ (4, 400) = 1.07$, $p > .05$). Thus, participant PBL practices were not influenced by their degree type. Therefore, H_0 *1.2* null hypothesis was accepted.

H_0 *1.3*: There are no statistically significant differences between Tatweer teacher's educational degree and their PBL practices.

Finding:

Factorial MANOVA results (table 21) based on Pillai's test indicated that there were no significant differences between Tatweer teachers' educational degrees ($V= .006$, $F\ (4, 400) = .64$, $p > .05$). Thus, participants' PBL practices were not influenced by their educational degrees. Therefore, H_0 *1.3* null hypothesis was accepted.

H_0 *1.4*: There are no statistically significant differences between Tatweer teacher's years of teaching experience and their PBL practices.

Finding:

Factorial MANOVA results (table 21) based on Pillai's test indicated that there were no significant differences between Tatweer teachers' years of teaching experience (V= .049, F (12, 1206) = 1.67, p > .05). Thus, participants' PBL practices were not influenced by their years of teaching experience. Therefore, H_0 *1.4* null hypothesis was accepted.

H_0 *1.5*: There are no statistically significant differences between Tatweer teacher's level of school and their PBL practices.

Finding:

Based on Pillai's test, factorial MANOVA result (table 21) indicated that the main effect of Tatweer teachers' school level was statistically significant (V= .050, F (8, 802) = 2.58, at p < .05 with partial η^2= .025. Thus, participants' PBL practices were influenced by their school level. Therefore, H_0 *1.5* null hypothesis was rejected. To determine the exact differences between school level groups a univariate ANOVA test was conducted. Table 25 shows the significance values of PBL practices on school level.

Table 25 *ANOVA Results for Teacher PBL Practices by School Level*

Dependent Variables (PBL Practices)	Type II SS	Mean Square	F	df	Error df	Sig.	Partial Eta Squared
Teacher roles	.081	.040	.123	2	403	.885	.001
School system	3.115	1.558	5.261	2	403	.006	.025
Learning environment	1.041	.521	1.231	2	403	.293	.006
Assessment	1.271	.635	1.879	2	403	.154	.009

According to the ANOVA results, school level effects on PBL practices were found to be statistically significant for the school system (F (2,403) = 5.26, partial η^2 = .025, at p < .05). A *Post hoc* test was conducted to determine the exact difference.

Table 26 *Post hoc Test Results on School System*

Independent Variable Levels	Mean difference	Standard Error	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
Elementary vs. Intermediate	-.1314	.05454	.043	-.2597	-.0031
Elementary vs. High	-.19922	.05303	.001	-.3170	-.0674
Intermediate Vs. High	-.0608	.05168	.467	-.1824	.0607

Table 26 shows *Post hoc* test results on the school system to determine the significant differences between school levels. Results indicated that there was a significant difference between elementary and intermediate school participants in terms of the school system: elementary (N= 190, M= 2.56), Intermediate (N= 209, M= 2.69), mean difference was -.13, $p < .05$, which indicated that intermediate school participant PBL practices related to school system were significantly better than elementary participants. Results also showed that there was a significant difference between elementary and high school participants in terms of the school system: high (N= 236, M= 2.75), mean difference was -.20, $p < .05$, which indicated that high school participants' PBL practices related to school system were significantly better than elementary participants. On the other hand, results found that there were no significant differences between intermediate and high school participants in terms of their PBL practices related to school system; mean difference was .061, $p > .05$.

H_0 1.6: There are no statistically significant differences between Tatweer teacher's content area and their PBL practices

Finding:

Factorial MANOVA results (table 21) based on Pillai's test indicated that there were no significant differences between Tatweer teachers' content area (V= .087, F (32, 1612) = 1.12, p > .05). Thus, participant PBL practices were not influenced by their content area. Therefore, H_0 *1.6* null hypothesis was accepted.

H_0 *1.7*: There is no statistically significant interaction between independent variables (gender, types of degree, educational degree, years of teaching experience, school level, and content area) in the effect on Tatweer teacher's project-based learning practices.

Finding:

Factorial MANOVA results (table 21) based on Pillai's test indicated that there were no significant interactions between independent variables (gender, types of degree, educational degree, years of teaching experience, school level, and content area) in the effect on Tatweer teacher's PBL learning practices (V= 1.46, F (860, 1612) = 1.12, p > .05). Thus, participants' PBL practices were not influenced by the interaction of the study independent variables (gender, types of degree, educational degree, years of teaching experience, school level, and content area). Therefore, H_0 *1.7* null hypothesis was accepted.

Research Question #2

"How are the International Society for Technology in Education National Education Technology Standards for Teachers used in Tatweer classrooms?"

The use of the International Society for Technology in Education National Education Technology Standards for Teachers in Tatweer classrooms was examined in the second section of the survey. This section contains 10 closed-ended items (40-49). Descriptive analysis was used to describe and summarize the findings by reporting frequencies, mean and mode to examine data central tendencies, and standard deviation to measure the variations in the data.

Finding the frequencies of the International Society for Technology in Education National Education Technology Standards for Teachers gave the researcher a better understanding of how these standards were applied in Tatweer classrooms.

Table 27 *ISTE NETS for Teachers: Mean, Media, Mode, and Standard Deviation*

		Collaborative knowledge construction	Personalizing learning activities	Exploring real-world issues	Designing Relevant learning	Practicing safe and legal use of technology
N	Valid	640	640	640	640	640
	Missing	0	0	0	0	0
Mean		3.2172	3.0828	2.9938	2.8625	2.8438
Median		3.0000	3.0000	3.0000	3.0000	3.0000
Mode		3.00	3.00	3.00	3.00	3.00
Std. Deviation		.77602	.83789	.80294	.83159	.82258

Table 28 *ISTE NETS for Teachers: Mean, Media, Mode, and Standard Deviation (Cont.)*

		selecting technology effectively and productively	Sharing best uses of technology with PBL	Communicating relative info with students, parents, peers	Locating, organizing, analyzing, evaluating information	Interaction, collaboration, and publishing
N	Valid	640	640	640	640	640
	Missing	0	0	0	0	0
Mean		2.9359	2.8813	2.9000	2.9609	2.8234
Median		3.0000	3.0000	3.0000	3.0000	3.0000
Mode		3.00	3.00	3.00	3.00	3.00
Std. Deviation		.79353	.83261	.86272	.82605	.87304

- Results of statement 40 (M= 3.22, SD= .78) indicated that 46.9% somewhat agreed and 39.4% strongly agreed on using technology in teaching to model collaborative knowledge construction by engaging in learning with students, colleagues, and others, while only 13.7% strongly or somewhat disagreed.

- Results of statement 41 (M= 3.08, SD= .84) indicated that 42.8% somewhat agreed and 35.0% strongly agreed on using technology in teaching to customize and personalize learning activities to address student diversity of learning styles, working strategies, and abilities, while 22.2% strongly or somewhat disagreed.
- Results of statement 42 (M= 2.99, SD= .80) indicated that 48.8% somewhat agreed and 27.5 strongly agreed while 23.8% strongly or somewhat disagreed on the use of technology in teaching to engage students in exploring real-world issues and solving authentic problems.
- Results of statement 43 (M= 2.86, SD= .83) indicated that 45.9% somewhat disagreed and 23.0% strongly agreed on the use of technology in teaching to design relevant learning experiences that incorporate digital tools and resources to promote student creativity and curiosity, while 31.1% strongly or somewhat disagreed.
- Results of statement 44 (M= 2.84, SD= .82) indicated that 48.3% somewhat agreed and 21.1% strongly agreed on the use of technology in teaching to advocate and practice safe, legal, and responsible use of information and technology, while 30.6% strongly or somewhat disagreed.
- Results of statement 45 (M= 2.94, SD= .79) indicated that 50.8% somewhat agreed and 23.8% strongly agreed on the use of technology in teaching to help students to select and use technology effectively and productively while 25.5% strongly or somewhat disagreed.
- Results of statement 46 (M= 2.88, SD= .83) indicated that 46.3% somewhat agreed and 23.8% agreed on the use of technology in teaching to share best practice uses of

technology with PBL with other teachers and schools while 30.0% somewhat or strongly disagreed.

- Results of statement 47 (M= 2.90, SD= .86) indicated that 44.4% somewhat agreed and 26.1% strongly agreed on the use of technology in teaching to communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats while 29.6% somewhat or strongly disagreed.
- Results of statement 48 (M= 2.96, SD= .86) indicated that 48.6% somewhat agreed and 26.6% strongly agreed on the use of technology in teaching to help students to locate, organize, analyze, synthesize, evaluate, and ethically use information from a variety of sources and media, while 24.8% somewhat or strongly disagreed.
- Results of statement 49 (M= 2.82, SD= .87) indicated that 40.0% somewhat agreed and 24.4% strongly agreed on the use of technology in teaching to help students to interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media while 35.6% somewhat or strongly disagreed.

Table 29 *Tatweer Schools Teacher ISTE NETS for Teachers Reponses: Frequency (Percentages)*

	Statements	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
40	I use technology in teaching to model collaborative knowledge construction by engaging in learning with students, colleagues, and others	25(3.9)	63(9.8)	300(46.9)	252(39.4)
41	I use technology in teaching to customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities	29(4.5)	113(17.7)	274(42.2)	224(35.0)
42	I use technology in teaching to engage students in exploring real-world issues and solving authentic problems	28(4.4)	124(19.4)	312(48.8)	176(27.5)
43	I use technology in teaching to design relevant learning experiences that incorporate digital tools and resources to promote student creativity and curiosity	36(5.6)	163(25.5)	294(45.9)	147(23.0)
44	I use technology in teaching to advocate and practice safe, legal, and responsible use of information and technology	39(6.1)	157(24.5)	309(48.3)	135(21.1)
45	I use technology in teaching to help students to select and use technology effectively and productively	30(4.7)	133(20.8)	325(50.8)	152(23.8)
46	I use technology in teaching to Share best practice uses of technology with PBL with other teachers and schools	36(5.6)	156(24.4)	296(46.3)	152(23.8)
47	I use technology in teaching to communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats	42(6.6)	147(23.0)	284(44.4)	167(26.1)
48	I use technology in teaching to help students to locate, organize, analyze, synthesize, evaluate, and ethically use information from a variety of sources and media	36(5.6)	123(19.2)	311(48.6)	170(26.6)
49	I use technology in teaching to help students to interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media	41(6.4)	187(29.2)	256(40.0)	156(24.4)

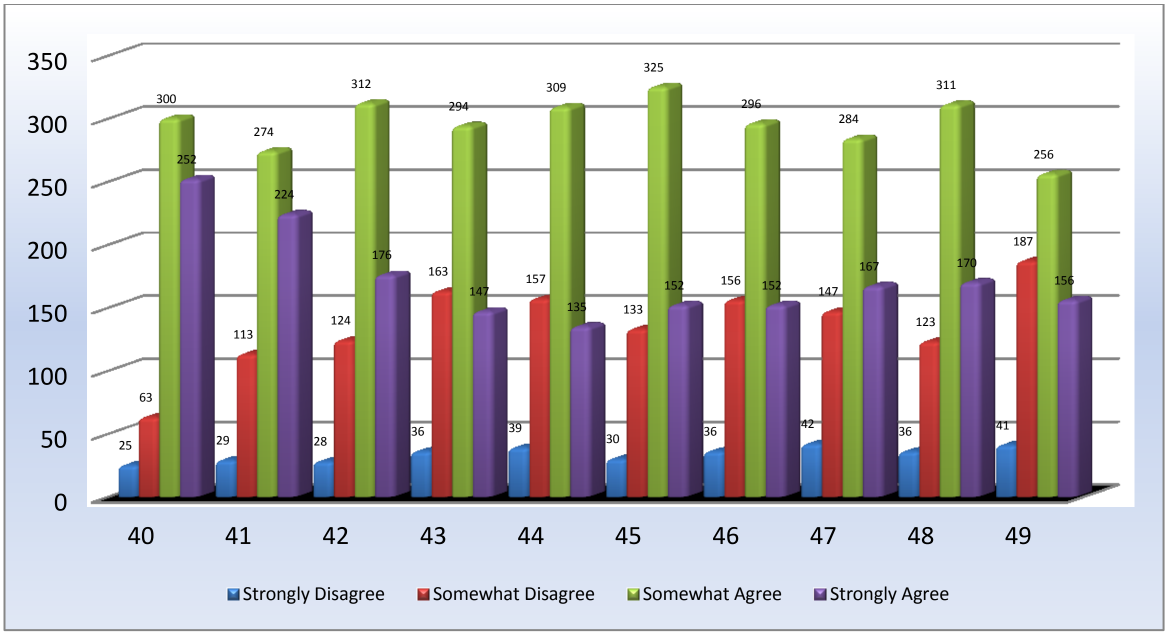

Figure 12. Tatweer Schools Teacher ISTE NETS for Teachers Reponses Summary

Research Question #3

For what purposes do Tatweer teachers use technology in PBL projects?

The purposes for using technology in PBL projects by Tatweer teachers were examined through the third and fourth sections of the survey. The third section contains 13 closed-ended items (51-63) asking about the frequency of technology use for specific purposes to support PBL. The fourth section contains six closed-ended items (65-70) related to how frequently specific classroom technologies are used by Tatweer teachers. Descriptive analysis was used to describe and summarize the findings by reporting frequencies, mean and mode to examine data central tendencies, and standard deviation to measure the variations in the data. Finding the frequencies of technology use in classroom helped to indicate the different purposes for which Tatweer teachers used technology, particularly in PBL projects.

Table 30 *Technology Use in PBL: Mean, Median, Mode, and Standard Deviation*

		Developing complex concepts	Exploring answers to project problems	Sharing ideas, resources, and products	Developing collaborative documents or project tasks	Planning and managing activities to complete a project
N	Valid	640	640	640	640	640
	Missing	0	0	0	0	0
Mean		2.4281	2.5266	2.0797	2.3469	2.1656
Median		2.0000	3.0000	2.0000	2.0000	2.0000
Mode		2.00	3.00	1.00	3.00	1.00
Std. Deviation		1.04716	1.02362	1.06952	1.06663	1.05591

Table 31 *Technology Use in PBL: Mean, Median, Mode, and Standard Deviation (Cont.)*

		Enter virtual world for authentic experiences	Cell phone for student lesson (polling)	Publishing student work and products	Participating in online PD opportunity	Developing digital artifacts and presentations
N	Valid	640	640	640	640	640
	Missing	0	0	0	0	0
Mean		1.9703	1.8453	1.9266	2.1750	2.4172
Median		2.0000	1.0000	2.0000	2.0000	2.0000
Mode		1.00	1.00	1.00	1.00	3.00
Std. Deviation		1.04846	1.01606	1.06410	1.10370	1.07001

Table 32 *Technology Use in PBL: Mean, Median, Mode, and Standard Deviation (Cont.)*

		Exploring complex systems via gamming and simulations	Video conferencing with colleagues and experts	Schedule meetings with colleagues
N	Valid	640	640	640
	Missing	0	0	0
Mean		2.0922	1.9266	1.8484
Median		2.0000	2.0000	1.0000
Mode		1.00	1.00	1.00
Std. Deviation		1.07581	1.01441	1.03936

- Results of statement 51 (M= 2.43, SD= 1.05) indicated that 52.8% of the participants either “never” or “sometimes” used technology in PBL projects to develop complex concepts, while 47.2% used technology for this purpose either “most of the time” or “all of the time”.
- Results of statement 52 (M= 2.53, SD= 1.02) indicated that 54.4% of the participants used technology in PBL projects to explore answers to PBL problems either “most of the time” or “all of the time”. However, 45.6% of the participants either “never” or “sometimes” used technology for this purpose.
- Results of statement 53 (M= 2.08, SD= 1.07) indicated that 65.2% of the participants either “never” or “sometimes” used technology in PBL projects to share ideas, resources, and products. However, only 34.9% of the participants used technology for this purpose either “most of the time” or “all of the time”.
- Results of statement 54 (M= 2.35, SD= 1.07) indicated that 54.2% of the participants either “never” or “sometimes” used technology in PBL projects to develop student

collaborative document construction or project tasks. However, 45.8% used technology for this purpose either “most of the time” or “all of the time”.

- Results of statement 55 (M= 2.17, SD= 1.06) indicated that 62.2% of the participants either “never” or “sometimes” used technology in PBL projects for planning and managing activities to develop a solution or complete a project, while only 37.9% used it either “most of the time” or “all of the time”.
- Results of statement 56 (M= 1.97, SD= 1.05 indicated that 68.7% of the participants either “never” or “sometimes” used technology in PBL projects to have students enter three-dimensional immersive spaces/virtual worlds for more authentic learning experiences, while only 31.3% of the participants used technology for this purpose either “most of the time” or “all of the time”.
- Results of statement 57 (M= 1.85, SD= 1.02) indicated that 72.9% of the participants either “never” or “sometimes” used cell phones in PBL projects for student lessons (polling, etc.), while only 27.2% of the participants used technology for this purpose either “most of the time” or “all of the time”.
- Results of statement 58 (M= 1.92, SD= 1.06) indicated that 70.6% of the participants either “never” or “sometimes” used technology in PBL projects to publish student work and project products through blogging, while only 29.4% of the participants used technology for this purpose either “most of the time” or “all of the time”.
- Results of statement 59 (M= 2.18, SD= 1.10) indicated that 62.4% of the participants either “never” or “sometimes” used technology in PBL projects to participate in online professional development opportunities, while only 37.6% of the participants used technology for this purpose either “most of the time” or “all of the time”.

- Results of statement 60 (M= 2.42, SD= 1.07) indicated that 50.2% of the participants either “never” or “sometimes” used technology in PBL projects to develop digital artifacts through presentations (PowerPoint, Prezi, Animoto, Glogster, etc.), while about the same number (49.8%) of the participants used technology for this purpose either “most of the time” or “all of the time”.
- Results of statement 61 (M= 2.09, SD= 1.08) indicated that 63.3% of the participants either “never” or “sometimes” used simulations and gaming in PBL projects to explore complex systems and issues, while only 34.7% of the participants used technology for this purpose either “most of the time” or “all of the time”.
- Results of statement 62 (M= 1.93, SD= 1.01) indicated that 71.8% of the participants either “never” or “sometimes” used technology in PBL projects for videoconferencing with colleagues and meeting experts (e.g., Skype), while only 28.2% of the participants used technology for this purpose either “most of the time” or “all of the time”.
- Results of statement 63 (M= 1.85, SD= 1.04) indicated that 72.8% of the participants either “never” or “sometimes” used technology in PBL projects to schedule meetings with colleagues (e.g., Doodle), while only 27.2% of the participants used technology for this purpose either “most of the time” or “all of the time”.

Table 33 *Tatweer Schools Teacher Technology Use in PBL Responses: Frequency (Percentages)*

	Statements	Never	Sometime	Most of the Time	All of the Time
51	I use technology in PBL projects to develop complex concepts	150(23.4)	188(29.4)	180(28.1)	122(19.1)
52	I use technology in PBL projects to explore answers to PBL problems	133(20.8)	159(24.8)	226(35.3)	122(19.1)
53	I use technology in PBL projects to share ideas, resources, and products (e.g., Delicious)	257(40.2)	160(25.0)	138(21.6)	85(13.3)
54	I use technology in PBL projects to develop student collaborative document construction or project tasks (e.g. Edmodo, Google Docs, etc.)	181(28.3)	166(25.9)	183(28.6)	110(17.2)
55	I use technology in PBL projects for planning and managing activities to develop a solution or complete a project (e.g., Google calendar)	224(35.0)	174(27.2)	154(24.1)	88(13.8)
56	I use technology in PBL projects to have students enter three-dimensional immersive spaces/virtual worlds (Quest Atlantis, Dimension M, Whyville, Jumpstart, etc.) for more authentic learning experiences	290(45.3)	150(23.4)	129(20.2)	71(11.1)
57	I use cell phones in PBL projects for student lessons (polling, etc.)	330(51.6)	136(21.3)	117(18.3)	57(8.9)
58	I use technology in PBL projects to publish student work and project products through blogging (Blogger, Edmodo, etc.)	311(48.6)	141(22.0)	112(17.5)	76(11.9)
59	I use technology in PBL projects to participate in online professional development opportunities (e.g. a personal learning network, Google Reader, Diigo, De.lic.ious)	236(36.9)	163(25.5)	134(20.9)	107(16.7)
60	I use technology in PBL projects to develop digital artifacts through presentations (PowerPoint, Prezi, Animoto, Glogster, etc.)	170(26.6)	151(23.6)	201(31.4)	118(18.4)
61	I use simulations and gaming in PBL projects to explore complex systems and issues (Purpose Games, Games for Change, etc.)	253(39.5)	165(25.8)	132(20.6)	90(14.1)
62	I use technology in PBL projects for videoconferencing with colleagues and meeting experts (e.g., Skype)	291(45.5)	168(26.3)	118(18.4)	63(9.8)
63	I use technology in PBL projects to schedule meetings with colleagues (e.g. Doodle)	336(52.5)	130(20.3)	109(17.0)	65(10.2)

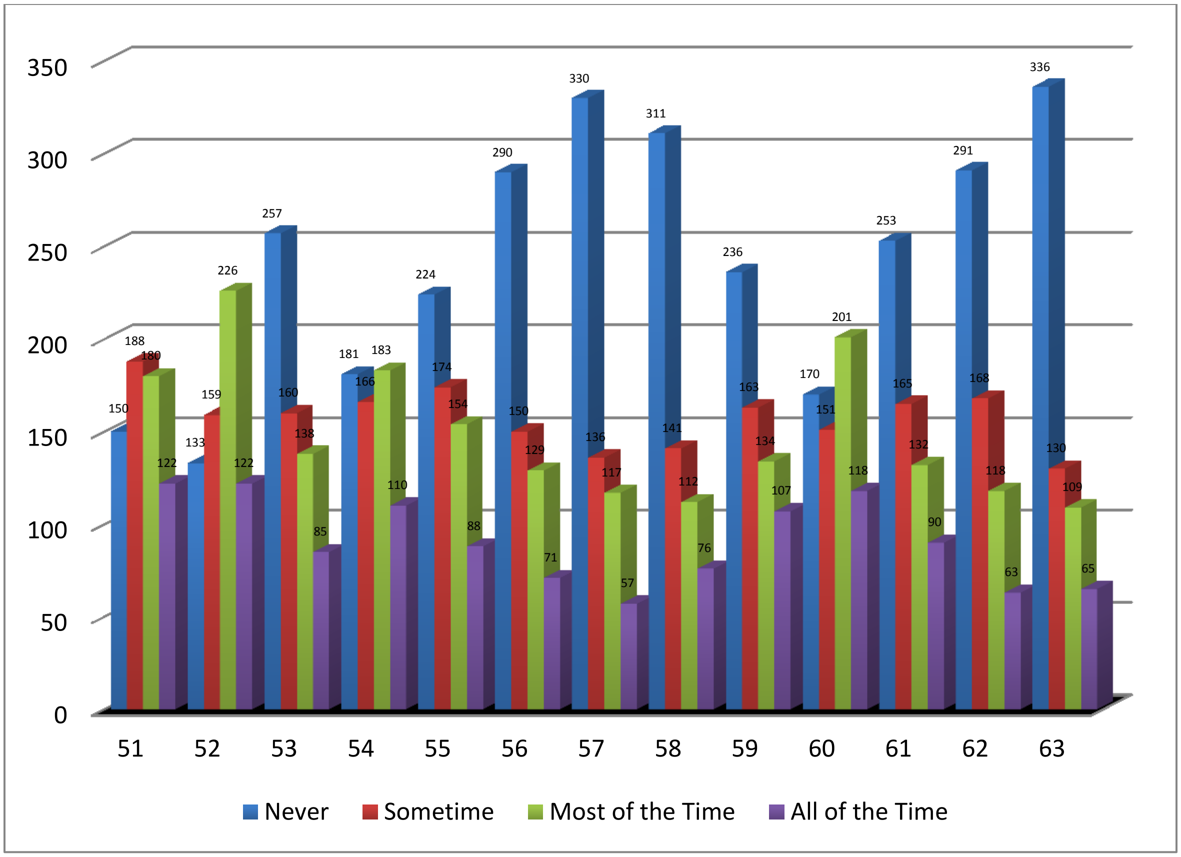

Figure 13. Frequencies of Tatweer Schools Teacher Technology Uses in PBL

Table 34 summarizes the descriptive analysis results of using classroom technology in Tatweer schools.

Table 34 *Classroom Technology Uses in Tatweer Schools*

		e-Readers (Nook, Kindle)	Tablets (iPad)	Digital cameras	Music players (iPod)	Clickers	Whiteboard
N	Valid	640	640	640	640	640	640
	Missing	0	0	0	0	0	0
Mean		1.5906	1.8047	1.8094	1.8172	1.6203	1.9984
Median		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode		1.00	1.00	1.00	1.00	1.00	1.00
Std. Deviation		.96313	1.03203	1.05018	1.02825	.94176	1.19401

- Results of statement 65 (M= 1.59, SD= .96) indicated that 83.0% of the participants either “never” or “sometimes” used e-readers (Nook, Kindle, etc.) in teaching students, while only 17.0% used them either “most of the time” or “all of the time”.
- Results of statement 66 (M= 1.80, SD= 1.03) indicated that 74.4% of the participants either “never” or “sometimes” used tablets (iPad, etc.) in teaching students, while only 25.6% used them either “most of the time” or “all of the time”.
- Results of statement 67 (M= 1.81, SD= 1.05) indicated that 74.6% of the participants either “never” or “sometimes” used digital cameras in teaching students, while only 25.4% used them either “most of the time” or “all of the time”.
- Results of statement 68 (M= 1.82, SD= 1.03) indicated that 74.4% of the participants either “never” or “sometimes” used digital music players (iPod, etc.) in teaching students, while only 25.6% used them either “most of the time” or “all of the time”.
- Results of statement 69 (M= 1.62, SD= .94) indicated that 80.9% of the participants either “never” or “sometimes” used clickers in teaching students, while only 19.1% used them either “most of the time” or “all of the time”.
- Results of statement 70 (M= 2.0, SD= 1.19) indicated that 67.0% of the participants either “never” or “sometimes” used whiteboards in teaching students, while 33.0% used them either “most of the time” or “all of the time”.

Table 35 *Classroom Technology Use in Tatweer Schools: Frequency (Percentages)*

	Statements	Never	Sometime	Most of the Time	All of the Time
65	I use e-readers (Nook, Kindle, etc.) in teaching students	426(66.5)	105(16.4)	54(8.5)	55(8.6)
66	I use tablets (iPad, etc.) in teaching students	352(55.0)	124(19.4)	101(15.8)	63(9.8)
67	I use digital cameras in teaching students	355(55.5)	122(19.1)	93(14.5)	70(10.9)
68	I use digital music players (iPod, etc.) in teaching students	344(53.8)	132(20.6)	101(15.8)	63(9.8)
69	I use an interactive student response system ("clickers") in teaching students	408(63.8)	110(17.2)	79(12.3)	43(6.7)
70	I use an interactive whiteboard (Smart board, Promethean, etc.) in teaching students	334(52.2)	95(14.8)	89(13.9)	122(19.1)

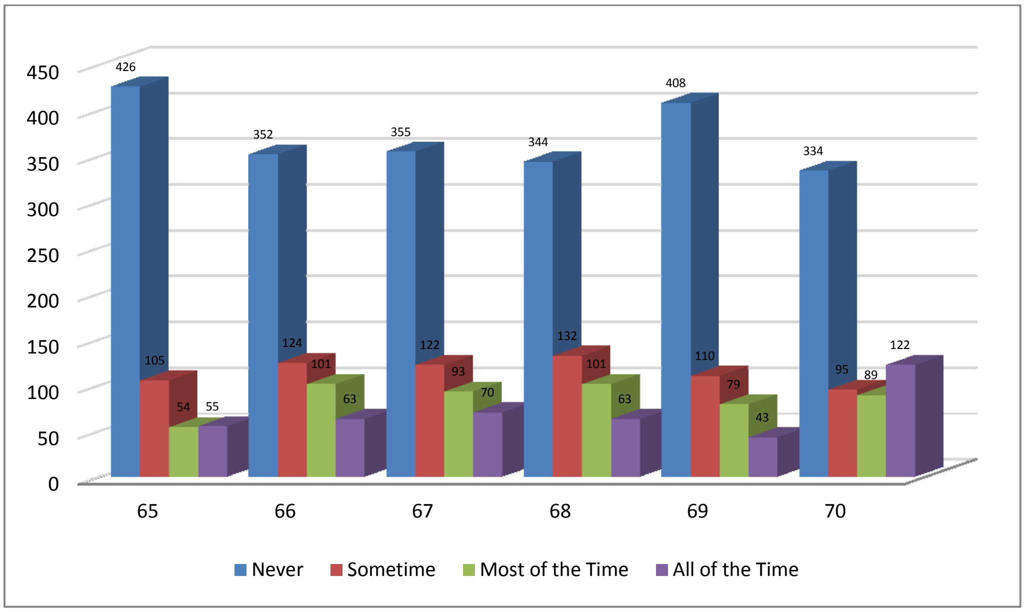

Figure 14. Frequencies of Classroom Technology Uses in Tatweer Schools

Qualitative Measures

The qualitative data in this study was obtained from the seven open-ended questions. From 710 respondents, 640 surveys were valid and of these surveys, a total of 177 responses were provided that yielded to 177 units of information. Of these 177 units, some were unrelated to the research questions. See Appendix J for the list of survey responses. These responses indicated that they knew very little about PBL (Research Question 1), ISTE NETS Standards (Research Question 2), and used little technology (Research Question 3). In order to further elucidate why this lack of knowledge existed and to learn more about how to introduce these concepts into Tatweer Schools, Grounded Theory was used to code their responses in order to provide insight into how to provide professional development, resources, and curriculum support for PBL. These responses were analyzed based on units, categories and themes, which are also displayed in appropriate tables and charts.

Open-Ended Survey Questions

Questions 7, 17, 30, and 39 were developed to learn more about PBL practices of Tatweer teachers. Question 50 was written to learn more about the use of ISTE NETS for Teachers by Tatweer teachers. Questions 64 and 71 were written to get deeper understanding about using technology in PBL projects at Tatweer classrooms.

Question Number Seven

Please state other items related to teacher roles in PBL practices in the space below.

Among 46 responses for this question two were found useful for this question and were categorized as "Traditional Teaching" and formed a "Teaching Methods" theme. One respondent wrote:

We don't have PBL. We teach via lecture.

Another respondent emphasized:

We don't have PBL. It is only a theoretical concept.

Other responses explained participant lack of PBL understanding. Consequently, the nature of their answers will be discussed in chapter five.

Question Number Seventeen

Please state other items related to school system supporting PBL practices in the space below.

There were 24 responses to this question. The respondents offered three units of information on this question, with two categories and two themes.

The first theme was "Teaching Methods" with two units, which categorized as "Traditional Teaching". One respondent mentioned PBL as:

Unknown step.

Another participant asserted:

We don't have PBL.

Another category found was "Content Coverage" and formed the theme of "Curriculum", which emphasized that the school system focuses content coverage rather than working on projects. One participant said:

We don't have this type of learning. What is important is content coverage.

Other responses will be left to Chapter Five in a discussion of the extent to which the current school system supports Tatweer schools in PBL implementation.

Question Number Thirty

Please state other items related to the learning environment supporting PBL practices in the space below.

There were 19 responses to this question. The respondents offered eight units of information on this question, with three categories, which formed the theme of "PBL Obstacles". One category was "Classroom Design", consisting of three units. One respondent said:

There are no suitable classrooms for PBL.

Another participant added:

The current classrooms do not support PBL, which contradicts the new approach advocated by the new curriculum.

Another category found was “Number of Students,” consisting four units. One respondent wrote:

The large number of students in classrooms doesn’t support PBL.

The final category found in this question was “PBL materials” with one unit. A respondent said:

Materials required to apply PBL are not offered.

Question Number Thirty-Nine

Please state other items related to the Assessment used in PBL in the space below.

There were 20 responses to this question. The respondents offered three units of information on this question. One category was “Testing” with two units and formed the theme of “Traditional Assessment”. One participant mentioned:

Questions include both essays and objective questions.

Another participant characterized the assessment used in the schools:

Traditional assessments.

The other theme emerged was “Alternative Assessment” with one category “Continual Assessment” containing one unit.

Question Number Fifty

Please state other items related how are the International Society for Technology in Education National Education Technology Standards for Teachers used in Tatweer classrooms.

There were nine responses to this question. Based on the International Society for Technology in Education National Technology Standards for Teachers, one unit was found which was coded as “communication” and formed the theme of “Technology Used”. One participant said:

Communicate with students via smart phones and social networking websites.

This lack of responses related to the focus of this question is expected as many responses indicated that technology was not offered at Tatweer schools. One participant stated:

> *The Ministry of Education didn't equip classrooms with computers, except those that are provided by the teacher.*

Another participant also emphasized the same idea:

> *There are no technologies in the classroom.*

Question Number Sixty-Four

Please state other items related to using technology in PBL.

There were 13 responses to this question. None of the responses were found to be related to using technology in PBL projects. One respondent mentioned that:

> *We don't have a smart classroom that is connected to the internet. Some classrooms are equipped with projectors.*

This response was repeated several times in the responses, which indicates the lack of technology access in Tatweer schools.

Question Number Seventy-One

Please state other items related to using classroom technology in teaching.

There were 24 responses to this question. The only new classroom technology added by the respondents was "Projector", which was mentioned in ten responses. Other responses repeated the use of "Computers" (4 responses) and "Laptops" (2 responses). The lack of classroom technologies was also obvious. One respondent indicated:

> *I don't have internet in my classroom.*

Grounded Theory

Though most of the information provided in the qualitative responses was found to be unrelated to the research questions, the responses provided useful information on the resources, professional development, and curriculum changes needed in order to apply technology-assisted PBL in Tatweer schools. All Jeddah Tatweer schools are located in rural areas, teach the same curriculum, and are expected to have the same support and facilities. However, analysis of quantitative and qualitative data revealed several differences between male and female teacher roles, learning environment, technology use, and professional development.

Therefore, Grounded Theory was utilized to propose actions that needed to be taken and recommendations that might be applied to improve the implementation of technology-assisted PBL in Tatweer schools and fulfill the school's mission, especially since there had been little exploration of the contextual factors that affect PBL and technology use in the Saudi education. Data were first coded and then grouped into concept for themes emergence. Coding was generated word-by-word and line-by-line, since open-ended questions were data to be explored. After open coding was completed then axial coding was used to relate codes (categories and concepts) to each other, via a combination of inductive and deductive thinking (Strauss & Corbin, 1990; Strauss & Corbin, 1998).

There were 177 units, 73 categories, and 19 overall themes were found after analyzing the whole open-ended question responses. Table 36 and chart 15 summarize these units, categories, and themes.

Table 36 *Summary of Themes, Categories, and Units of Grounded Theory Analysis*

Theme	**# of Cats.**	**Category**	**# of Units**
Technology Access		Lack of Technology	13
		Classroom Technology	12
		Teacher Offers Technology	10
		Learning Center	3
		Using Technology	2
		Parent Technology Donation	1
		Lack of Internet Access	1
		E-Learning	1
		Poor School in Comparison to Other Tatweer Schools	1
		PBL Technology	1
		Student Offers Technology	1
	11	Total Units	45
PBL Obstacles		High Student Number	6
		Flexible Schedule	5
		Classroom Facilities	4
		Classroom Space/Design	3
		PBL Learning Environment	2
		Poor Learning Environment	2
		Low Motivation	2
		Lack of Interest	1
		Lack of PBL materials	1
		Lack of Teacher Support	1
		Teaching to the Test	1
		Teaching Load	1
		Time to Apply PBL	1
		Community Understanding of PBL	1
		Ministry Funding	1
		PBL facilities	1
		Administration Support	1
	17	Total Units	34
Teaching Methods		Traditional Teaching	11
		Cooperative Learning	6
		Student Products	1
		Presentation Modes	1
	4	Total Units	19
Professional Development		Teacher Preparation	4
		Technology Training	2
		Need Assessment	2
		Ministry/ District Support	1
		On-Site Training	1
		PBL Topics	1
		Teacher Informal Meetings	1
		Teaching Skills	1
		Tests Preparation skills	1
		Training Center Improvement	1
		Regular Training	1
	11	Total Units	16
Technology Use		Classroom Technology	11
		Internet	2
		International Communications	1
	3	Total Units	14

Traditional Assessment		Testing	14
	1	Total Units	14
Advanced Technologies		Classroom Technology	2
		Communication	2
		Publishing	1
		Films	1
	4	Total Units	6
Outside Class Enrichment Activities		Field Trips	3
		Community Contact	1
		Community Services	1
	3	Total Units	5
Advanced Teaching Methods		Educational games	2
		Internet Knowledge	1
		Internet Quizzes	1
	3	Total Units	4
Curriculum Flexibility		Somewhat Flexible Curriculum	3
		Subject Options	1
	2	Total Units	4
PBL support		Flexible classroom Structure	2
		Less Number of Subjects	1
	2	Total Units	3
Teacher Dedication		Teacher Effort	1
		Female Teacher Volunteer work	1
		Personal Development	1
	3	Total Units	3
Survey Items		Survey Completeness	2
		Survey Inadequacy	1
	2	Total Units	3
Curriculum		Content Coverage	1
		PBL Activities	1
	2	Total Units	2
Alternative Assessment		New Assessment	1
	1	Total Units	1
Mandatory Curriculum		Inflexible Curriculum	1
	1	Total Units	1
Multi-Types Assessment		All Types of Assessment	1
	1	Total Units	1
Researcher Good Will		Encouragement	1
	1	Total Units	1
Student Growth		Values Development	1
	1	Total Units	1

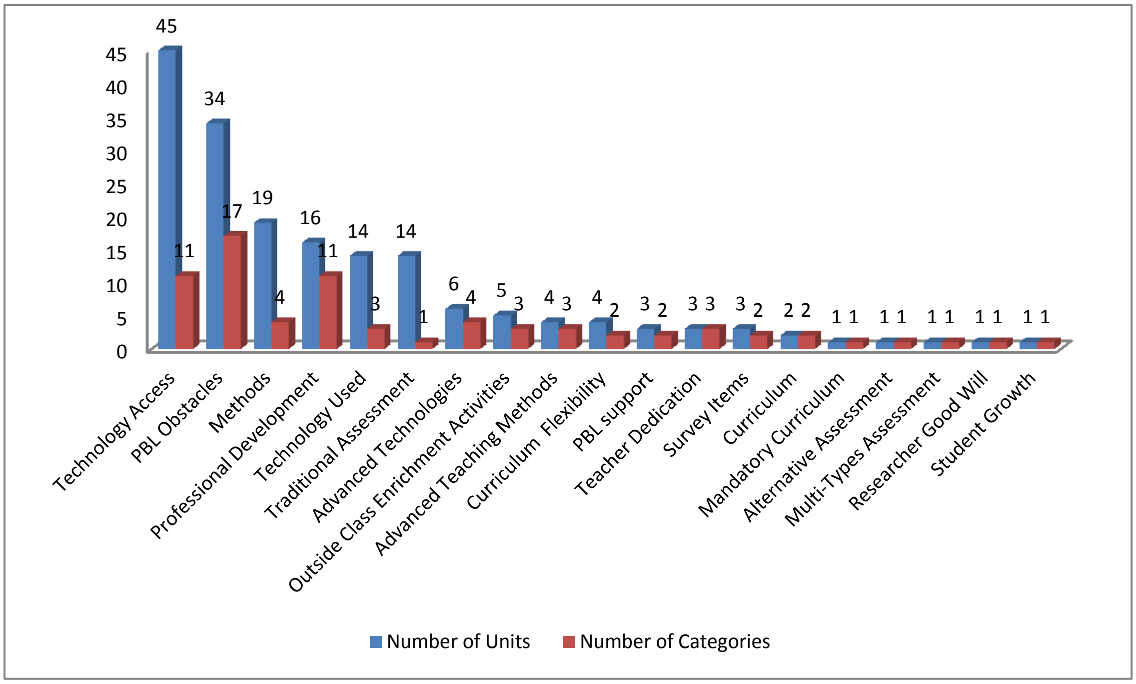

Figure 15. Summary of Themes, Categories and Units

Technology Access

The largest theme found was the "Technology Access" with 45 units and 11 categories. Thirteen units were on the category of "Lack of Technology." One respondent said:

We rarely use technology because it is not offered.

Another teacher especially emphasized the lack of technology needed for PBL:

PBL needs technology and devices that are not offered in my school.

Another category emerged was "Classroom Technology" with 12 units. The need for specific classroom technologies, such as smart boards, was mentioned. One respondent said:

Offering whiteboards (smart) and projectors.

The third category found in this theme was "Teacher Offers Technology" with 10 units. Several participants indicated that teachers offer classroom technologies by their own effort, since it is not offered by the school, the school district, or the ministry of education.

Technology is offered by teachers' efforts and is not offered by the school district or the ministry of education.

The fourth category in this theme was "Learning Center" with three units. One teacher said:

We only have one computer room: the Educational Learning Center.

Chart 16 shows all categories in this theme and their frequencies.

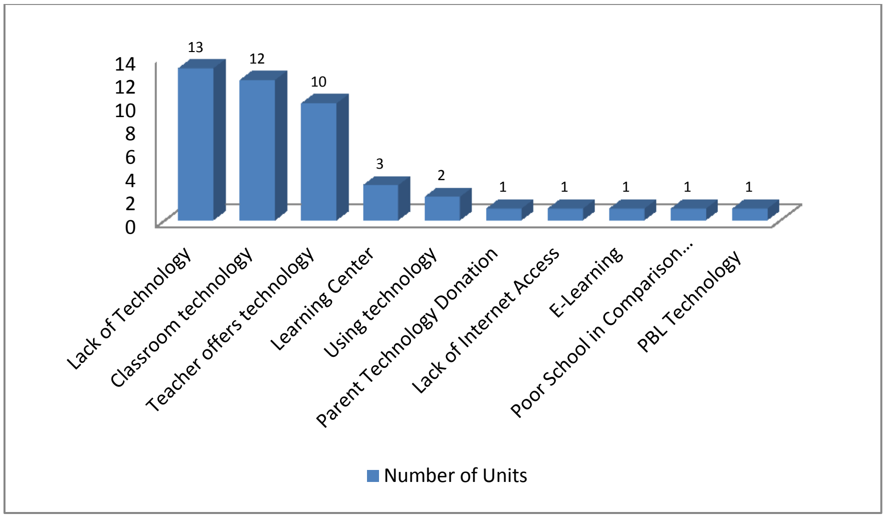

Figure 16. Technology Access: Categories and Units

PBL Obstacles

The Second theme was "PBL Obstacles" with 34 units and 17 categories. Six units were on the category of "High Students Number." One participant mentioned the large number of students per classroom as an oppose of individualizing learning:

There is a large number of students in classes, which doesn't support individualized learning.

Another respondent said:

The large number of students in classrooms doesn't support PBL.

The second category in "PBL Obstacles" theme was "Flexible schedule" with five units. One respondent mentioned that block scheduling was applied last year, but cancelled this year:

Block scheduling was tried last year and was cancelled.

Another category with four units was "Classroom Facilities." One teacher said:

We need to equip the classrooms before we start a new curriculum.

The fourth category found in this theme was "Classroom Space/Design" with three units. One participant pointed out to the need for equipping the classroom before applying the new curriculum, which requires special facilities:

The classrooms do not allow use changes.

Two other related categories to the classroom design emerged were "Poor Learning Environment" and more specific "PBL Learning Environment" with two units each. One teacher mentioned:

There is no appropriate learning environment that supports PBL.

Another category found in the "PBL Obstacles" was "Motivation Lack" with two units. One respondent said:

Students and teachers should be encouraged by some types of incentives.

The rest of the categories were found to have one unite for each category. Chart 17 summarizes the categories and units for "PBL Obstacles" theme.

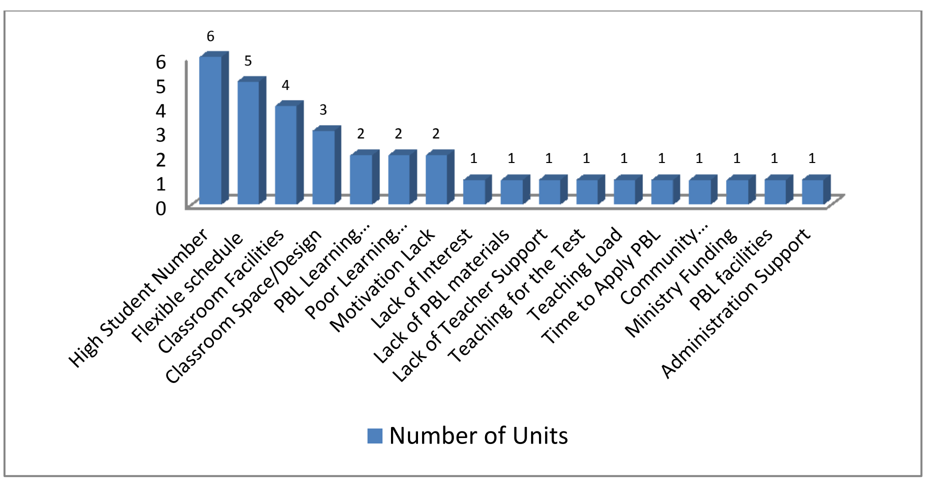

Figure 17. PBL Obstacles: Categories and Units

Teaching Methods

The third theme emerged was "Teaching Methods" with 19 units and four categories. Eleven units were on the category of "Traditional Teaching." Several respondents emphasized the absences of PBL in their schools while traditional teaching is the norm. One teacher said:

We teach via traditional methods.

On the other hand, "Cooperative Learning" was emerged as another category with six units. One participant mentioned the teaching methods in his/her school as:

Cooperative learning- learning with peers, active learning

The other two categories were "Student Products" and "Presentation Modes" with one unit each. Chart 18 summarizes the categories and units for this theme.

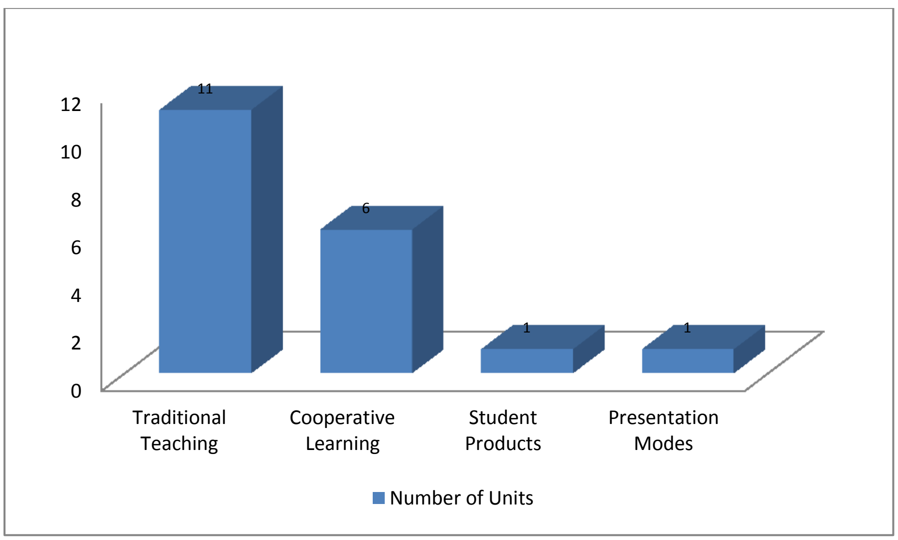

Figure 18. Teaching Methods: Categories and Units

Professional Development

The fourth theme emerged was "Professional Development" with 16 units and 11 categories. This theme included responses that focused on different aspects related to the professional development mentioned by the participants to prepare them for PBL implementation and technology using. Four units were on the category of "Teacher Preparation." One participant mentioned the need for:

Intensive training for PBL.

Another category was "Technology Training" with two units. One participant said:

Teachers need to be trained in using the new technologies.

One more category emerged was the "Need Assessment" with two units, which emphasized on the need to assess teachers' need in order to apply PBL

Assess each teacher to determine what he/she need to in terms of professional development

Chart 19 summarizes categories and units for "Professional Development" theme.

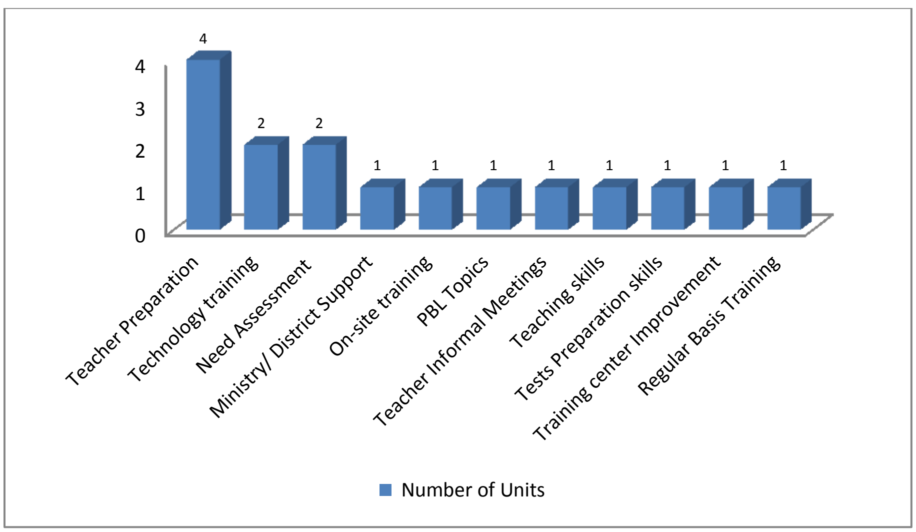

Figure 19. Professional Development: Categories and Units

Technology Use

The fifth theme emerged was "Technology Use" with 14 units and three categories. This theme included responses that focused on technology used by the teachers. Eleven units were on the category of "Classroom Technology." The classroom technologies mentioned were

“Projector”, “Computer”, and “Laptop”. The other category was “Internet” with two units. One participant mentioned the technology used as:

Learning using Internet.

The last category in this theme was “International Commination” with one unit. A participant said:

Participating in the Globe program. [The Global Learning and Observation to Benefit the Environment (GLOBE) program is a worldwide hands-on, primary and secondary school-based science and education program (*The globe program,* n.d.)].

Chart 20 summarizes categories and units for “Technology Used” theme.

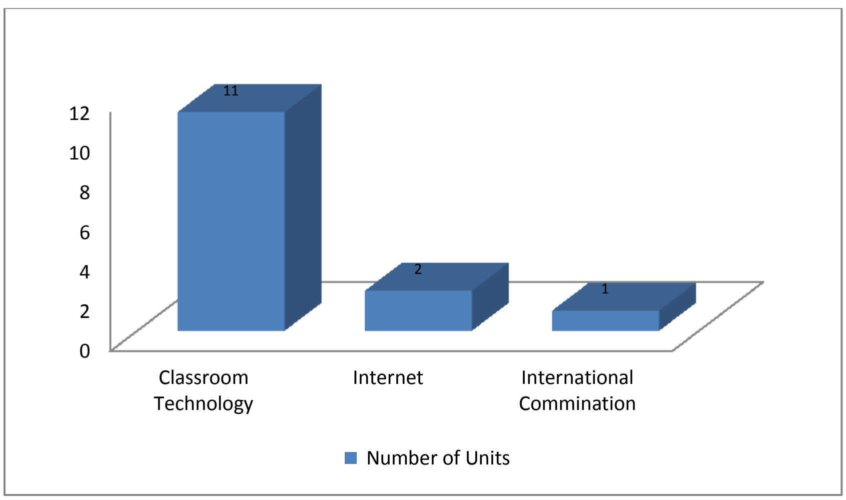

Figure 20. Technology Use: Categories and Units

Traditional Assessment

The sixth theme emerged was “Traditional Assessment” with 14 units and one category-“Testing”. This theme included responses that mentioned the type of assessment used in Tatweer schools. Fourteen were on the category of “Testing.” For example, one respondent mentioned:

On the test the questions are either essays or objective questions.

And another teacher insisted the type of assessment used:

Traditional assessments.

Advanced Technologies

The seventh theme emerged was "Advanced Technologies" with six units and four categories. This theme included responses showed the advanced technologies used by Tatweer school teachers. Two units were on "Classroom Technology". One advanced classroom technology mentioned was smart board; unfortunately it hadn't been used yet:

We have interactive whiteboards, but we haven't used them, yet.

Another category was "Communication" with two units. One teacher stated the use of smart phones and social networking:

I communicate with students via smart phones and social networking websites.

The last two categories in this theme were "Publishing" and "Films" with one unit for each. Chart 21 displays the categories and their units for the theme of "Advanced Technologies."

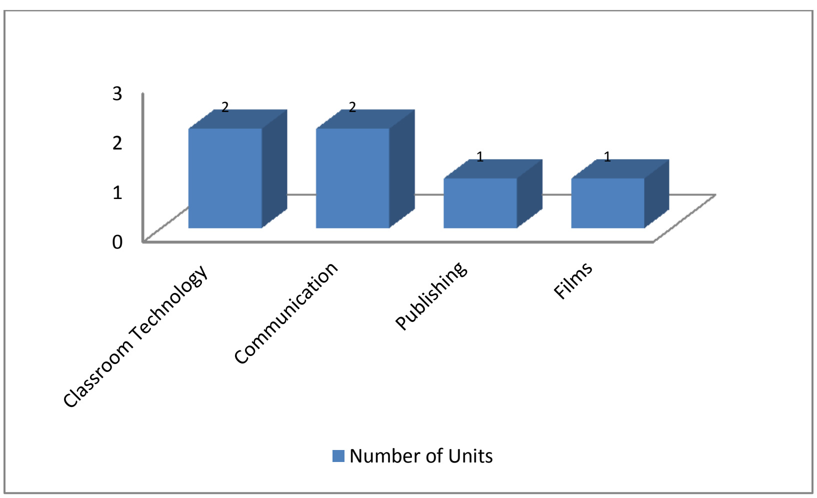

Figure 21. Advanced Technologies: Categories and Units

Outside-Class Enrichment Activities

The eighth theme emerged was “Outside-Class Enrichment Activities” with five units and three categories. This theme included responses showed the out of class enrichment activities, which were mentioned by Tatweer school teachers to support teaching and learning process. Three units were on “Field Trips”, and one unit each for the other two categories; “Community Contact” and “Community Services”. One teacher mentioned an activity he/she did as:

Train student for volunteer community services.

Chart 22 displays the categories and units of “Outside Class Enrichment Activities”

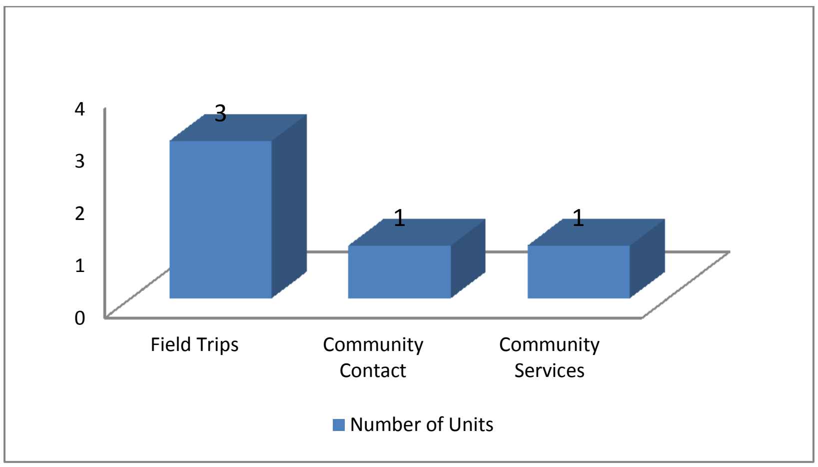

Figure 22. Outside Class Enrichment Activities: Categories and Units

Advanced Teaching Methods

The ninth theme emerged was “Advanced Teaching Methods” with four units and three categories. In this theme, respondents mentioned some advanced teaching methods applied in Tatweer schools. One method was “Educational Games”, which was mentioned by two participants. The other two categories were “Internet Quizzes” and “Internet Knowledge” with one unit for each category. One participant indicated that:

The best website I benefited from is "My language" and I use some websites to publish students' works.

Chart 23 shows the categories and units for this theme.

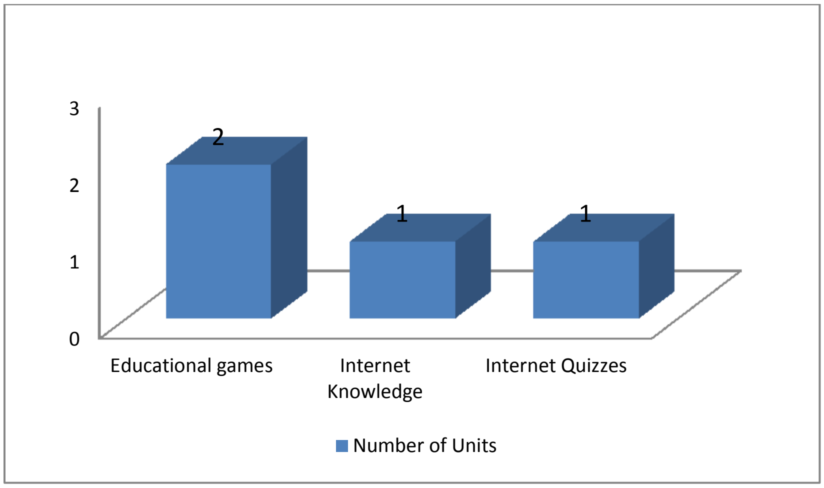

Figure 23. Advanced Teaching Methods: Categories and Units

Curriculum Flexibility

The tenth theme emerged was "Curriculum Flexibility" with four units and two categories. Participants indicated some aspects related to flexibility in the curriculum to support PBL. One category was "Somewhat Flexible Curriculum," with three units. One participant indicated that:

In some subjects, students can choose what they learn.

The second category emphasized student freedom to choose among subjects - "Subject Options," which had one unit. One teacher said:

Choosing what to learn is relative.

Chart 24 shows the categories and units for this theme.

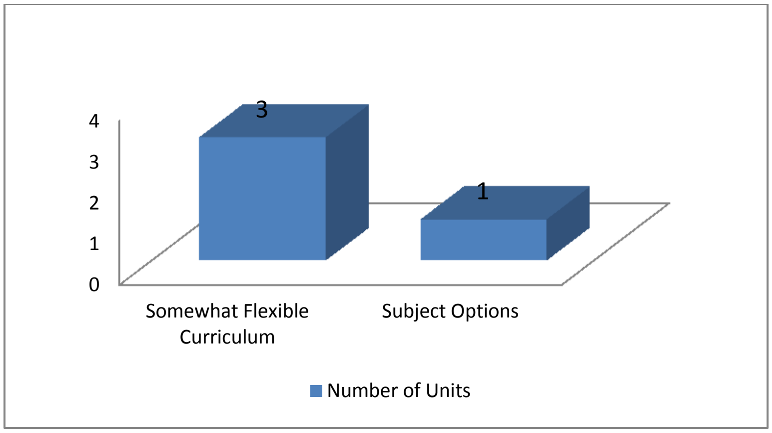

Figure 24. Curriculum Flexibility: Categories and Units

PBL Support

The eleventh theme emerged was “PBL Support” with three units and two categories. Participants indicated to some aspect that could support PBL implementation. Two units were on “Flexible Classroom Structure”. One participant said:

The learning environment at my school allows to apply PBL, preparing posters easily because each teachers has his own classroom (Moving classrooms).

Another category was “Less Number of Subjects” with one unit. One respondent indicated that:

A decreased number of subjects is needed.

Chart 25 shows categories and units of the “PBL Support” theme.

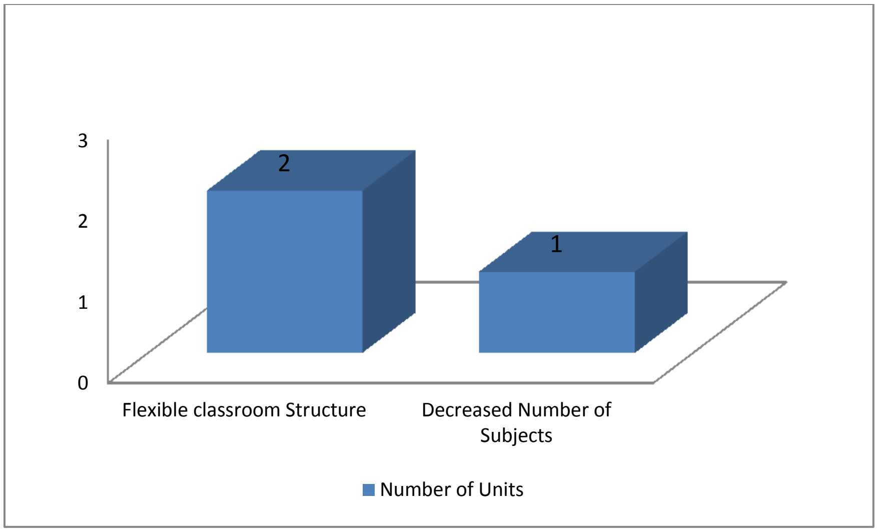

Figure 25. PBL Support: Categories and Units

Teacher Dedication

The Twelfth theme emerged was “Teacher Dedication” with three units and three categories. In this theme, participants indicated to their personal efforts in issues related to the teaching and learning process. One category was “Teacher Effort” with one unit. Another category found was “Female Teacher Volunteer Work”. One female teacher said:

Teachers (female) work voluntarily to improve school performance.

The last category in this theme was “Personal Development” with one unit. One respondent indicted that:

Teacher tries to improve himself/herself that fits the nature of his/her content area, which leads to create teaching strategies that encourage students to gain research skills.

Chart 26 displays “Teacher Dedication” theme’s categories and units.

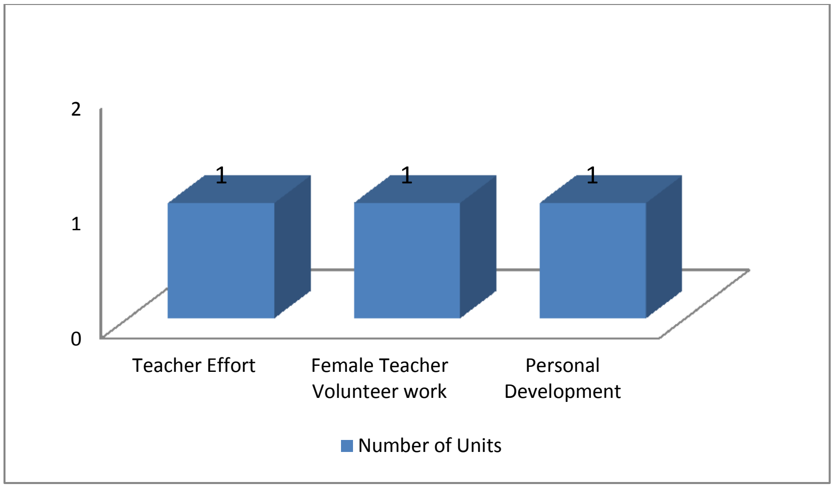

Figure 26. Teacher Dedication: Categories and Units

Survey Items

The Thirteenth theme that emerged was “Survey Items” with three units and two categories. Two units were on “Survey Completeness”. When asked about other items can be added to survey items, one participant said:

Nothing, everything was mentioned.

Another category in this theme was “Survey Inadequacy” with one unit. One respondent mentioned:

Some questions are unclear.

Chart 27 shows the categories and units for this theme.

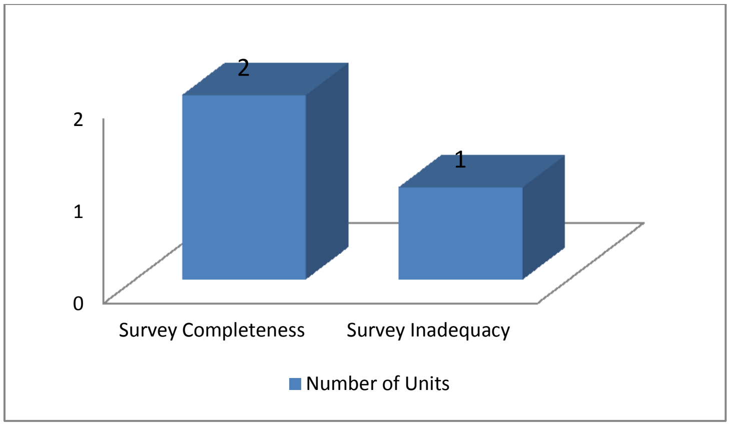

Figure 27. Survey Items: Categories and Units

Curriculum

The fourteenth theme emerged was “Curriculum” with two units and two categories. In this theme, participants indicated to aspects related to PBL curriculum. One category was “Content Coverage” with one unit. One teacher said:

We don’t have this type of learning; what is important is content coverage.

Another category found in this theme was “PBL Activities” with one unit also. One participant mentioned that the new text book included some activities that support PBL.

One of the most important technology or mean from my point of view to support PBL is that the new textbooks include activities to support PBL.

Chart 28 shows categories and units for this theme.

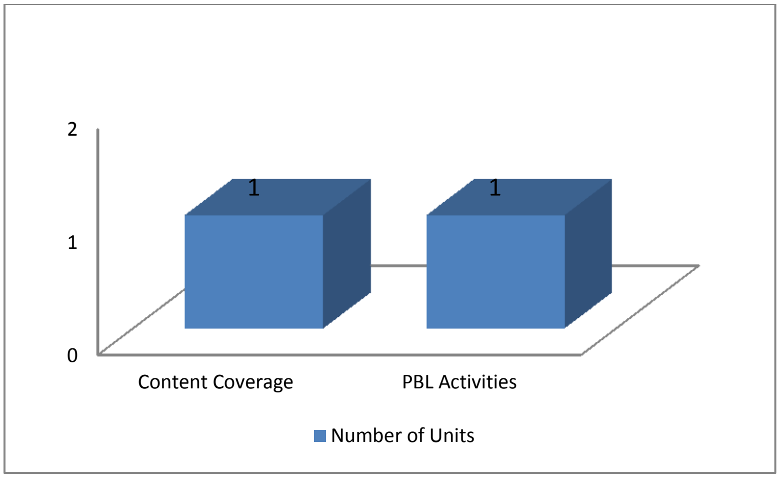

Figure 28. Curriculum: Categories and Units

Alternative Assessment

The fifteenth theme emerged was "Alternative assessment" with one unit and one category "Continual Assessment". One participant mentioned that he/she used continual assessment types.

Multi-Types Assessment

The sixteenth theme emerged was "Multi-Types Assessment" with one unit and one category "All Types of Assessment". One participant said:

Students are assessed using all types of assessments mentioned above.

The assessment items in the survey included both traditional and alternative types of assessment.

Mandatory Curriculum

The seventeenth theme emerged was "Mandatory Curriculum" with one unit and one category "Inflexible Curriculum". One participant mentioned the curriculum as:

Curriculum is mandatory. (No choices in education).

Student Growth

The eighteenth theme emerged was “Student Growth” with one unit and one category “Values Development”. One participant mentioned teacher work as of:

Development of love, empathy, and belonging (dedication).

Researcher Good Will

The last theme emerged was “Researcher Good Will” with one unit and one category “Encouragement”. One participant said to the researcher:

I wish you the best.

Chapter Summary

The data in this study were obtained from the responses of 640 Tatweer school teachers. Both quantitative and qualitative data were collected through closed-ended and open-ended questions. The data were analyzed using quantitative measures (descriptive data analysis and inferential analysis) and qualitative measures (units, categories, and themes). Descriptive analysis of respondents’ characteristics was run first. Results indicated that 50.9% were male and 49.1% were female. It is also found that 93.9% of the participants had a bachelor degree and 5.3% had a master’s degree while only 0.8% had a Ph.D. degree. Most of the Participants (81.4%) were found to have educational degree and less (18.6%) were not. Most of the participant (52.2%) had more than 15 years of teaching experience, 24.4% had 11-15 years of teaching experience, 14.7% had 6-10 years of teaching experience, and only 8.8% had 1-5 years of teaching experience. Respondents were found to represent all school levels almost equally: high school (37.2%), intermediate (33.1%), and elementary (29.7%). Islamic Studies teachers were the largest number among participants (18.3%) while the general teachers were the smallest number (3.6%). The second largest teachers participated in the study was Arabic studies teachers (17.0%) followed by science teachers (15.9%). Participants among other subjects were as follows: Mathematics 13.3%, Social studies 10.3%, practical subjects 9.8%, English 7.3%, and computer science 4.4%.

Research question one results: Based on Pillai's test, factorial MNOVA results indicated that gender and school level were statistically significant at $p < .05$ while other teacher characteristics (degree types, educational degree, years of teaching experience, and content area) including their interaction were not. Therefore, participants' PBL practices were influenced by their gender and the H_0 *1.1* null hypothesis was rejected. According to the ANOVA results, gender effects on PBL practices were found statistically significant on both teacher roles (F (1,403) = 17.77, partial η^2 = .042, $p < .05$) and learning environment (F (1, 403) = 10.83, partial η^2 = 026, p < .001). Mean comparison indicated that Tatweer male (M= 3.056, SD= .661) and female (M= 2.825, SD= .534) teachers significantly differed in their roles related to PBL practices (t(633) = 4.84, $p < .05$). It is also found that Tatweer male (M= 2.903, SD= .674) and female (M= 2.619, SD= .614) teachers significantly differed in the learning environment related to their PBL practices (t(633) = 5.55, $p < .05$). Participants' PBL practices were also influenced by their school level. Therefore, H_0 *1.5* null hypothesis was rejected. According to the ANOVA results, school level effects on PBL practices were found statically significant on school system (F (2,403) = 5.26, partial η^2 = .025, at $p < .05$). *Post hoc* test results indicated that there was a significant difference between elementary (N= 190, M= 2.56) and intermediate (N= 209, M= 2.69) school participants in terms of school system, with mean difference equals to -.13, $p < .05$, which indicated that intermediate school participants' PBL practices related to school system were significantly better than elementary participants. Results also showed that there was a significant difference between elementary (N= 190, M= 2.56) and high (N= 236, M= 2.75) school participants in terms of school system, with mean difference equals to -.20, $p < .05$, which indicated that high school participants' PBL practices related to school system were significantly better than elementary participants. It is also found that there were no significant differences between intermediate and high school participants in terms of their PBL practices related to school system; mean difference was .061, $p > .05$.

Research question two results: Results of using International Society for Technology in Education National Education Technology Standards for Teachers in Tatweer classrooms were analyzed through descriptive analysis to describe and summarize the findings by reporting frequencies, mean, mode, and standard deviation. The highest use of technology by Tatweer teachers found was "using technology in teaching to model collaborative knowledge construction by engaging in learning with students, colleagues, and others" (M= 3.22, SD= .78) followed by "using technology in teaching to customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities" (M= 3.08, SD= .84). The least use of technology by Tatweer teachers found was "using technology in teaching to help students to interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media" (M= 2.82, SD= .87). In general, results showed good uses of technology by Tatweer teachers based on ISTE NETS.T as the highest response in all items was "Somewhat Agree" (See Figure 11).

Research question 3 results: Results of the purposes of using technology in PBL projects by Tatweer teachers were analyzed through descriptive analysis to describe and summarize the findings by reporting frequencies, mean, mode, and standard deviation. The highest purpose technology used for was "to explore answers to PBL problems" (M= 2.53, SD= 1.02), followed by "to develop complex concepts" (M= 2.43, SD= 1.05). On the other hand, the least two purpose technology used for was “to use cell phones in PBL projects for student lessons (polling, etc.)” (M= 1.85, SD= 1.02) and “to use technology in PBL projects to schedule meetings with colleagues (e.g. Doodle)” (M= 1.85, SD= 1.04). In general results indicated that less uses of technology in PBL projects as the highest response in most of the items was “Never” or “Sometimes” (See Figure 12).

Results also showed few uses of classroom technologies by Tatweer school teachers. The highest technology used was whiteboard (M= 2.0, SD= 1.19), followed by Music players (iPod) (M= 1.82, SD= 1.03) and digital cameras (M= 1.81, SD= 1.05). The least classroom technology used was e-Readers (M= 1.59, SD= .96).

Qualitative measures: The qualitative data were obtained from the responses of the seven open-ended questions. Qualitative data were first, analyzed based on the research questions and then, Grounded Theory was used to code the qualitative responses in order to get deeper understanding about the nature of applying technology-assisted PBL at Jeddah Tatweer schools.

Research question one: Even though research question one has a quantitative nature, open-ended questions (7, 17, 30, 39) were included at the end of each section of the survey to give participants more opportunities to add ideas related to PBL practices that had not been included in the closed-ended items. Forty-six participants answered question seven. Two responses were found to give useful information for this question (one category and one theme). In survey question 17, 24 responses were found, which yielded to three units of useful information (two categories and two themes). In survey question 30, 19 responses were found, which resulted in four units of useful information (two categories and one theme). Responses for survey question 39 were 20 answers, which yielded to three units of useful information (two categories and two themes).

Research question two: Survey question number 50 focused on items related to the use of technology based on the International Society for Technology in Education National Education Technology Standards for Teachers. Nine responses were found for this question. One unit of information was found to be pertinent to this question and was coded as "Technology Use".

Research question Three: Survey question number 64 focused on the use of technology in PBL projects. While 13 responses were found to this question, none of them were useful in answering the question. Survey question number 71 focused on the use of specific classroom technologies in teaching. There were 24 responses to this question. Sixteen were found to be related to the question (three categories and one theme).

Grounded Theory analysis: After analyzing the open-ended question responses, there were 177 units, 73 categories, and 19 overall themes found. "Technology Access" was the highest found (45 units and 11 categories). Most of the responses focused on "Lack of Technology" and more specifically on "Classroom Technology", such as the interactive white board (smartboard). There was also emphasis on the offering of technologies through personal teacher effort, rather than the Ministry of Education or the school district. "PBL Obstacles" was the second highest theme found in the responses (34 units and 17 categories). The focus of this theme was on "High Student Number" (per class), "Flexible Schedule", "Classroom Facilities", and "Classroom Space/Design". "Teaching Methods" was the third theme emerged (19 units and four categories). Responses focused on "Traditional Teaching" and "Cooperative Learning". The fourth theme found was "Professional Development" (16 units and 11 categories). Responses focused on preparing teachers for the new curriculum and the use of technology through on-site and continual training. The fifth theme that emerged was "Technology use" (14 units and three categories). Respondents mentioned projectors, computers, and laptops as the most used classroom technologies in addition to some internet uses. The sixth theme was "Traditional Assessment" (14 units and one category- "Testing"). The seventh theme emerged was "Advanced Technologies" (6 units and four categories). Examples of technology used included "Classroom Technologies", such as smart board, and "Communications", such as using smart phones and social networking to communicate with students and publishing students' work on YouTube. The eighth theme was "Outside-Class Enrichment Activities" (five units and three categories). Examples mentioned included field trips, community contact, and community services. "Advanced Teaching Methods" and "Curriculum Flexibility" themes contained four units. Three themes were found to include three units for each: "PBL Support", "Teacher Dedication", and "Survey Items". "Curriculum" was found to include two units and two categories. Six themes were found to have one unit only for each one: "Alternative Assessment", "Multi-Types Assessment", "Mandatory Curriculum", "Student Growth", and "Researcher Good Will".

Chapter 5 - Summary, Discussion, and Recommendations

Chapter Overview

The purpose of this study was to examine teacher practices of enabling factors in the implementation of technology-assisted PBL in Tatweer schools in Jeddah, Saudi Arabia. This study also sought to explore how the International Society for Technology in Education (ISTE) National Education Technology Standards for Teachers (NETS.T) were used in Tatweer classrooms and for what purposes technology was used to support PBL in the Tatweer schools. Using a survey included closed and open-ended items, the study explored the following research questions:

1. Is there a significant difference between Tatweer teacher general characteristics (gender, types of degree, educational degree, years of teaching experience, school level, and content area) and their project-based learning practices?
2. How are the International Society for Technology in Education National Education Technology Standards for Teachers used in Tatweer classrooms?
3. For what purposes do Tatweer teachers use technology in PBL projects?

This chapter presents a summary of quantitative and qualitative data analysis and findings. It also discusses them. Finally, recommendations for Jeddah Tatweer schools and for the future studies are presented.

Summary

Data Screening

To be prepared for analysis, especially factorial MANOVA, data were first screened. Using deletion and missing values replacement based on researcher knowledge techniques, total valid survey number was 640 with 59.65% response rare. Although unequal cell sizes were exited in some variables, the large sample size and having more than 20 cases in the smallest cell made this not a problematic issue as asserted by Tabachinck and Fidell (2007). The one exception found was in the cell of Ph.D. degree respondents since there were only five cases. Therefore, Ph.D. degree respondents were excluded from the MONOVA analysis. Results of the evaluation of assumptions of normality, outliers, multicollinearity and singularity were satisfactory. The assumption of homogeneity of variance-covariance matrices was violated. Therefore, Pillai's test was used instead of Wilks' lambda because it is more robust in this case (Field, 2009; Tabachnick & Fidell, 2007; Warner, 2008).

Characteristics of the Respondents

Both male and female were represented about equally in the study. There were 326 male and 314 female valid responses. Most of the participants (93.9%) had a bachelor degree and very few (5.3%) had a master degree while only 0.8% had a Ph.D. degree. Most of the participants (81.4%) had a degree in Education and less (18.6%) did not. More than half of the participants were found to be experienced in teaching (more than 15 years). About quarter of the participants had 11-15 years of teaching experience while 14.7% had 6-10 years and only 8.8% had 1-5 years of teaching experience. All the three school levels were represented about equally in the study. Slightly more than a third of the participants were high school teachers, a third of the participants were intermediate teachers, and a little bit less than a third were elementary teachers. More than a third of the participants were Islamic Studies (18.3%) and Arabic Studies (17.0%), which was expected, since Islamic studies and Arabic Studies weigh heavily in the Saudi curriculum. Also, slightly less than one third of the participants were Science (15.9%) and Mathematics (13.3%) teachers. The rest of the participants were: 13.3%, Social Studies 10.3%, Practical Subjects 9.8%, English 7.3%, Computer Science 4.4%, and 3.6% General Teachers.

Quantitative Measures

Research Question #1

"Is there a significant difference between Tatweer teacher general characteristics (gender, types of degree, educational degree, years of teaching experience, school level, and content area) and their project-based learning practices?"

Based on Pillai's test results, factorial MANOVA analysis indicated that participants' PBL practices were influenced by their gender and school level at $p < .05$ level. According to the ANOVA results, gender effects on PBL practices were found to be statistically significant for both teacher roles (F (1,403) = 17.77, partial η^2 = .042, $p < .05$) and learning environment (F (1, 403) = 10.83, partial η^2 = 026, p < .001). In teacher roles related to PBL practices, the mean comparison indicated that Tatweer school male teachers (M= 3.056, SD= .661) were better than their female counterparts (M= 2.825, SD= .534). It is also found that Tatweer school male teachers rated their learning environment to support PBL (M= 2.903, SD= .674) better than the female teachers (M= 2.619, SD= .614). This means that Tatweer boy's schools had better learning environment and more advantages to apply PBL than girl's Tatweer schools, which made male teachers' role better than female teachers' role related to PBL practices.

Tatweer school teacher PBL practices were also influenced by their school level. ANOVA results showed that school level effects on PBL practices were statistically significant on school system (F (2,403) = 5.26, partial η^2 = .025, at $p < .05$). Based on *Post hoc* test results, there was a significant difference between elementary and intermediate schools. The intermediate school system (N= 209, M= 2.69) was found to be better in supporting PBL practices than the elementary school system (N= 190, M= 2.56). *Post hoc* test results also indicated that there was a significant difference between the elementary and high school system. The high school system (N= 236, M= 2.75) was found to be better in supporting PBL practices than the elementary school system (N= 190, M= 2.56). No significant differences were found between intermediate and high school system (mean difference = .061, $p > .05$). The other Tatweer teacher general characteristics (types of degree, educational degree, years of teaching experience, and content area) were not found to be statistically significant. The interaction between Tatweer teacher general characteristics was not significant.

Research Question 2

"How are the International Society for Technology in Education National Education Technology Standards for Teachers used in Tatweer classrooms?"

Descriptive analysis results showed that the highest response for all items (40-49) was "Somewhat Agree" (See figure 11), which indicated good use of technology by Tatweer teachers based on ISTE NETS.T.

Research Question 3

"For what purposes do Tatweer teachers use technology in PBL projects?"

Descriptive analysis results showed that the highest response in all items (51-63) was either “Never” or “Sometimes” (See figure 12). This indicated that there were few uses of technology by Tatweer teachers in PBL projects. Descriptive analysis also indicated that there were few uses of classroom technology by Tatweer school teachers. The highest response found was “Never” in all items (65-70) (see figure 13).

Qualitative Measures

Research Question 1

Regardless of the quantitative nature of the research question one, survey items included four open-ended questions related to this research question to give participants opportunities to add more information not included in the closed-ended items related to PBL practices. In survey question seven, among the 46 responses two responses were found to have useful information and formed one category “Traditional Teaching” and one theme “Teaching Methods”. In survey question 17, three units of useful information were found with two categories: “Traditional Teaching” and “Content Coverage” and two themes: “Teaching Methods” and “Curriculum”. In survey question 30, four units of useful information found with two categories: “Classroom Design” and “Number of Students” and one theme “PBL Obstacles”. In survey question 39, three units of useful information found with two categories: “Testing” and “Continual Assessment” and two themes: “Alternative Assessment”.

Research Question 2

Nine responses were found for survey question 50. One unit of useful information was found with one category “Communication” and “Technology Use” theme.

Research Question 3

There were 13 answers to survey question 64. None of them were found useful to the focus of research question three. In survey question 71, 24 answers were found with 16 units of useful information that formed three categories “Projector”, “Computers”, and “Laptop”, which formed the theme of “Classroom Technology”.

Grounded Theory Analysis

Grounded Theory was applied to further code open-ended responses. Based on open coding of the 177 responses, 73 categories and 19 overall themes emerged. “Technology Access” was the largest them found with 45 units and 11 categories. Responses focused on “Lack of Technology”, “Classroom Technology”, and “Teacher offers Technology”. Thirty-four units were found in the second theme “PBL Obstacles” with 17 categories. Obstacles mentioned focused on “High Students Number”, “Flexible Schedule”, “Classroom Facilities”, “Classroom Design/Space”, “PBL Environment”, and “Motivation Lack”. “PBL Support” theme emerged with three units and two categories “Flexible Classroom Structure” and “Less Number of Subjects”. Another theme was “Professional Development” with 16 units and 11 categories. While “Teacher Preparation” mentioned by four responses, “Technology Training” was mentioned by two responses. “Needs Assessment” was another category with two units focused on the need to assess teacher needs before applying PBL. “Teaching Methods” theme emerged with 19 units and four categories. “Traditional Teaching” category was repeated 11 times while “Cooperative Learning” category repeated six times. Each of “Student Products” and “Presentation Modes” were mentioned once. The theme of “Advanced Teaching Methods” was found with four units and three categories “Educational Games”, “Internet Quizzes”, and “Internet Knowledge”. The “Technology Use” theme, with 14 units and three categories, emerged. Eleven units were found in the category of “Classroom Technology” while “Internet” included two units and “International Communication” included one unit. “Advanced Technologies” theme emerged with six units and four categories. Categories included “Classroom Technology”, Communication”, “Publishing”, and “Films”. “Traditional Assessment” theme included one category “Testing” with 14 units while the “Alternative Assessment” theme included one unit and one category “Continual Assessment”. The theme of “Multi-Types Assessment” also included one unit and one category “All Types of Assessment”. Four units were found on “Curriculum Flexibility” theme with three categories: “Somewhat Flexible Curriculum”, “Flexible Curriculum”, and Subject Option”. “Curriculum” theme was also found with two units and two categories: “Content Coverage” and “PBL Activities”. “Outside-Class Enrichment Activities” theme emerged with five units and three categories: “Field Trips”, “Community Contact”, and “Community Services”. Another theme emerged was “Mandatory Curriculum” with one unit and one category “Inflexible Curriculum”. Three units were found on “Teacher Dedication” theme, which formed three categories: “Teacher effort”, “Female Teacher Volunteer Work”, and “Personal Development”. “Survey Items” theme included three units, which formed two categories: “Survey Completeness” and “Survey Inadequacy”. Two more themes emerged with one unit each were “Student Growth” and “Researcher Good will”. Axial coding was applied to further relate (categories and concepts) and will be discussed later in this chapter.

Discussion

The following discussions and conclusions are based on the results of both quantitative and qualitative data analysis. They are organized according to each research question and provide the implications and significance of the results obtained applicable to technology-assisted PBL in Jeddah Tatweer schools.

Research Question 1

"Is there a significant difference between Tatweer teacher general characteristics (gender, types of degree, educational degree, years of teaching experience, school level, and content area) and their project-based learning practices?"

Factorial MANOVA results indicated that Tatweer school teacher PBL practices were influenced by their gender at the $p < .05$ level. A statistically significant difference was found between male and female teachers in their roles related to PBL practices. Results also indicated that Tatweer school male teachers rated their PBL learning environment better than the female teachers. This means that in Tatweer boy's schools teachers had more advantages than teachers in girl's Tatweer schools, which helped male teachers to have better teacher roles related to PBL practices than did female teachers. Even though no study found in the literature compared male and female PBL practices, gender differences found in the current study confirms the gender differences found in AlZahrani (2004) study, who examined the attitudes of Saudi high school Mathematics teachers regarding the use of calculators in teaching Mathematics. He found that male and female teachers differed in the factors that they identified as affecting the use of calculators in teaching Mathematics.

These differences might be interpreted as being an element of the Saudi educational system and culture. For example, female teachers usually have a higher teaching load than male teachers, which gives male teachers more time for classroom visitations and instructional coaching. Also, male teachers have more opportunities to attend professional development training, usually provided in places outside the school, like the educational training centers (means for the item of PBL professional development offered were: male= 3.18, female= 2.84). In addition, when compared to girl students, boy students could easily participate in outside-class activities, such as field trips and community service (means for participation in community services were: male= 2.86, female= 2.37).

Factorial MANOVA results also showed that Tatweer teacher PBL practices were influenced by school level $p < .05$ level. ANOVA and *post hoc* test results indicated that there were significant differences between elementary and intermediate schools and between elementary and high schools in school system support of PBL. School system support of PBL was found to be better in intermediate schools than in elementary schools. It was also found that school system support of PBL was better in high schools than in elementary schools, as rated by respondents. While the Al-Abdulkareem (2004) study population included teachers from all school levels (elementary, intermediate, and high), the study did not aim to compare teacher practices in inquiry-based learning in science teaching among different levels (elementary, intermediate, and high). Therefore, differences between participant school levels were not reported. School level difference was significant in examining the alignment of technology uses with the National Educational Technology Standards for Teachers in the U.S. (Bergacs, 2008). Having better school system support of PBL at high and intermediate schools, when compared to elementary schools, was expected, particularly in the higher levels of education, which get more attention by educational stakeholders and the public, since the high school GPA determines his/her college admission. Several reform initiatives (e. g., *Developing Secondary Education*, *Comprehensive Secondary Education)* had been performed on targeted high school education, specifically. In addition, high school teachers in Saudi Arabia are selected carefully with more specific criteria than other levels. For example, a teacher with a general Science Bachelor's degree can't teach Chemistry, Biology, or Physics; he/she should have a specific major like Chemistry in order to be allowed to teach Chemistry in high school.

However, in the elementary school a teacher with any Bachelor degree, such as Arabic Studies, can teach Science, for example. Therefore, high school teachers usually are found to be more open to adopt new curriculum and teaching methods and they also have greater support from principals and the school system, in general.

Moreover, some survey items in the school system section seemed to fit high and intermediate schools more than elementary schools. For example, in the item: “My school uses block or flexible scheduling to allow for extended periods for working on projects or other activities”, it was expected that high and intermediate school teachers would respond positively to this item more than the elementary school teachers, since the nature of elementary classes is that they don’t fit extended periods. The item, “My school requires senior or capstone projects for students to demonstrate readiness for the next grade or to graduate,” was more likely to have a more positive response by high school teachers, since it is required in high schools for some subjects, while it is not required in elementary schools.

While responses to open-ended questions related to research question one included very little useful information for the dependent variables examined in this question, an indication of the nature of PBL practices at Tatweer was found. Therefore, a detailed discussion for open-ended question responses will be left to the grounded theory section. Both male and female responses to open-ended survey question seven indicated that Tatweer School teacher roles focused on “Traditional Teaching”. One female participant mentioned:

We don’t practice PBL.

A male participant emphasized the same idea:

We don’t have PBL, we only have teaching via lecture.

Other responses explained participant lack of PBL understanding. One female teacher responded to teacher roles in PBL as:

Cooperative learning. We teach students research skills in simple ways.

A male teacher responded to the same question as:

One of the most important technologies or means, from my point of view, would be to support PBL with new textbooks that include activities to support PBL.

Some qualitative responses to survey question seven can be used to explain gender differences found in the quantitative results. For example, one male teacher mentioned the availability of some training programs to prepare teachers for PBL:

From time to time there are some training programs to prepare teachers and give them skills needed for the teaching strategies.

However, female teachers mentioned their need for such training programs. One female teacher emphasized this importance:

Intensive training programs need to be offered.

In an indication of the difficulty of attending training offered outside the school, another female teacher said:

Having on-site (school) coaching to help teachers to apply PBL would be good.

These responses emphasized the differences between male and female teachers in professional development provided and require the Ministry of Education to take actions that help female teachers to have the same training opportunities as the male teachers through offering more appropriate professional development for teachers in girl schools. In addition, in order to fulfill the Tatweer schools' mission of active learning strategies, actions should be taken to help teachers have better roles in order to act as facilitators who design learning activities using high-ordered thinking skills (Tatweer, n.d.).

Responses to open-ended question 17, which focused on PBL practices related to the school system, also showed very little useful information on the research question. Two categories emerged that also emphasized that "Traditional Teaching" and "Content Coverage" were supported by the school system, rather than PBL. One male elementary teacher mentioned PBL as being an:

Unknown step.

A male intermediate teacher said:

We don't have this type of learning. What is important is content coverage.

Supporting the same idea, a female high school teacher insisted that:

We don't have PBL.

The problem of not applying PBL because of the lack of time and content coverage, rather than skills acquisition, confirmed results found in studies conducted in the U.S. and Saudi Arabia. In the U.S. McGrath and Sands (2004) study found that high school teachers didn't apply PBL, as a result of having to prepare students for the test, so the time spent to cover content was needed rather than in working in working on projects. Also in the U.S., Luehman (2001) and Toolin (2004) found content to be covered was a concern for teachers in applying PBL. In Saudi Arabia, Participants in the Basamh (2002) study mentioned the amount of content to be covered as being an obstacle in applying cooperative learning. Content coverage was also found as an obstacle in applying inquiry-based learning in science teaching in S. Al-Abdulkareem (2004) study. Since knowledge is endless and schools can't provide students with "all" knowledge in a specific subject, what is most important is to provide learners with the needed skills to be proficient and skillful in order to compete in today's knowledge-based economy. The new curriculum adopted more student-centered approaches and focused more on skills (Tatweer, n.d.). However, as the researcher noticed from his daily school visitation as a Chemistry consultant in Jeddah, the system still requires teachers to focus on the coverage of lengthy textbooks, which have placed pressure on teachers to get through material and have made them unwilling to apply the new strategies, such as PBL. Therefore, Tatweer school leaders might want to think of taking action to close the gap between the school's curriculum framework and needed instructional practices.

Even though quantitative results found that the school system was significantly affected by school level (elementary, intermediate, and high), there were not enough responses in this question to compare participant responses for the school system. Among the 24 responses to this question, 18 were high school, five intermediate, and one elementary. Very little useful information was found, but information that was present indicated that the Tatweer schools still supported traditional teaching over PBL.

Among the nineteen responses to question 30, which focused on the learning environment related to PBL practices, eight units of useful information were found and formed the "PBL Obstacles" theme. Quantitative results indicated a significant difference between male and female responses related to PBL learning environment. Similarly, male and female qualitative responses were found to have some differences, as well. Both male and female teachers mentioned having a large number of students per class as an obstacle to implementing PBL successfully. One male teacher said:

> *We have a large number of students in the classes, which doesn't support individualizing learning.*

Similarly, one female teacher asserted that:

The large number of students in classrooms doesn't support PBL.

Teachers in the Basamh (2002) study also mentioned this problem when they indicated that the number of students per classroom hindered them from implementing cooperative learning. This result also supported the S. Al-Abdulkareem (2004) study, which stated that class size hindered participant inquiry-based leaning implementation. While the S. Al-Abdulkareem (2004) study examined teacher attitudes and perceptions, the current study examined teacher practices, which made findings more reliable in reflecting the application of student-centered learning teaching strategies.

Quantitative results showed that male (M= 2.80) and female (M= 2.17) participants differed in their rating of appropriate physical classroom arrangement for PBL. Qualitative results confirmed this difference, since responses showed that only female participants indicated the inappropriateness of classroom design with PBL, which requires student movement and working in groups, for example. One female participant wrote:

There are no suitable classrooms for PBL.

This idea was further asserted by another female participant:

We need to have appropriate classes and space for PBL.

The Freshwater (2009) study also pointed out the need for a change in classroom design and the difficulty to perform PBL activities within the limitations of rigid classroom space.

Female participants also mentioned the need to offer materials needed for PBL. This need was not mentioned by the male participants. One female teacher said:

Materials required to apply PBL are not offered.

This concern supports the Freshwater (2009) findings in which students ranked limited resources as the first barrier and teachers ranked this as the second highest barrier to implementing PBL. Male and female differences related to the learning environment were also found in the current study, especially in classroom design, since there is a different school design for boy's and girl's schools in Saudi Arabia. Classrooms need to be redesigned to fit the needs of the new teaching methodology and learning strategies to be adopted by the new curriculum. In addition, since the Tatweer school framework emphasized (Tatweer, n.d.) technology use, schools should offer the required equipment, instruments, and resources, such as computers, projectors, internet connections, and science laboratory equipment, in order to better serve these new learning strategies.

Responses to question 39, which focused on the types of assessment applied at Tatweer schools, showed that traditional assessment was pervasive. Responses indicated different types of traditional assessment, such as objective and essays and tests.

Questions include both essays and objective questions.

However, one respondent indicated the need for authentic assessment as he wrote:

We need continual assessment.

This result confirms the quantitative results, which found that "multiple choice or short answer test" the highest type of assessment used by Tatweer school teachers (M= 3.30). This result agrees with Rogers et al. (2010), since teachers pointed out their concern about student mastery of basic concepts if PBL was applied. Moreover, about one-third of the participants (30 teachers) in the Luehman (2001) study indicated that assessment and hands-on activities were concerns in applying PBL. Though Tatweer schools has adopted more authentic assessment practices (Tatweer, n.d.), teacher practices indicated that traditional testing was still preferred by schools, especially since this type of assessment can be prepared and scored easily. Another reason might be the lack of teacher skills and technology needed to prepare and apply authentic assessments, such as hands-on demonstrations, digital portfolios, and group projects.

Research Question 2

"How are the International Society for Technology in Education National Education Technology Standards for Teachers used in Tatweer classrooms?"

Descriptive analysis, through reporting the mean, median, mode, standard deviation, and frequencies, was utilized to summarize the use of the International Society for Technology in Education National Education Technology Standards for Teachers in Tatweer classrooms. Overall results showed good use of technology by Tatweer teachers based on ISTE NETS.T. The most frequent response found in all items was "Somewhat Agree".

The highest use of technology by Tatweer teachers found was "using technology in teaching to model collaborative knowledge construction by engaging in learning with students, colleagues, and others" (M= 3.22, SD= .78). This use of technology included the growth of social networking tools, such as Facebook and Twitter, among Saudis in recent years. Utilizing these technologies in educational activities is very significant progress in Saudi education. This provides an indication of the positive impacts of the recent initiatives of the Ministry of Education to integrate educational technology into Saudi education, such as participation in the Intel Education for Future Program and the Microsoft worldwide "Partner in Learning" program. In recent years smart phones have been spread in the Saudi community and "WhatsApp" application has been used to create social and fewer professional groups, which can be used as a useful professional development tool for teachers and other educators. The least use of technology by Tatweer teachers was in "using technology in teaching to help students to interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media" (M= 2.82, SD= .87). Although this use was the lowest, it had a very good mean, which still reflected the alignment of Tatweer school teacher technology use with ISTE NETS.T, but with more variations, which might indicate school differences in technology use.

Reponses to open-ended question fifty, which focused on other items related to how the International Society for Technology in Education National Education Technology Standards for Teachers were used in Tatweer classrooms, had one useful unit of information only. As found in the quantitative results, one respondent emphasized the use of smart phones and social networking to communicate with students. Other open-ended responses for research question two and for both quantitative and qualitative responses to research question three indicated a lack of uses of newer technology in Tatweer schools. One participant mentioned the lack of technology as:

> *These types of technology are not offered in classrooms.*

Another participant said:

> *We rarely use technology because it is not offered. We only have Physics and Chemistry labs.*

This contradiction in the responses might be interpreted by teachers misunderstanding the question, which focused on Tatweer school teacher practices in using technology based on ISTE NETS.T, not their own knowledge. It might also be interpreted by cultural factors, since Saudi subjects tend to answer positively to survey questions. Campbell and Stanley (1963) mentioned this as one of the external validity threats known as *Hawthorne effect,* which occurs when participants respond differently as a result of being a research participant. It is also likely that technology varies by school, since there was variation in technology responses, not only between male and female teachers, but also between schools.

Research Question 3

For what purposes do Tatweer teachers use technology in PBL projects?

Descriptive analysis, through reporting the mean, median, mode, standard deviation, and frequencies were utilized to summarize the purposes of using technology in PBL projects by Tatweer teachers. Results showed few uses of technology in PBL projects, since the highest response in most of the items was “Never” or “Sometimes”. Responses showed mixed results in using technology in PBL. For example, low means were found for using technology for highly cognitive purposes, such as entering three-dimensional immersive spaces/virtual worlds for more authentic learning experiences (M= 1.97, SD= 1.05) or exploring complex systems and issues through simulation and gamming (M= 2.09, SD= 1.08). A better mean was found for using technology in developing complex concepts (M= 2.43, SD= 1.05). Better uses were found in simpler educational purposes, such as developing digital presentations like Power Point (M= 2.42, SD= 1.07) and in developing collaborative documents (M= 2.35, SD= 1.07). However, sharing ideas, resources, products, and publishing student work had a lower mean (M=2.0).

Overall results indicated more uses in the lower cognitive level tasks than in technology use to support high-order thinking skills. Nevertheless, the results showed improvement in technology use in the Saudi schools over what was found in the Al-Qurashi (2004) study, which indicated that teachers used technology for classroom management tasks more than to enhance student learning. These findings require the Ministry of Education to offer professional development programs that prepare teachers to use technology purposefully to create meaningful learning and support high-order thinking skills development.

Quantitative results for items asked about using specific classroom technologies in Tatweer classrooms also indicated few uses. The most common response found in all items was "Never". The most technology used was Whiteboards (M= 2.0, SD= 1.19), followed by Music Players (iPod) (M= 1.82, SD= 1.03) and Digital Cameras (M= 1.81, SD= 1.05). E-Readers (M= 1.59, SD= .96) was the least used. This result might indicate teacher lack of technology access or lack of skills needed to use these technologies in effective ways to support and improve the learning process.

While projectors and computers were mentioned as the only classroom technologies available in Tatweer classrooms, responses to open-ended questions 64 and 71, which focused on using technology in PBL projects, might be used to interpret the quantitative results of question three that indicated few uses of technology in Tatweer schools. In an indication of the lack of technology access, one respondent stated that:

Classrooms are not equipped by technologies.

Another teacher insisted that technology was not available unless provided by the teacher's personal effort:

Technology is offered by the teacher's own efforts and not by the school.

Similar results were found in previous studies in both the U.S. and Saudi Arabia, in which technology was not as prevalent as educators desired. In the U.S., in the Freshwater (2009) study, one participating principal indicated that the school could not afford the necessary technologies to support PBL properly. Other studies support the variability by school district in the US in not having enough computers or not having high speed internet connections at school to support PBL (Freshwater, 2009; Luehmann, 2001). Edelson et al., (1999) mentioned having slow and outdated computers as a PBL implementation obstacle. Technology and internet connectivity were ranked as the third barrier to ICT PBL implementation in the Kramer et al. (2007) study. Two studies indicate their importance in Saudi Arabia. The Al-Alwani study (2005) found that infrastructure support of technology was the most significant barrier to participants in using technology in Science teaching. Lack of technology, such as projectors, was rated as the largest obstacle to using technology in Mathematics teaching (Al-Qurashi, 2008), which is also an infrastructure issue.

Open-ended responses also indicated the lack of technology skills as an obstacle in using technology in PBL projects. One respondent mentioned this need:

Teachers need to be trained in using the new technologies.

This result supports previous studies. The Al-Alwani (2005) study found that the lack of technology-related professional development was rated as the second-highest barrier by participants. The study further stated that teachers who received both pre-service and in-service training were found to use technology more frequently than those who did not receive any training. The Al-Qurashi (2008) study also found that the lack of appropriate professional development was an obstacle for using technology in teaching Mathematics in the Al-Taif intermediate boy's schools. In the Alshumaim and Alhassan (n.d.) study, with a population that included male and female English teachers from five large educational regions in the Saudi Arabia, the greatest barrier mentioned by participants in using technology in their teaching was a lack of experience in using computers. In alignment with the Tatweer school framework, which requires the use of appropriate emerging technologies and digital resources to support high-ordered thinking skills (Tatweer, n.d.), all these findings indicate the need for offering appropriate technology in Tatweer schools and the need to provide training for teachers, particularly the teachers in the girls' schools, in using technology properly to support the teaching and learning process.

Grounded Theory

Though most of the information provided in the open-ended questions were found to be unrelated to the research questions, the responses provided useful information related to challenges in developing technology-assisted PBL. Therefore, Grounded Theory was utilized to better understand PBL implementation and technology uses in Tatweer schools. Open coding yielded 19 themes. Axial coding (phenomenon of interest, casual conditions, action strategies, and consequences) was then used to further relate codes (categories and concepts) to each other to reach a theory that could be used to explain the implementation of technology-assisted PBL in Tatweer schools in Saudi Arabia. Though 19 themes were found during the open coding stage, only the themes useful to the technology-assisted PBL phenomenon discovered will be mentioned during the axial coding stage.

The phenomenon of interest found from the open coding stage was "less PBL implementation and technology uses". Analysis of the themes emerging from the open coding stage yielded several causal conditions for this phenomenon. Many conditions were found under the "Technology Access" theme. Except for having an educational learning center containing about 30 computers and a projector, participants mentioned the lack of technology needed for PBL. One teacher wrote "*We rarely use technology because it is not offered.*" Another participant emphasized that "*PBL needs technology and devices that are not offered in my school.*" Another teacher insisted the need for specific classroom technologies like smart boards and projectors "*Offering whiteboards (smart) and projectors.*"

Several respondents indicated that technology was offered by teacher's efforts or parent donations - "*Technology is offered by teachers' efforts and not offered by the school district or the ministry of education.*" One female teacher mentioned that in her classroom she had her own laptop and "*A projector (a donation from a student's mother).*" One teacher also mentioned the lack of internet access in the classroom "*Technologies are poor in the school. I don't have internet in my classroom.*"

Other casual conditions were found under the theme of "PBL Obstacles". One obstacle reported was classroom space/design. One respondent said "*There are no suitable classrooms for PBL.*" Also, respondents pointed out the large number of students in the classroom, which hindered teachers from conducting PBL activities that required space and flexible design "*The large number of students in classrooms doesn't support PBL.*" Another obstacle found was the classroom facilities. One participant indicated that "*We need to equip the classrooms before starting the new curriculum.*" Since PBL needs an extended instructional period, some respondents indicated that block scheduling was applied last year, but was cancelled during the current school year (2011-2012) - "*Block was applied last year and was cancelled.*" Participants also mentioned having a poor leaning environment. "*There is no appropriate learning environment that supports PBL.*" Lack of interest or motivation was also mentioned as a PBL obstacle. "*There is nothing that encourages or motivates teachers to do their best.*" In addition, lack of support was mentioned as hindering teachers from implementing PBL. "*Teachers need real support, NOT encouragement only.*" Participants emphasized the need for more time to apply PBL. "*Time needed for applying PBL*". This was especially true, since most of the time was spent in preparing students for the tests, as one participant mentioned. "*Most of the time is spent to prepare students for tests.*" "Teaching Methods" was also found as another casual condition, which found that while cooperative learning was applied in some cases, traditional teaching was still dominant in Tatweer schools. "*We don't have PBL. We teach via lecture.*"

However, the open-ended responses mentioned several action strategies that could be taken to improve PBL implementation and technology uses. One action found was offering "Professional Development" needed for PBL and technology uses, which included several aspects. While one participant mentioned the need for preparing teachers by offering "*intensive training programs*", another participant emphasized that the training should be "*continuous workshops during the year and on suitable time for the teacher.*" Another teacher insisted the need for PBL training specifically - "*intensive training for PBL*", while a female teacher asked for the training to be at schools. "*Having on-site (school) coaching to help teachers to apply PBL*". Teachers also asked for a professional development project to be built based on a needs assessment to determine teacher needs. "*Assess each teacher to determine what he/she need to in terms of professional development*". These actions related to "Professional Development" suggested by Tatweer school teachers, who pointed out several issues in the current training offered. It is important that the training provided fits teacher needs, which means that it must be constructed after conducting a needs assessment. Participants also indicated the inadequacy of the current training programs. Therefore, they asked for continual training in a "just-in-time" format that fit the teacher's busy schedule. On-site coaching has several advantages over other training types, such as monitoring the accuracy of practicing the new skills and giving immediate feedback. It was also found to be easier for the busy schedules of teachers and gave more opportunities for training a larger number of teachers, especially female teachers.

In response to the lack of technology skills, participants also asked to be trained in using technology. "*Teachers need to be trained in using the new technologies*", which was very important as in some schools. Teachers mentioned that some types of technology were available, but they were not used totally or not used in a proper way to create meaningful learning. As it was mentioned that, "*There is no accuracy in building tests*", participants asked for training for teachers in preparing tests and more importantly to apply them more appropriately as an assessment for PBL - authentic assessment. Finally, one participant mentioned the need for improving "*The efficiency of the training centers.*" In Saudi Arabia, each educational directorate has one training center that is responsible for the professional development programs aim to improve educators in aspects related to the learning and teaching process. Learning centers are required to provide quality programs based on the teachers' needs and with new strategies advocated by the new curriculum.

Another action strategy focused on offering needed technology for PBL. One participant mentioned "*We need support to facilitate classrooms with technology*". Another participant insisted stated that "*We hope to offer these types of new technologies and use them effectively*". While several respondents indicated the availability of computers and projectors, other technologies, such as smart boards were still needed or training was needed in order to use them. "*I hope to have a smart board and to be able to use it*". Also, it is important to facilitate classrooms with internet connections in order to help teachers utilize web-based tools, like Google Docs and other Web 2.0 technologies, to create more engaging learning and to apply advanced teaching methods.

Other action strategies mentioned by respondents were found related to the "PBL Support" theme. One support needed was a flexible curriculum, rather than the focus being on content coverage. This would give students freedom to choose what subjects or topics to learn, as one participant said "*In some subjects, students can choose what they learn*", and another participant asserted that "*Choosing what to learn is relative*" in Tatweer schools. Also, PBL needed extended period or flexible scheduling that was applied before but cancelled. The school system should allow for outside-class enrichment activities such as field trips and community services. One teacher mentioned his role in PBL as being to "*Train students for volunteer community services*". Advanced teaching methods, such as cooperative learning and educational games, should be supported. While teachers asked for having fewer students per classrooms, they also asked for the redesign of the classrooms to provide a more flexible structure that helped them to individualize learning and fit the nature of PBL activities that require movement, cooperation, and hands-on activities. The Tatweer school framework supports many of these actions (Tatweer, n.d.) in theory. However, the school system should be modified to give schools more freedom to apply teaching and assessment strategies to support the approach adopted in the new curriculum that supports more learner-centered learning. The learning environment should be improved to help in applying the new approach, as one teacher mentioned. "*Improve the school building to have all facilities needed for the educational process.*"

The consequences of applying these action strategies is to have more prepared teachers, better equipped and more productive learning environments, and a more supportive school system that allows for better technology-assisted PBL implementation to create meaningful learning. Instead of focusing on content coverage and teaching to the test, which has yielded "Banking Education" (Freire, 1993) that emphasizes pouring information into students' minds and asking them to empty this information back during the test, meaningful learning focuses more on learning how to learn so that skills acquisition prepares students for their future in a changing world.

Recommendations for Jeddah Tatweer Schools

This research revealed that Tatweer schools in Jeddah needed to assist their teachers to successfully implement technology-assisted PBL in their teaching. Recommendations were developed from study findings in Tatweer schools in Jeddah, only. Therefore, findings generalizability is limited. Following are some recommendations for professional development, learning environment, technology use, and school support.

Professional Development: Teachers are "milestones" in the learning process, since they play the most important factor in the success of any innovation. Therefore, teachers should be prepared and consulted in any educational reform process. Tatweer schools need to offer appropriate professional development programs to improve teacher knowledge and enhance instructional practices and consequently reach a successful technology-assisted PBL implementation. It is recommended that a needs assessment be conducted to determine teachers' needs first, rather than building training programs for general needs. Continual and on-time training fit teachers' busy schedule training and should be offered. On-site (school) training is recommended, particularly for female teachers; it helps in building the learning communities in schools by involving more participants among the same grades or teaching subjects according to their needs. In addition to providing practical ways to apply the new pedagogy, classroom-embedded training allows the examination of training effectiveness. Therefore, this approach is recommended in order to reach better teacher training outcomes. Another easy, cost-free, and collaborative professional development strategy is to have teachers visit each other's classes to observe, critique, and give feedback on implementing new instructional strategies. In addition to providing teachers with knowledge and skills needed for applying new strategies, professional development should train teachers in using instructional technologies to enhance student learning, gaining 21st century skills, and creating meaningful learning. Professional development should also improve teachers' knowledge and skills in using authentic types of assessment. Training center planning and training strategies need to be reviewed in order to better align with the new learning approaches adopted by the new Saudi curricula.

Learning Environment: This recommendation focuses on the physical learning environment wherein the learning process takes place. The school environment should be equipped with the needed facilities and materials for technology-assisted PBL, such as a library rich with useful and updated resources, more computers that can be used for classes and flexible room plans. Since PBL requires hands-on activities and experiments, offering apparatus, instruments and materials is essential. Classroom technologies are also needed, such as computers, smart boards, digital cameras, tablets, and projectors. Internet access with a reliable speed in classrooms is also important in order to allow teachers to utilize web-based tools to enhance the student learning and create a more engaged learning environment. Another important aspect is to have fewer students per classroom so that instruction can proceed.

Technology Use: Different studies showed the positive impacts on student learning of using technology with PBL, such as improving student technical skills, accomplishing complex tasks, and reaching outside resources more easily (Means & Olson, 1995), managing the course more easily, enhancing communication, acquiring more skills (Helic et al., 2005), and increasing student motivation (Perera, 2008). Teachers can use technology for planning and managing projects, giving feedback, collaborating, finding examples of projects and resources, and linking with experts (Ravitz, 2010). Therefore, a standards-based approach to technology use in PBL, based on ISTE NETS in professional development should focus on preparing teachers to use technology purposefully in the classrooms to develop student cognitive skills.

School Support: Having a well-prepared teacher and an excellent learning environment is not enough for creating real and effective reform without a supportive school system. In the school system that supports PBL, more responsibility and authority should be moved from the Ministry of Education and the Educational Directorate to the school. The PBL school system should support a "skills acquisition" approach more than a "content coverage" approach. This gives more freedom for students and teachers to choose appropriate subjects/topics to be learned. It is understandable that PBL needs more time than traditional teaching. However, knowledge is continually changing. Therefore, it is recommended to apply PBL gradually and in selected topics, first. The PBL school system should also adopt "assessment for learning" rather than "assessment of learning". If modifications could be made to the current assessment system, which focuses on tests as the most important factor in promoting students from grade to grade, teachers would apply more appropriate assessments to PBL in order to be able to assess students. Since PBL activities usually need a longer time than the limited 45-minute period, it might be better to allow for extended periods or a flexible schedule. Schools might be given more freedom to have more community involvement and communicate with community associations in arranging outside-class enrichment activities. The school system should also give teachers clear responsibilities and better roles in shaping the school's norms, values, and practices.

A general recommendation from this study is to adopt more learner-centered learning strategies, such as PBL, which play an important role in curriculum reform efforts. However, these strategies require changing teacher and student practices. Therefore, as supported by prior research (Freshwater, 2009; Luhmann, 2001; Short, 2011) using the aforementioned action strategies and recommendations, stakeholders and change agents need to understand that for successful technology-assisted PBL implementation teachers should be supported through offering appropriate professional development, developing an effective learning environment supported with meaningful use of technology, and a supportive school environment.

Recommendations for Future Studies

1- This study was limited to the examination of the practices of all subject teachers in PBL implementation and the use of technology in the elementary, intermediate, and high school for boys and girls Tatweer schools in Jeddah, Saudi Arabia. Since Tatweer schools are designed to support a learner-centered approach enhanced by emerging technology, it might be interesting to conduct a similar study on a wider population of schools, including regular public schools.

2- Private schools are considered to be exemplary in adopting advanced teaching methods, like PBL, and technology integration. Therefore, a similar study could be conducted on a private school population to get a better understanding of how the new teaching methods with technology integration are applied and then compare and contrast their findings with the current study findings.

3- While the current study focused on Tatweer schools in Jeddah, it might be interesting to conduct a similar study involving schools from the all seven cities wherein the Tatweer school model is applied to learn how they differ.

4- Participants in their responses to the open-ended questions mentioned several obstacles related to PBL and technology use. Thus, a qualitative study through a series of focus groups of selected Jeddah Tatweer school teachers is recommended to gain a deeper understanding of these obstacles and how they hindered teachers from applying PBL and integrating technology into their teaching.

5- Since the current study findings revealed several obstacles and actions needed related to technology-assisted PBL implementation through the open-ended questions responses, it would be interesting to conduct another quantitative study to examine teacher perceptions of the extent of these obstacles.

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Appendix A - Survey

A. **Please rate your agreement with the practices of these factors s in your teaching at your school**				
Statement	**Strongly Agree**	**Somewhat Agree**	**Somewhat Disagree**	**Strongly Disagree**
Teachers:				
1. Teachers in my school have regularly scheduled meetings with each other that focus on instructional practices and student learning				
2. Teachers in my school take a major role in shaping the school's norms, values and practices				
3. Teachers in my school have instructed coaching or critical friends visiting between teachers				
4. Teachers in my school get regular professional development to prepare them apply PBL				
5. Teachers in my school receive needed support from the principal required for PBL				
6. Teachers in my school have access to technology needed for PBL				
7. Other (please state in the space below):				
School System:				
8. My school uses block or flexible scheduling to allow for extended periods for working on projects or other activities				
9. My school uses school-wide emphasis on problem-based, project-based, or inquiry learning				
10. My school uses school-wide rubrics for assessing student work across different subjects, grades, or courses				
11. In my school there is a school-wide emphasis on skills beyond academics (e.g., collaboration, presentation or other				

"21st century" skills)				
12. My school requires senior or capstone projects for students to demonstrate readiness for the next grade or to graduate				
13. In my school students take the same courses				
14. My school uses a curriculum that emphasizes PBL and related projects				
15. My school uses a curriculum that emphasizes the use of technology for PBL and related assignments				
16. In my school more time is spent in preparation for local or national tests (reverse)				
17. Other (please state in the space below):				
Learning environment:				
18. The learning environment at my school allows students to meet individually with the teacher to reflect on progress and receive support				
19. The learning environment at my school allows students to have individual statements of learning goals that are periodically reviewed with the teacher				
20. The learning environment at my school allows students to encourage and support their peers as learners				
21. The learning environment at my school allows students to give their best effort and make the most of opportunities to learn				
22. The learning environment at my school allows students to demonstrate that they are striving for in-depth knowledge, not just superficial learning				
23. The learning environment at my school allows students to decide how to present what they have learned				
24. The learning environment at my school allows students to evaluate and defend their ideas or views				
25. The learning environment at my school allows students to orally present their work to peers, staff, parents, or others				

26. The learning environment at my school allows students to participate in community- or work-based projects or internships				
27. The learning environment at my school allows students to use technology to develop projects and activities that use higher order thinking skills				
28. The learning environment at my school offers appropriate physical classroom arrangement for PBL				
29. The learning environment at my school allows for appropriate student number per class that support PBL				
30. Other (please state in the space below):				
Student achievement:				
31. Students at my school are assessed using multiple choice or short answer tests				
32. Students at my school are assessed using essay tests				
33. Students at my school are assessed using open-ended problems				
34. Students at my school are assessed using digital portfolios of student work				
35. Students at my school are assessed using group technology projects				
36. Students at my school are assessed using individual technology projects				
37. Students at my school are assessed using student peer reviews				
38. Students at my school are assessed using hands-on demonstrations, exhibitions or oral presentations				
39. Other (please state in the space below):				

B. **Technology used in teaching:**	**Strongly Agree**	**Somewhat Agree**	**Somewhat Disagree**	**Strongly Disagree**
40. I use technology in teaching to model collaborative knowledge construction by engaging in learning with students, colleagues, and others				
41. I use technology in teaching to customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities				
42. I use technology in teaching to engage students in exploring real-world issues and solving authentic problems				
43. I use technology in teaching to design relevant learning experiences that incorporate digital tools and resources to promote student creativity and curiosity				
44. I use technology in teaching to advocate and practice safe, legal, and responsible use of information and technology				
45. I use technology in teaching to help students to select and use technology effectively and productively				
46. I use technology in teaching to Share best practice uses of technology with PBL with other teachers and schools				
47. I use technology in teaching to communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats				
48. I use technology in teaching to help students to locate, organize, analyze, synthesize, evaluate, and ethically use information from a variety of sources and media				
49. I use technology in teaching to help students to interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media				
50. Other (please state in the space below):				

C. **Technology in teaching PBL**:	**All of the Time**	**Most of the time**	**Some Time**	**Never**
51. I use technology in PBL projects to develop complex concepts				
52. I use technology in PBL projects to explore answers to PBL problems				
53. I use technology in PBL projects to share ideas, resources, and products (e.g., Delicious)				
54. I use technology in PBL projects to develop student collaborative document construction or project tasks (e.g. Edmodo, Google Docs, etc.)				
55. I use technology in PBL projects for planning and managing activities to develop a solution or complete a project (e.g., Google calendar)				
56. I use technology in PBL projects to have students enter three-dimensional immersive spaces/virtual worlds (Quest Atlantis, Dimension M, Whyville, Jumpstart, etc.) for more authentic learning experiences				
57. I use cell phones in PBL projects for student lessons (polling, etc.)				
58. I use technology in PBL projects to publish student work and project products through blogging (Blogger, Edmodo, etc.)				
59. I use technology in PBL projects to participate in online professional development opportunities (e.g. a personal learning network, Google Reader, Diigo, De.lic.ious)				
60. I use technology in PBL projects to develop digital artifacts through presentations (PowerPoint, Prezi, Animoto, Glogster, etc.)				
61. I use simulations and gaming in PBL projects to explore complex systems and issues (Purpose Games, Games for Change, etc.)				
62. I use technology in PBL projects for videoconferencing with colleagues and meeting experts (e.g., Skype)				
63. I use technology in PBL projects to schedule meetings with colleagues (e.g. Doodle)				

64. Other (please state in the space below):				

D. **Classroom technology used in teaching:**	**All of the time**	**Most of the time**	**Sometimes**	**Never**
65. I use e-readers (Nook, Kindle, etc.) in teaching students				
66. I use tablets (iPad, etc.) in teaching students				
67. I use digital cameras in teaching students				
68. I use digital music players (iPod, etc.) in teaching students				
69. I use an interactive student response system ("clickers") in teaching students				
70. I use an interactive whiteboard (Smartboard, Promethean, etc.) in teaching students				
71. Other (please state in the space below):				

E. Demographic Information

72. Gender: ☐ Male ☐Female

73. Highest degree earned:
☐ Bachelor ☐ Master ☐ Doctorate

74. Your degree is:
☐ Education college ☐Non-education College

75. Number of years of experience as a teacher:
☐1- 5 years ☐6-10 years ☐11- 15 years ☐More than 16 years

76. Level of school:
☐Elementary school ☐ Intermediate school ☐ High school

77. What subject(s) do you currently teach?

☐ Islamic Studies ☐ Arabic Studies ☐ Social Studies ☐Science (biology, physics, chemistry, Earth science) ☐ Math ☐ English ☐ Computer Science ☐ Practical subjects (P.E, Art, Family studies) ☐ General (Classroom teacher at 1st – 3rd grades)

Appendix B - Survey Informed Consent Form

Kansas State University

Informed Consent Form

SURVEY PURPOSE

This survey is given to Tatweer teachers who are willing to share their opinion in the study's focus topics. This survey aims to get participants opinion and valuable feedback about their project-based learning (PBL) enabling factors practices, how the International Society for Technology in Education
(ISTE) NETS.T is used in PBL classroom, and technology uses and utilization. Participation in this survey in totally voluntarily and participant can quite any time or skip any question. Participation is anonymous and responses will only be used for the research purposes of this study.

SURVEY PROCEDURES AND LENGTH OF STUDY

If you agree to participate, you will be asked to response to the survey items that include closed-ended questions and an open item, at the end of each section, to give participants more freedom to add more information not covered in the closed-ended questions. This is a paper-pencil survey will be sent to school principals via Tatweer school unit (Boys and Girls) in Jeddah education, Saudi Arabia. Completing the survey will require about 15-20 minutes to response.

RISKS
There are no foreseeable risks for participating in this survey.

BENEFITS
Even though, there are no direct benefits to you as a participant; however, the benefits to the larger educational community in Saudi Arabia may include an indication on the readiness of the Saudi schools to implement progressive education that supports learner-centered approach. Also, with the increase in the use of emerging technologies in PBL, this study will provide a better understanding of how technology can support PBL. All these will help to make required modifications in school environment and build better professional development for teachers based on formal need assessment.

CONFIDENTIALITY
The data in this study will be confidential to the researcher. Moreover, participation will be anonymous and there is no personal information will be asked.

PARTICIPATION
Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party.

CONTACT
If you have any question or concern regarding this survey, please contact the study supervisor: Dr. Rosemary Talab at:talab@ksu.edu

CONSENT

The Kansas State University Institutional Review Board waives the requirement for a signature on this consent form, below, if you check the appropriate box and print your name.

____CONSENT I, ___________________, have read this form and agree to voluntarily participate in this research study. My name and all personal information will be confidential. Only the researcher will know my identity. The Kansas State University Institutional Review Board has waived the requirement for a signature on this consent form. However, if you wish to sign a consent, please contact Rosemary Talab at 785-532-5716 or via e-mail at talab@ksu.edu for a consent form.

I give consent to participate in this study.

____I do NOT give consent to participate in this study.

Appendix C - Survey- Arabic Version

الاستبانة

أ- **من فضلك اختر الإجابة التي تتفق مع درجة ممارسة العوامل التالية في تدريسك في مدرستك الحالية**	أوافق بشدة	أوافق	لا أوافق	لا أوافق إطلاقًا
المعلمون/ المعلمات				
1. يعقد المعلمون في مدرستي اجتماعات دورية لمناقشة الممارسات التعليمية وتعلم الطلاب				
2. المعلمون بمدرستي لهم دور واضح ورئيس في تشكيل المعايير والقيم والممارسات المدرسية				
3. المعلمون في مدرستي من خلال الزيارات الصفية المتبادلة يحصل لهم تدريب موجه				
4. المعلمون في مدرستي يتلقون تدريبا مهنيا لاعدادهم لتطبيق التعلم بالمشاريع				
5. المعلمون في مدرستي يلقون دعما ايجابيا من مدير المدرسة لتطبيق التعلم بالمشاريع				
6. التقنيات اللازمة لتطبيق التعلم بالمشاريع متوافرة للمعلمين في مدرستي				
7. الرجاء ذكر الممارسات المتعلقة بالمعلمين والتي لم يتم ذكرها في الفقرات السابقة والتي تدعم تطبيق التعلم بالمشاريع				
النظام المدرسي التعليمي:	أوافق بشدة	أوافق	لا أوافق	لا أوافق إطلاقًا
8. تطبق مدرستي نظام البلوك (نظام الحصتين المتتاليتين) أو جدول مرن للسماح بحصة ممتدة تساعد على انجاز المشروع				
9. تتبني مدرستي استخدام طرق تدريس حديثة (التعلم الاستقصائي – التعلم بأسلوب حل المشكلات – التعلم بالمشاريع)				
10. على مستوى مدرستي هناك استخدام للمعايير المتدرجة (السلم المتدرج للتقييم rubrics) لتقييم أعمال الطلاب في المواد المختلفة				
11. على مستوى مدرستي هناك تأكيد على اكساب الطالب المهارات الحياتية مثل العمل التعاوني- حل المشكلات- اتخاذ القرارات- التفكير الناقد-الالقاء				
12. الطلاب في مدرستي يطلب منهم تقديم مشروع نهائي كمتطلب للنجاح والانتقال للمرحلة الأعلى أو التخرج				
13. في مدرستي لا يمنح الطالب حرية اختيار المواد والمقررات الدراسية				
14. المناهج الدراسية في مدرستي تدعم استخدام التعلم بالمشاريع				
15. المناهج الدراسية في مدرستي تدعم استخدام التقنية في التعلم باستخدام المشاريع				
16. في مدرستي يصرف غالبية الوقت في إعداد الطلاب للاختبارات				

17. الرجاء ذكر أي ممارسات أخرى لم تذكر في الفقرات السابقة والمتعلقة بأنظمة المدرسة حول تطبيق التعلم بالمشاريع				
بيئة التعلم	أوافق بشدة	أوافق	لا أوافق	لا أوافق إطلاقًا
18. بيئة التعلم في مدرستي تسمح للطلاب بالالتقاء بشكل فردي بالمعلم ليناقشوا انطباعهم حول تعلمهم ويتلقوا تغذية راجعة من المعلم				
19. بيئة التعلم في مدرستي تسمح للطلاب بتحديد أهداف تعلم فردية ومراجعتها دوريا بمساعدة المعلم				
20. بيئة التعلم في مدرستي تسمح للطلاب بتشجيع ودعم زملائهم كمتعلمين				
21. بيئة التعلم في مدرستي تسمح للطلاب ببذل قصارى جهدهم للاستفادة من الفرص المتاحة للتعلم (بيئة حافزة للتعلم)				
22. بيئة التعلم في مدرستي تسمح للطلاب بإظهار سعيهم الحثيث نحو الحصول على معرفة عميقة				
23. بيئة التعلم في مدرستي تسمح للطلاب بإختيار طريقة العرض التي يرونها مناسبة لعرض ما تعلموه				
24. بيئة التعلم في مدرستي تسمح للطلاب بتقييم أرائهم والدفاع عنها				
25. بيئة التعلم في مدرستي تسمح للطلاب بالعرض الشفوي لأعمالهم وما تعلموه أمام زملائهم، الهيئة المدرسية، الأباء، وغيرهم من أفراد المجتمع				
26. بيئة التعلم في مدرستي تسمح للطلاب بالمشاركة في مشاريع خدمة مجتمعية، أو المشاركة في أعمال مهنية خارج المدرسة (مثلا ممارسة عمل في شركة أو جمعية او في مستوصف مجاور لفترة محددة)				
27. بيئة التعلم في مدرستي تسمح للطلاب باستخدام التقنية الحديثة لعمل مشاريع وأنشطة والتي تساعد على تنمية مهارات التفكير العليا (التحليل، التقويم، الاستحداث على غير سابقة create)				
28. بيئة التعلم في مدرستي توفر قاعات مناسبة لتنفيذ المشاريع				
29. بيئة التعلم في مدرستي تسمح بعدد مناسب من الطلاب في الفصول للمساعدة في تنفيذ المشاريع				
30. الرجاء ذكر أي ممارسات أخرى تتعلق بخلق بيئة مدرسية حول دعم تطبيق التعلم بالمشاريع، لم تذكر في الفقرات السابقة				
تقييم تعلم الطلاب وانجازاتهم	أوافق بشدة	أوافق	لا أوافق	لا أوافق إطلاقًا
31. يتم تقييم الطلاب في مدرستي باستخدام الاختبارات الموضوعية (اختيار من متعدد مثلا) والأسئلة المفتوحة ذات الاجابة المختصرة				

32. يتم تقييم الطلاب في مدرستي باستخدام الاختبارات المقالية				
33. يتم تقييم الطلاب في مدرستي باستخدام اسئلة تركز على مشكلات ذات نهايات مفتوحة				
34. يتم تقييم الطلاب في مدرستي باستخدام حقائب الانجاز التي توضح تقدم المتعلمين				
35. يتم تقييم الطلاب في مدرستي باستخدام المشاريع الجماعية المدعومة باستخدام التقنية				
36. يتم تقييم الطلاب في مدرستي باستخدام المشاريع الفردية المدعومة باستخدام التقنية				
37. يتم تقييم الطلاب في مدرستي باستخدام تقييم الأقران				
38. يتم تقييم الطلاب في مدرستي باستخدام العروض التوضيحية، العروض الشفهية، المنتجات اليدوية أو الرقمية				
39. الرجاء ذكر أي أساليب وأنواع أخرى لتقويم الطلبة تطبق بالمدرسة				

ب- من فضلك اختر الإجابة التي تتفق مع استخدامك للتقنية في التدريس في الجوانب التالية:	أوافق بشدة	أوافق	لا أوافق	لا أوافق إطلاقًا
40. أستخدم التقنية في التدريس لتوضيح كيفية بناء المعرفة بشكل تعاوني وجماعي				
41. أستخدم التقنية في التدريس لتخصيص أنشطة تعلم تراعي قدرات الطلاب وتنوع أساليب تعلمهم (الذكاءات المتعددة: سمعي، بصري، حركي، منطقي، اجتماعي، ذاتي)				
42. أستخدم التقنية في التدريس لتمكين الطلاب من استكشاف والتعامل مع مشكلات واقعية تمس حياتهم؛ لحلها				
43. أستخدم التقنية في التدريس لتصميم خبرات تعليمية ترتبط بالطالب من خلال دمج المصادر الرقمية والمصادر الأخرى لتشجيع الطلاب على الإبداع				
44. أستخدم التقنية في التدريس لمساعدة الطلاب على تبني وممارسة الإستخدام الامن والمسؤول الذي يراعي القوانين والحقوق في استخدام المعلومات والتقنية				
45. أستخدم التقنية في التدريس لمساعدة الطلاب على اختيار واستخدام التقنية بشكل فاعل ومنتج				
46. أستخدم التقنية في التدريس للمشاركة ولتبادل أفضل الممارسات في تفعيل التقنية مع المعلمين الأخرين داخل مدرستي أو خارجها				
47. أستخدم التقنية في التدريس للتواصل الفعال مع الطلاب والزملاء وأولياء الأمور				
48. أستخدم التقنية في التدريس لمساعدة الطلاب على البحث عن المعلومات من مصادر مختلفه وتنظيمها وتحليلها وتقييمها				
49. أستخدم التقنية في التدريس لمساعدة الطلاب على التفاعل والتعاون والنشر مع الأقران والخبراء وغيرهم باستخدام مجموعة من الوسائط والبيئات الرقمية				
50. الرجاء ذكر أي استخدامات أخرى للتقنية تقوم بها ولم تذكر في				

الفقرات السابقة	

ت- العبارات التالية تمثل **استخدامات مختلفة للتقنية الحديثة في دعم التعلم بالمشاريع**. من فضلك اختر الإجابة التي تتفق مع درجة استخدامك:	دائما	غالبا	أحيانًا	لا أستخدمه أبدا
51. أستخدم التقنية في دعم التعلم بالمشاريع للمساعدة في شرح المفاهيم المركبة (المجردة)				
52. أستخدم التقنية في دعم التعلم بالمشاريع للمساعدة في ايجاد حلول واجابات للمشكلة قيد الدراسة في المشروع (مثل البحث في الانترنت والتواصل مع الخبراء)				
53. أستخدم التقنية في دعم التعلم بالمشاريع لمشاركة وتبادل الأفكار والمصادر والمنتجات المختلفة (مثل استخدام دليشس (De.lici.ous				
54. أستخدم التقنية في دعم التعلم بالمشاريع لدعم تعاون الطلاب في انشاء الوثائق أو المهام المختلفة في المشروع (مثل أدوات جوجل وموقع إيدمودو والويكي: Google Docs, Edmodo, Wikis)				
55. أستخدم التقنية في دعم التعلم بالمشاريع في التخطيط للمشروع وإدارة أنشطته وانجازه (مثل استخدام تقويم جوجل Google calendar)				
56. أستخدم التقنية في دعم التعلم بالمشاريع لمساعدة الطلاب على دخول العالم الافتراضي ثلاثي الابعاد لإضافة خبرات حقيقية للتعلم (Quest Atlantis, Dimension, Whyville, Jumpstart, etc.)				
57. أستخدم الهواتف النقالة في دعم التعلم بالمشاريع (مثل اجراء الاستفتاءات والتصويت)				
58. أستخدم التقنية في دعم التعلم بالمشاريع لنشر منتجات المشروع ومشروعات الطلاب (مثل المدونات و وموقع إيدمودو Blogs, Edmodo)				
59. أستخدم التقنية في دعم التعلم بالمشاريع للاستفادة من فرص التطوير المهني المتوفرة من خلال الانترنت (مثل الشبكات الشخصية للخبراء وأعضاء هيئة التدريس ومعلمين آخرين، قارئ جوجل، و دليشس : Google Reader, Diigo, De.lic.ious)				
60. أستخدم التقنية في دعم التعلم بالمشاريع لتصميم منتجات رقمية مثل (بور بوينت، بريزي، أنيموتو، جلوستر: PowerPoint, Prezi, Animoto, Glogster)				
61. أستخدم برامج المحاكاة والألعاب التعليمية الإلكترونية في دعم التعلم بالمشاريع لاكتشاف أنظمة وبيئات تعلم معقدة (Purpose Games, Games for Change, etc.)				
62. أستخدم التقنية في دعم التعلم بالمشاريع للتواصل مع الزملاء والخبراء من خلال وسائل الاتصال عن بعد بالفيديو (مثل سكاي بي: Skype)				
63. أستخدم التقنية لدعم التعلم بالمشاريع لتنظيم الاجتماعات (مثل دودل				

(Doodle				
64. أستخدم التقنية في دعم التعلم بالمشاريع في أمور أخرى لم تذكر (من فضلك أذكرها هنا)				

ث- العبارات التالية تركز على استخدام أدوات وأجهزة تعليمية محددة. من فضلك اختر الإجابة التي تتفق مع درجة استخدامك لهذه الأدوات والأجهزة:	دائما	غالبا	أحيانًا	لا أستخدمه أبدا
65. أستخدم القارئ الالكتروني في تعليم الطلاب (مثل نوك وكندل: (Nook, Kindle				
66. أستخدم الكمبيوترات اللوحية tablets PC (مثل الايباد) في تعليم الطلاب				
67. أستخدم الكاميرا الرقمية في تعليم الطلاب				
68. أستخدم مشغلات الملفات الصوتية في تعليم الطلاب (مثل الايبود: (IPod				
69. أستخدم نظام الاستجابة التفاعلية في تعليم الطلاب (clickers)				
70. أستخدم السبورة الذكية التفاعلية في تعليم الطلاب (Samartboard)				
71. أدوات وأجهزة تقنية حديثة لم تذكر (من فضلك أذكرها هنا)				

ج- معلومات ديموغرافية (تعريفية)

72. الجنس: ☐ ذكر ☐ أنثى

73. المؤهل العلمي:
☐ بكالريوس ☐ ماجستير ☐ دكتوراة

74. هل لديك مؤهل تروبوي (مثل الدبلوم التربوي)
☐ نعم ☐ لا

75. عدد سنوات الخبرة في التدريس:
☐ 1-5 سنوات ☐ 6-10 سنوات ☐ 11-15 سنة ☐ أكثر من 15 سنة

76. المرحلة الدراسية التي تدرسها الأن:
☐ ابتدائي ☐ متوسط ☐ ثانوي

77. مادة التدريس:

☐ تربية اسلامية ☐ لغة عربية ☐ اجتماعيات ☐ علوم (أحياء- فيزياء-كيمياء-علم أرض) ☐ رياضيات ☐ لغة انجليزية ☐ حاسب آلي ☐ مواد عملية (تربية رياضية- تربية فنية- تربية أسرية)

☐ عام (معام صف)

Appendix D - Consent Form Arabic Version

بسم الله الرحمن الرحيم

عزيزي المعلم/المعلمة بمدارس تطوير بالإدارة العامة للتعليم بجدة سلمه الله،،،

السلام عليكم ورحمة الله وبركاته وبعد،،،،

أنا عبدالرحمن بن عبدالملك كمال مشرف علوم سابقا بتعليم جدة وأكمل دراستي حاليا بالولايات المتحدة الأمريكية لنيل درجة الدكتوراة بإذن الله قسم مناهج وطرق تدريس – قسم (حوسبة وتصميم التعليم وتعلم عن بعد)- بجامعة ولاية كانساس الحكومية.
أرجو مساعدتكم في تعبئة الاستبانة المرفقة والتي تختص بدراستي بعنوان (العوامل المساعدة وممارسات المعلمين والمعلمات في تطبيق التعلم المبني على المشاريع المدعوم بالتقنية الحديثة في مدارس تطوير بتعليم جدة)

Enabling Factors and Teacher Practices in Using Technology-Assisted Project-Based Learning in Tatweer Schools in Jeddah, Saudi Arabia

والتي هي متطلب للحصول على درجة الدكتوراة.

إن الدراسة تهدف إلى استكشاف مدى ممارسة وتوفر عدد من العوامل المساعدة على تطبيق التعلم المبني على المشاريع. كما أن الدراسة تهدف إلى معرفة مدى استخدام معلمي ومعلمات مدراس تطوير بجدة للتقنيات الحديثة في التدريس عموما وفقا للمعايير الموضوعة من قبل الجمعية العالمية لاستخدام التقنية في التعليم (ISTE). وكذلك تهدف الدراسة إلى معرفة الاستخدامات المختلفة للتقنيات الجديثة من قبل معلمي ومعلمات مدراس تطوير في تطبيق التعلم بالمشاريع.

إن هذه نتائج هذه الدراسة سوف تساعد بإذن الله في معرفة مدى تطبيق مدارسنا بالمملكة العربية السعودية وخاصة مدارس تطوير في تطبيق مثل هذا النوع من التعلم. وباالتالي تعطي تصور أوضح يعين المسؤولين على توفير هذه العوامل وتهيئة الظروف المناسبة لتطبيق التعلم بالمشاريع مدعوما بالتقنية. كذلك تساعد الدراسة في معرفة مدى تطبيق التقنية في مدارسنا وفق المعايير الدولية مثل (ISTE) مما يساعد في وضع تصور عن الحاجات التدريبية للمعليمن للتطبيق الأمثل للتقنية الحديثة في مدراسنا بحيث يزيد من فاعلية استخدامها لدعم الاستراتيجيات الحديثة للتعلم مثل التعلم بالمشاريع.

مشاركتكم في تعبئة هذ الاستبانة مشكورة سلفا، علما بأنها تطوعية، ويمكنكم التوقف عن المشاركة بدون أي قيد أو شرط.
الاجابة على الاستبانة سوف يأخذ حوالي (15) دقيقة وتعبئة الاستبانة تعني الموافقة على المشاركة في هذه الدراسة.
الاجابة على الاستبانة لا تتطلب تصريحا باسم المشارك أو مدرسته، ومع ذلك فإن المعلومات الشخصية سوف تظل سرية وتستخدم فقط لأغراض البحث العلمية فقط.

إذا كان لديكم أي استفسار أو تساؤل حول الدراسة الرجاء الاتصال بالباحث من خلال بيانات التواصل الموضحة بالأسفل.
سائلا المولى عز وجل أن يجعل الوقت الذي تستقطعونه لتعبئة الاستبانة في موارزين حسناتكم.
ولكم خالص التحية ووافر التقدير،،،،

الباحث

عبدالرحمن بن عبدالملك كمال

كلية التربية- قسم المناهج وطرق التدريس- جامعة كانساس الحكومية

الولايات المتحدة الأمريكية

الهاتف 0017853177451- البريد الالكتروني: akamal21@hotmail.com

الموافقة على المشاركة في الدراسة: ☐موافق ☐غير موافق

ما هو التعلم بالمشاريع؟

يعد التعلم بالمشاريع احدى طرق التعليم التي تدعم التعلم المتحمور حول الطالب والمبني على النظرية البنائية في التعليم. يمكن تعريف التعلم بالمشاريع بشكل مبسط بأنه طريقة تعلمية تدمج الطلاب في عملية بحث موسعة تتطلب استقصاء عميق حول مشكلة أو موضوع محدد يلامس حياة الطالب وبيئته. هذه العملية التعلمية تتيح للطلاب -كمجموعة- الاعتماد على الذات وتتيح لهم فرصة الاختيار خلال جمع البيانات والبحث عن المعلومات في المصادر المختلفة ومن ثم القيام بعملية تحليلها واتخاذ القرارات (اختيار الحلول) المناسبة وبعد ذلك عرض النتائج بشكل مناسب والدفاع عنها أمام الزملاء في الفصل أو المدرسة أو المجتمع الخارجي.

وتلعب التقنية الحديثة دورا فاعلا في التعلم بالمشاريع من خلال سرعة الوصول للمعلومات وسهولة البحث عنها وتحليلها. وكذلك تتيح التقنية الحديثة المبنية على الانترنت الفرصة للتواصل السهل بين الطلاب والمعلمين والخبراء خارج المدرسة. كما أن التقنية تساعد الطلاب على عرض النتائج بطريقة جذابة والوصول إلى شريحة أكبر من المستفيدين خارج المدرسة مثل العرض من حلال الوسائط المتعددة والأدوات المختلفة المتوفرة في الانترنت.

بالرغم من أن التعلم بالمشاريع يتطلب جهدا ووقتا، الا أن العديد من الدراسات والتجارب قد أثبتت فاعليته في المساعدة على زيادة دافعية التعلم وتحسين مخرجات التعليم من خلال زيادة فاعلية الطلاب ودمجهم في العملية التعليمية. لذلك فإن الأنشطة التعلمية المصممة بشكل دقيق وفاعل في المشروع تساعد على اكساب الطلاب مهارات التفكير العليا مثل التحليل، والتركيب، وحل المشكلات، واتخاذ القرارات. وهذا يزيد من اكتساب الطالب للمهارات الحياتية والعملية التي تعده لمواصلة دراسته الجامعية أو تهيئه لسوق العمل بشكل أفضل وهو ما تسعى إليه استراتيجية تطوير التعليم العام بالمملكة.

تعريف ببعض التقنيات والأدوات المذكورة في الاستبانة

دِلِشْس أو *ديليشيوس* (Delicious.com) *:* هو موقع مفضلة اجتماعية يتيح لمستخدميه إضافة و مشاركة روابط مختلفة من الويب. و هو يعتبر من مواقع الويب 2.0 حيث يساعد المعلم والطلاب على تبادل الاستفادة من مواقع ومصادر مختلفة خلال المشروع.

أنيموتو (Animoto): من الأدوات القائمة على الشبكة العنكبوتية وهو يساعد في انتاج عروض تقديمية ابداعية تدمج بين الصوت والصورة والفيديو.

بريزي (Prezi): موقع يستند إلى الويب في تطبيقات العروض التقديمية وأداة لسرد القصص يستخدم خلفية واحدة بدلاً من الشرائح اللتقليدية. يمكن وضع عدد لا نهائي من النصوص والصور والفيديو وغير ذلك وجمعها مع بعض في إطارات. يتميز بامكانية التركيز على معلومة محددة باستخدام خاصية التكبير والتصغير.

جلوجستر (Glogster): وسلية عرض تفاعلية تساعد الطلاب على انتاج لوحات عرض (بوسترات) الكترونية ابداعية وجذابة.

إيدمودو (edmodo): موقع اجتماعي (يشبة الفيس بوك) لكنه يوفر بيئة أمنة ومغلقة لتبادل الأراء ة والأفكار بين المعلمين والطلاب وأولياء الأمور، مما يدعم من فرص التعلم التعاوني.

جوجل دوكس (Google Docs): عبارة عن أداة تستند على الويب وتساعد في إنشاء وثائق، جداول الكترونية، أو عروض تقديمية مشتركة (طلاب ومعلمين) مما يدعم التعلم التعاوني.

ويكي (Wiki): نوع من المواقع الالكترونية التي تسمح بالمشاركة الجماعية في تحرير محتويات الموقع.

المدونة الالكترونية (Blog): نوع من المواقع الالكترونية الشخصية التي تسمح للأفراد بالتعبير عن أرائهم ونشر أفكارهم حول موضوع محدد يقوم الأخرون بإثراء الموضوع من خلال إضافة تعليقاتهم.

دودل (Doodle): أداة تستند على الويب وتساعد على تنظيم مواعيد (اليوم والساعة) للقاء المجموعات مما يسهل عمل الفريق خلال المشروع.

سكايبي (Skype): برنامج يساعد على الاتصال بالصوت والصورة وعقد الاجتماعات عن بعد من خلال الاتصال عبر الانترنت.

قارئ جوجل (Google Reader): أحد أدوات جوجل ويقوم على قراءة ملخصات (RSS) بالاشتراك في موضوعات محددة من خلال عدد من المواقع والمصادر الموجودة على الشبكة، وبالتالي يساعد الطلاب الحصول على معلومات محدثة ترتبط بالمشروع القائم.

Appendix E - BIE Permission to Use the Survey

Dear Dr. Ravitz,
I am Abdulrahman Kamal, a Ph.D. candidate in the College of Education at Kansas State University. I am working on my dissertation proposal. You spoke to my major professor, Dr. Rosemary Talab, the other day and was quite helpful. You suggested that we contact the New Tech Network Schools, which Dr. Talab did.

They wish to review my proposal for a survey and interviews of teachers on technology-assisted PBL, and I would like to use your survey for this part of the study. It will be a mixed methods study and will include phone/Skype interviews with selected high school teachers in the network. The topic of my proposal is: Technology-assisted PBL at New Tech Network Schools: Teachers' Perspectives of Enabling Factors and Best Practices of Technology Utilization.

I would like your permission to use parts of the BIE survey, "National Survey of High School Reform and Project Based Learning," for my survey of New Tech Network schools teachers. Also, I am asking your permission to use the Belief Index published in the article: "Constructivist-Compatible Beliefs and Practices among U.S. Teachers" for the same survey. I would be happy to share my survey results with you, once it's completed.

Best regards,
Abdulrahman Kamal

Abdulrahman,

I see you tried to reach me while I was in a meeting. This is good, because it reminded me to reply. I'm sorry I did not do so sooner.

Yes, of course you have permission to use the instruments, with attribution -- meaning you acknowledge the origin of the instruments.

I would be very interested in hearing more about how you will approach the study given that we already did a report for New Tech based on this survey. I'm wondering which sections you think would be most useful? My thought is you might want to focus more closely on the details of technology use (of course) and also for whom, under what conditions these patterns exist, etc.

Do you have your research questions and proposal for review? I would like to see and offer feedback, if that is appropriate.

Also, are you aware of:

a) the report I did for New Tech

On New Tech site:
http://www.newtechnetwork.org/content/new-tech-high-schools-results-national-survey-project-based-learning-and-high-school-reform-

On the BIE site:
http://www.bie.org/research/study/new_technology_foundation_report

b) the existence of an abbreviated version of the TLC survey?
http://web.archive.org/web/20080829015517/http://www.bie.org/Ravitz/cilt_project/

Let me know how it goes, and if you want to have any further conversations. I would be delighted.

Best,

Jason Ravitz
Research Director
Buck Institute for Education
415-883-0122 x 310
http://www.bie.org/research
twitter: jasonbie

Appendix F - 2010-2011 Saudi Arabia Education Statistics

الإداريون المساعدون Administrative Staff		شاغلو الوظائف التعليمية Academic Staff		الطلاب Students		الفصول Class-rooms	المدارس Schools	الجنس Gender	المرحلة Stage
سعودي Saudi	جملة Total	سعودي Saudi	جملة Total	سعودي Saudi	Total جملة				
2,165	2,247	10,910	11,431	109,236	117,653	6,617	1,667	مشترك Boys & Girls	رياض أطفال Kindergarten
4,667	4,844	103,692	113,821	1,107,697	1,273,119	66,132	6,784	Male ذكور	ابتدائي Elementary
7,012	7,108	112,812	114,504	1,068,784	1,240,696	61,624	6,844	Female إناث	
11,679	11,952	216,504	228,325	2,176,481	2,513,815	127,756	13,628	Total جملة	
2,677	2,748	57,656	62,306	563,682	636,693	26,616	4,179	Male ذكور	متوسط Intermediate
3,565	3,597	59,714	60,174	489,664	561,721	22,599	3,820	Female إناث	
6,242	6,345	117,370	122,480	1,053,346	1,198,414	49,215	7,999	Total جملة	
1,750	1,892	41,729	49,654	565,970	625,365	22,597	2,533	Male ذكور	ثانوي Secondary
2,862	2,906	51,652	52,762	444,776	500,237	19,381	2,480	Female إناث	
4,612	4,798	93,381	102,416	1,010,746	1,125,602	41,978	5,013	Total جملة	
170	171	5,566	5,657	16,551	17,718	3,778	1,066	Male ذكور	تربية خاصة Special Ed.
157	163	2,107	2,202	8,742	9,420	1,453	528	Female إناث	
327	334	7,673	7,859	25,293	27,138	5,231	1,594	Total جملة	
0	0	0	0	9,435	12,638	1,261	729	Male ذكور	تعليم كبار Adult Ed.
50	50	10,195	10,197	59,536	70,159	6,806	2,356	Female إناث	
50	50	10,195	10,197	68,971	82,797	8,067	3,085	Total جملة	
9,264	9,655	208,643	231,438	2,263,335	2,565,533	120,384	15,291	Male ذكور	Total المجموع
15,811	16,071	247,390	251,270	2,180,738	2,499,886	118,480	17,695	Female إناث	
25,075	25,726	456,033	482,708	4,444,073	5,065,419	238,864	32,986	Total جملة	

http://www.moe.gov.sa/Pages/stats31-32.aspx

Appendix G - Dr. Ravitz Vitae

JASON RAVITZ 18 Commercial Blvd Novato, CA 94949 415-883-0122 jason@bie.org

Education

1999	Ph.D./MS Instructional Design, Development & Evaluation	Syracuse University
1989	Teaching credentials for high school social studies	Harvard Graduate School of Education
1988	B.A., with honors in Sociology and Psychology	Harvard College

Professional Experience

2002 – present	Director of Research	Buck Institute for Education
1998 – 2000	Postdoctoral Scholar / Visiting Scholar	UC, Berkeley / SRI International
1998 – 2000	Research Specialist	UC, Irvine
1997 – 1998	Lead Instructional Designer	GTE Internetworking (formerly BBN)
1994 – 1997	Research Associate	BBN Educational Technologies
1993 – 1994	Computer Teacher	Medford Public Schools
1989 – 1993	Consultant, Assistant to President	Management Strategies

Areas of Specialization

Research and evaluation, design and analysis; large scale studies of teaching and learning, educational technologies, problem- and project-based learning, professional development, high school reform, innovation

Published Books and Chapters

Mergendoller, J. R., Markham, T., __, & Larmer, J. (2006). Pervasive management of project based learning: Teachers as guides and facilitators. In C. M. Evertson & C. S. Weinstein (Eds.), *Handbook of Classroom Management: Research, Practice, and Contemporary Issues*, Mahwah, NJ: Lawrence Erlbaum, Inc.

Markham, T., Larmer, J. & __ (2004). *Project based learning handbook: A guide to standards-focused project based learning, 2nd Ed.* Novato, CA: Buck Institute for Education.

__ (2004). A doorway to new tools and practices: Supporting teacher education, research, and development with an online netcourse. In N. Sabelli and R. Pea. (Eds.). *Uniting people, technology and powerful ideas for learning. Six years of knowledge networking in learning sciences and technologies*, 94-101.

__ (1997). Evaluating learning networks: A special challenge for Web-based Instruction? In B. Khan (Ed.)., *Web-based Instruction*, Englewood Cliffs, NJ: Educational Technology Publications, 361-368.

Romiszowski, A. & __ (1997). Computer mediated communications. In A. Romiszowski and C. Dills (Eds.)., *Instructional development: State of the art.* Englewood Cliffs, NJ: Educational Technology Publications, 745-768.

Refereed Journal Articles

__ (2010). Beyond changing culture in small high schools: Reform models and changing instruction with project-based learning. *Peabody Journal of Education, 85*, 290-313.

__ (2008) Introduction: Summarizing findings and looking ahead to a new generation of PBL research. *Interdisciplinary Journal of Problem-based Learning, 3*(1), 4-11.

Smith, T. & __ (2008). Problem based learning in college economics. *Academic Exchange Quarterly, 12*(1).

__ & Hoadley, C. (2005). Supporting change and scholarship through review of online resources in professional development settings. *British Journal of Educational Technology, 36*(6), 967-974.

Yarnall, L., Penuel, W., __, Murray, G., and Means, B. (2003). Portable assessment authoring: Using handheld technology to assess collaborative inquiry. *Education, Information & Communication, 3*(1), 7-55.

__ (2002). Using technology to support ongoing formative assessment in the classroom. *Journal of Science Education and Technology, 11*(3).

Becker, H. & __ (1999). The influence of computer and Internet use on teachers' pedagogical practices and perceptions. *Journal of Research on Computing in Education, 31*(4).

Becker, H. & __ (1998). The equity threat of promising innovations: Pioneering Internet- connected schools. *Journal of Educational Computing Research, 18*(4).

Scholarly Reports (from a larger list)

__ (2008). *Evaluation of the Envision Schools' Stuart Foundation Initiative*. Buck Institute for Education. Novato, CA.

__ (2008). *New Tech High Schools: Results of the national survey of PBL and high school reform*. Buck Institute for Education: Novato, CA.

__ & Mergendoller, J. (2002). *Teaching with technology: A statewide professional development program evaluation for the J.A. and Kathryn Albertson Foundation*. Novato, CA: Buck Institute for Education.

__ & Mergendoller, J. (2002). *Technology use and achievement in Idaho schools: A statewide study of schools, teachers, and students. Final evaluation report on the Opportunity One Technology Initiative*. Novato, CA: Buck Institute for Education.

__, Becker, H. & Wong, Y. (2000). *Constructivist compatible beliefs and practices among U.S. teachers*. Teaching, Learning & Computing: 1998: UC, Irvine.

Peer-Reviewed Conferences (from a larger list) Member: ICLS, AECT, AEA, AERA

__ (2010). *Assessing the impact of online technologies on PBL use in US high schools*. Association for Educational Communications and Technology (AECT). Anaheim, CA.

__(2009). *Does Project Based Learning help foster communities of learners in small US high schools*. European Association for Resaerch on Learning and Instruction. (EARLI) Amsterdam NL.

__ (1999). *Emerging practical theory of assessment: Interactive portfolios*. Third Annual Conference on Computer-Supported Collaborative Learning (CSCL). In G. Stahl (Chair). Workshop for collaborating on the design and assessment of knowledge-building environments. Palo Alto, CA..

__ (1997). *Evaluation as a design issue for online learning experiments*. American Evaluation Association (AEA). San Diego, CA.

American Educational Research Association

__, Hixson, N., English, M., & Mergendoller, J. (2011). *Using project based learning to teach 21st century skills: Findings from a statewide initiative*. Vancouver, BC.

Kale, U., Selmer, S. & __. (2011). *A video case study of a problem-based learning mathematics classroom: Supporting professional development in West Virginia*. New Orleans, LA.

Smith, T., Roberts, H. & __ (2007). *Assessing the impact of problem-based learning on college student understanding of microeconomics principles*

Bransford, J., Means, B., Quellmalz, E., Brophy, S. & __. (2003). *Unlocking the potential of assessments for learning*. Chicago, IL.

__, Mergendoller, J., Rush, W. (2002). *What's school got to do with it? Cautionary tales about correlations between student computer use and academic achievement*. New Orleans, LA.

Manuscript Reviews: *American Educational Research Journal • Interdisciplinary Journal of Problem Based Learning • Educational Media International • Education Technology Research & Development • Journal of Computer-Mediated Communication • Educational Researcher • Teachers College Record • Computer Supported Collaborative Learning • International Journal of Continuing Engineering Education and Lifelong Learning*

Service/Recognition: AERA SIG-PBL • Co-Nect Schools • Union City (CCT) • Project Foundry • CARDET / NCREL • HPRTEC • Improving America's Schools • PT3 Vision Quest • enGuage • Technology Innovation Challenge Grants • AEL Workshop • NSF Workshop • Dorothea Weimnann Memorial Scholarship • Syracuse University Three Year Fellowship

University-level Teaching: ISED 797: Seminar in Education Research, UC, San Francisco • EDU 287: Data Analysis in Education Research and Evaluation (with H. Becker), UC, Irvine • EDU 279: Research Methods Applied to Administrative Practice (with H. Becker) UC, Irvine • IDE 501: Foundations of Educational Technology (with Don Ely), Syracuse University • IDE 506: Computers in the Classroom (with Dan Lake), Syracuse University.

Guest Lectures: University of Hawaii, Manoa (Technology and Social Justice) • Stanford University (Learning Design and Technology) • UC, Berkeley Evaluation & Assessment Research (BEAR) Seminar • UC, Berkeley Cognition and Development Colloquium • UC, Berkeley (Introduction to Social Sciences) • Syracuse University (Summer Institute on Evaluating Internet Based Services and Resources)

Appendix H - IRB Approval Form

KANSAS STATE UNIVERSITY | University Research Compliance Office

TO: Rosemary Talab
Curriculum & Instruction
226 Bluemont

Proposal Number: 6244

FROM: Rick Scheidt, Chair
Committee on Research Involving Human Subjects

DATE: 5/7/12

RE: Proposal Entitled, "Enabling Factors and Teacher Practices in Using Technology-Assited Project-based Learning in Tatweer Schools in Jeddah, Saudi Arabia"

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written – and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §46.101, paragraph b, category: 2, subsection: ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

203 Fairchild Hall, Manhattan, Lower Mezzanine, KS 66506-1003 | (785) 532-3224 | fax: (785) 532-3278 | www.k-state.edu/research/comply

Appendix I - Jeddah Education Approval and Support Letter-Arabic

بسم الله الرحمن الرحيم

المملكة العربية السعودية
وزارة التربية والتعليم
الإدارة العامة للتربية والتعليم بمحافظة جدة
إدارة التخطيط والتطوير
قسم البحوث التربوية

وزارة التربية والتعليم
Ministry of Education

الرقم : ١٤٣٨ / أ / ٥٣
التأريخ : ٩ /٦/ ١٤٣٣هـ

إلـــى : مدير/ة وحدة تطوير المدارس:

إلـــى : مدير/ة مدرسة تطوير :

مـــن : مديرة إدارة التخطيط والتطوير المكلّفة

بشـأن : تسهيل مهمة المبتعث الباحث/ عبدالرحمن بن عبدالملك كمال

السلام عليكم ورحمة الله وبركاته ، وبعد :

إشارة إلى إحالة سعادة المدير العام للتربية والتعليم بمحافظة جدة برقم ٣٣٩٨٠٠٠٠ وتأريخ ١٤٣٣/٦/٤هـ المبنية على خطاب المبتعث الباحث/عبدالرحمن بن عبدالملك كمال برقم بدون وتأريخ بدون ؛ أحد طلاب الدراسات العليا لمرحلة الدكتوراه بكلية التربية/ قسم المناهج وطرق التدريس بجامعة كانساس الحكومية في الولايات المتحدة الأمريكية ؛ بشأن تسهيل مهمته في تطبيق أداة **بحثه بعنوان"العوامل المساعدة وممارسات المعلمين والمعلمات في تطبيق التعلم المبني على المشاريع المدعوم بالتقنية الحديثة في مدارس تطوير بتعليم جدة" , ويرغب الباحث في تطبيق أداة بحثه (الاستبانة) على عينة من المعلمين والمعلمات بمدارس تطوير**

؛ نأمل منكم التعاون مع الباحث وتسهيل مهمته بحَثّ المعلمين/المعلمات على تعبئة الاستبانة على الرابط:

https://www.surveymonkey.com/s/HV88TTG

والتواصل مع الباحث في حالة الاستفسار على بريده الالكتروني akamal21@hotmail.com أو الهاتف (٠٠١٧٨٥٣١٧٧٤٥١) . شاكرين ومقدرين اهتمامكم بالبحث العلمي وتجاوبكم مع الباحثين المبتعثين في الخارج .

والسلام عليكم ورحمة الله وبركاته

ابتسام بنت سعيد منسي
١٤٣٣/٦/٩

وزارة التربية والتعليم
تعليم البنات
إدارة التطوير التربوي

ن/ثابت

Appendix J - Open-Ended Survey Question Responses

Responses
Educational games
educational games
The best website I benefited from is “My language” and I use some websites to publish students’ works and myschool122 YouTube channel
Quizzes and other activities from the internet
We only have one smart board
We have smart board, but we haven’t used it yet
Communicate with students via smart phones and social networking websites
School website/ I use some websites to publish students’ works and myschool122 YouTube channel
documentary films
Continual assessment
WE don’t have this type of learning. What is important is content coverage
One of the most important technology or mean from my point of view to support PBL is that the new textbooks include activities to support PBL
In some subjects, student can choose what they learn, but not in all subjects
Some subjects, students have the freedom to choose
In some subjects, student can choose what they learn
Choosing what to learn is relative
Curriculum is mandatory. (no choices in education)
Many teaching strategies: cooperative learning,
Cooperative learning. Teaching students research skills in simple ways
Cooperative learning and deductive thinking
Cooperative learning- learning with peers, active learning
Cooperative learning, self-learning
Products, models, and posters
Presentations, posters
We don’t practice PBL.
We don’t have PBL
We don’t have PBL. It is only a theoretical concept.
The new curriculum will be applied starting next year
The concept of projects doesn’t exist in my school
We don’t have PBL, I don’t know anything about this type of learning, and we don’t have any type of these technologies
We don’t have PBL. We teach via lecture.
There are not many projects done
Cooperative learning- self learning
Unknown step

Unfortunately, it is not applied
We don't have PBL
Student are assessed using all types of assessments mentioned above
Field trips, training student in self-development and language
Field trips
interviews
Train student for volunteer community services
Field trips and out-of-school visits
We need to equip the classrooms
We need to equip the classrooms before starting the new curriculum
Facilities needed for PBL are not offered in my school
School is not supported by facilities and tools needed to improve school and students
Offering appropriate classes and space for PBL
There are no suitable classrooms for PBL
The current classrooms do not support PBL, which contradicts the new approach advocated by the new curriculum.
Not interested
The learning environment is unproductive (sterile)
There is no appropriate learning environment that supports PBL
The learning environment should be prepared
Improve the school building to have all facilities needed for the educational process
Students and teachers should be encouraged by some types of incentives
There is nothing that encourages or motivates teachers to do their best
Decrease number of students in the classes
number of students
and less number of students per class
Large number of students in the classes, which doesn't support individualizing learning. Teaching 6 periods/day, burdens teachers
The large number of students in classrooms doesn't support PBL.
Large number of students in classroom negatively affects PBL
Materials required to apply PBL are not offered.
Teachers need real support (technical support) NOT encouragement only.
Most of the time is spent to prepare students for tests as alternative assessment is applied
Teaching load
time needed for applying PBL
understanding and acceptance of the whole school community
Financial support
Block was applied last year and was cancelled. Students are not required to have a senior project
Block applied last year
Block applied last year and was cancelled

Block was applied last year
Block was applied last year and was cancelled
PBL needs special facilities that are not offered
PBL needs administrators to meet with parents to teach them about the new curriculum and changes happing in the educational system. PBL also requires a team of staff to organize student movement
The learning environment at my school allows to apply PBL, preparing posters easily because each teachers has his own classroom (Moving classrooms)
Assign a classroom for each teacher (moving classrooms), helps in applying PBL
This strategy need to a decreased number of subjects,
Training in the curriculum
Having on-site (school) coaching to help teachers to apply PBL
Topics that can be taught using PBL are not specified in the curriculum
Teachers meet on a regular basis informally (Training)
Offering intensive training programs
Continuous workshops during the year
Intensive training for PBL
Providing Professional Development needed for PBL, especially by subject consultants
From time to time there are some training programs to prepare teachers and give them skills needed for the teaching strategies
Teachers need to be trained in using the new technologies
Teachers need to be trained in using the new technologies
There is no accuracy in building tests
Improve the efficiency of the training centers
Assess each teacher
Assess each teacher to determine what he/she need to in terms of professional development
Providing required training on a regular basis and on suitable times for teachers
I wish you the best…
Development of love, empathy, and belonging (dedication)
Nothing
Nothing, everything was mentioned
Some questions are unclear
Teacher's personal efforts
Teacher tries to improve himself/herself that fits the nature of his/her content area, which leads to create teaching strategies that encourage students to gain research skills
Teachers (female) work voluntarily to improve school performance

We have the educational learning center and labs where we can do projects
We only have one computer room: the Educational Learning Center.
Offering whiteboards (smart) and projectors
We need support to facilitate classrooms with technology
We don't have the smart classroom that is connected to the internet. Some classrooms are equipped with projectors.
There is not enough equipment in the school environment for students to use
We have all the technologies mentioned above, but all of them will be used next year
I hope to have a smart board and to use it
The concept of technology used in our educational program does not function properly
Some of the technologies, such as smart board, haven't been used because they are not offered in the school
Offering the required technology
There are projects, but they not supported by technology
There are no technologies in the classroom.
We hope to offer these types of new technologies and use them effectively.
A projector (a donation from a student's mother)
Technology and other tools are not offered
PBL needs technology and devices that are not offered in my school
The new curricula requires using technology, which is not offered at the school,
These types of technology are not offered in classrooms
We rarely use technology because it is not offered. We only have physics and chemistry labs
Classrooms are not equipped by technologies
We don't have any of the above technologies
We hope the needed technology is offered by the school
We don't have the needed technology in the school
and, if it is used, it will be by the student's own effort at home
Students are the only ones who use these types of technology at their homes
Lacking technology
Technologies are poor in the school. I don't have internet in my classroom.
Implementing e-learning
My school is poor when compared with other schools
Offering the technology needed to apply PBL
Technology is offered by teachers' efforts and not offered by the school district or the ministry of education.
Technology is offered by teachers' efforts and not offered by the school
Technology is only provided by teacher's individual efforts
except what is provided by the teacher's own efforts
The Ministry of Education didn't equip classrooms with computers, except what is provided by the teacher.
Technology is offered by the teacher's own efforts and not by the school

The new curriculum supports using technology, but since it is not offered by the school, teachers offer to buy these technologies
Needed technology is offered by the teacher's personal efforts
Technology is provided by teachers and students (2)
We don't have any equipment in the classroom, except what is offered by the teacher's personal efforts
None of the teachers use any type of technology
We try to use technology as much as we can
Educational learning center
Computer and projector
Projector and computer.
Computers and projector
Laptop and projector
Projector
Projector
Computer and projector
Projector
Projector
In my classroom there are only my personal laptop and a projector (a donation from a student's mother)
Projector
Participating in the Glob program
Learning using Internet
Internet: educational websites??
On the test the questions are either essays or objective questions
Use different types of questions
As all schools in SA
Achievement test at the end of the school year
Tests and some activities using computer and internet??
We use more than one type of questions (essays and objectives)
Questions include both essays and objective questions
Written tests only
Written tests
Use different types of questions
In the test, questions are varied
Traditional assessments.