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Investigating project-based learning (PBL) in a STEM school in Egypt: A case study

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INVESTIGATING PROJECT-BASED LEARNING (PBL)

IN A STEM SCHOOL IN EGYPT: A CASE STUDY

A Thesis submitted to

The Department of International and Comparative Education

In partial fulfillment of the requirements for

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By

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ABSTRACT

The initiative of STEM Schools in Egypt with a boys' school in 6th of October and a girls' school in Maadi can be considered a turning point in the teaching and learning of science and mathematics in Egypt. Applying Project-based learning (PBL) in STEM schools is innovative to the educational system in Egypt. Project-based learning is the main pedagogical method representing 60% of students' final scores in grade one and two and 20% of students' final scores in grade three for STEM School students. The goal of this study was to investigate PBL in 6th of October STEM High school for Boys, the first STEM School in Egypt, and the model for the new seven STEM schools that started in Egypt in October, 2015. This investigation was to understand students' perceptions of PBL. A focus group protocol was carried out by three trained teachers from the school with six groups of students, two from each grade. Data collected through the focus groups were analyzed according to three themes: (1) students' perceptions of PBL (1) students' learning, and (2) students' collaboration. Findings of the study suggested that students were able to voice clear perceptions; and they believe that applying PBL has enhanced their learning of subjects integrated in their projects as well as increasing their collaborations with each other in the projects' groups. However, they also suggested that more attention should be given to grade one students since doing projects is a new experience for them. Findings also suggested that students' grade level as well as their previous exposure to PBL influenced their perceptions of PBL.

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CHAPTER 1: INTRODUCTION

In the strategic plan of pre-university education in Egypt (2014-2030), Education: The National Project of Egypt, "Together We Can", the Ministry of Education (MOE) categorized STEM Education under the special education program. MOE aims through the plan to provide STEM students with high quality education that is appropriate for their multiple intelligences; to reinforce their potential skills and to equip them with tools required to lead the ship of education through the world of knowledge in the future (MOE Strategic Plan, 2014). MOE consider STEM schools as centres where future generations of scientists are prepared (Ministerial Decree 382, 2012). In this chapter, STEM education as a new type of instruction in Egypt is briefly defined; a call for STEM schools and the USAID support; the presidential decision to have one STEM school in each governorate; and the distinguished curricula and assessment of STEM schools. These four points gives brief introduction to STEM Education in Egypt.

1.1. What is STEM Education?

STEM is a new discipline where content areas of study; Science, Technology, Engineering and Mathematics are integrated for students (Aaron, 2012).The acronym STEM has been widely used by U.S. stakeholders to call for the need to have better schools and better colleges that can compete globally (Breiner, Johnson, Harkness, & Koehler, 2012). Engaging students in learning tasks that go beyond low level cognitive skills, motivates them to apply high-order thinking skills helping achieve success during STEM learning experiences and supports students' understanding as they make connections within the content (Marino, Basham, & Marino, 2015). Integrated STEM education requires that students learn valuable knowledge involved in more than one subject. Effective STEM education can also motivate students taking careers in STEM in the future (Stohlmann, Moore, & Roehrig, 2012). STEM education promotes

students' skills required for 21st century; five main skills were identified by the National

Research Council (NRC) which include to be adaptable, to be a problem solver, to communicate

effectively, to reflect on abilities and achievements and, to think in systematic ways (NRC,

2011). PBL is an instructional tool that apply hands-on activities can help students in STEM

(Han, Yalvac, Capraro & Capraro, 2015). Connecting students with the content through PBL

provides students with a learning environment where simulating conditions of the real world and

hands-on activities help students understand Science and Mathematics as they are existing in the

real world (Marino et al., 2015). PBL teaching strategies applied through STEM education could

motivate young learners' curiosity to figure out how things work which in turns leads to

promoting the innovation and creativity for those learners (Roberts, 2013). It is also claimed that

it encourages teams' cooperation where students achieve desired goals and build their knowledge

and understanding (Tseng, Chang, Lou, & Chen, 2013) . Moreover, there are opportunities for

students to apply science activities outside schools. Young students now have better

opportunities to learn about sciences through summer programs, clubs, parks, museums and even

through online activities (NRC,2011). To empower high school students talented in Science and

Mathematics in Egypt, there was a call to start STEM schools in Egypt.

1.2.   A call for STEM Schools in Egypt

In Egypt, students enrolled in High school general secondary education Certificate

Thanaweya Amma have two options either to choose the science Section or the Arts. For the

science section, students have two sub divisions; mathematics or science. Most students enroll in

the Arts section rather than Science. The reason is that students believe that the Arts section is

easier and offers better opportunities for universities' admission (Rissmann-Joyce & El Nagdi,

2013).For Science section students to be admitted into the faculty of Medicine, Pharmacy or

Engineering they have to have a score of 95% or even more . If a student fails to fulfill such a

score, he will be obliged to join other faculties of study. To encourage Egyptian students to pursue studies in the science section and to promote Science and Mathematics education in Egypt, the MOE made the decision to apply STEM Education in Egypt (Ministerial Decree 382, 2012) . The first STEM High school for boys started in September, 2011 near 6th of October City. The ultimate goal for starting this type of schools is not only to achieve the balance between the Science and Arts sections for high school students but also to create a generation of scientists for Egypt in the future who are able to overcome challenges of third world countries and to cope with modern countries (Ministerial Decree 382, 2012). The admission requirements for STEM Schools are; 98% or more in preparatory schools' certificate and full marks in at least two of three subjects (English Language, Mathematics and Science). After that students have to take an IQ test as well as an English language test. Only 150 students who get the highest scores in the placement tests are accepted for STEM schools (Ministerial Decree 382, 2012). The second STEM school is for girls. It started in September 2012 in Zahraa Al Maadi, a district in Cairo. It is important to mention here that STEM schools started in Egypt through a fund from The United States Agency for International Development (USAID). A grant of twenty five million dollars has been allocated to establish the first five STEM Schools in five governorates; Giza, Cairo, Alexandria, Dakahlia and Assuit.

Until the year 2014 only two of the five, in Giza and Cairo, were established and started to work. When October STEM School started in 2011, MOE witnessed a fast movement of ministerial change: Six Ministers of Education, starting from Dr. Ahmed Gamal El-Din Mousa who started the first STEM School and ended with Dr. El-Helaly El- Sherbeeny. Each of the first five ministers remained in office roughly a year, therefore none of them had an opportunity for a long term plans or even to make considerable changes in education in Egypt. The insufficient

time to evaluate the two new STEM Schools made the decision of starting more STEM schools a hard one to make. The decision of the extension of STEM schools was made by his Excellency the President of Egypt Adbelfatah El-Sisi in July, 2015. Dr. Moheb El-Rafey, the Minister of Education at that time announced that it is the political decision of the president to start one STEM school in each governorate and that seven STEM schools would start in September, 2015. Dr. Moheb asked professors from the National Centre for Examination and Educational Evaluation NCEEE to prepare reports on the two existing STEM Schools. STEM school graduates were all admitted to universities. All graduates were admitted to Faculties of Medicine, Pharmacy, Dentistry, Science, Engineering, Information Technology and other STEM tracks which is one of the main goals of STEM schools (Ministerial Decree 382, 2012). Moreover success stories of students from the first STEM schools were the reasons behind the decision made by the President to start more STEM schools. Examples are that students from October and Maadi STEM schools, managed to establish a place for Egypt in international STEM competitions such as, International Science and Engineering Fair (ISEF) in the United States of America. At the ISEF, a student from Maadi STEM School won the first place in the environmental sciences category in May, 2015. Another student from October STEM School won the third place in Taiwan International Science Fair (TISF) in the same year. Other STEM students from both schools participated in competitions such as, the Asian Science Fair in Singapore, Chemistry Arab Olympiad in Saudi Arabia, the Mathematics Olympiad in Italy, the Physics Olympiad in India and other competitions. Three of the new seven STEM schools that started in October, 2015 are funded by USAID through the grant that was allocated for the five STEM schools. These schools are in Alexandria, Dakahlia and Assuit. The other four STEM schools funded by the MOE are in Kafr El-Shaikh, Ismalia, Red Sea and Luxor.

1.3.   October STEM School: the first STEM school in Egypt

When MOE decided to start October STEM School in September, 2011, the decision was made that it would be a boarding school. Since the first 150 students starting the school were from different governorates all over Egypt, it was necessary to provide accommodation for them. All STEM schools in Egypt now are boarding, MOE believes that the boarding life of students would allow for more interaction time after school regular hours. October STEM School is part of the Cosmos Village in October City in Giza Governorate; a touristic village that has prototypes of almost all monuments in Egypt. Bass (2014) asserted that boarding schools offers a better level of communication among students. The fact that students spend time with each after the school regular time allows more opportunity for communication (Bass, 2014). October STEM School could be an example of a boarding school that has strong communication among student. The total number of students enrolled on the three grades is 406 students. 149 students in grade one, 136 students in grade two and 121 students in grade three. There are three buildings for students' accommodation. Each grade level has a separate building with a capacity of 50 rooms for students, five rooms for supervisors and a room for the building manager. Every three students stay in a furnished room with three single beds and three cupboards. Speaking in this time of accommodation, Bass (2014) refers to African-American disadvantaged students and how boarding schools could be better places for productive communication among students, the research findings indicated that in Douglas High School in North America, students enjoyed their friendship and said that they would be committed to their colleagues even after leaving the school. This leads itself to the same idea of good communication among students in October STEM school. The school sports facilities are a football pitch, a volleyball pitch and tennis pitch as well as a gymnastics hall for fitness. Students have multiple options after school time to do

sports and enjoy their free time. However, the school does not have a Physical Education specialist assigned to supervise such sporting activities after school regular time. Students also organize sports competitions where the winning teams are appreciated and receive prizes at the end of each tournament in the morning line. The goal behind such sports activities is to help students refresh their minds after a long school day and build strong relations with other classes, grades and school colleagues. Reinforcing social relations improves students' interactions in the learning environment (Kim, 2001). Also, the school library is available for students to read books after regular school time and the library is run by a group of volunteer students. Science Laboratories are also available for students after school regular time, usually about two weeks before the projects' exhibition (the final presentation of group projects at the end of each semester). STEM subject teachers as well as a group of volunteer students usually supervise after school activities and make a record of chemicals, physical instruments and tools that students need for preparing for their projects. October STEM School does not have a technical laboratory assistant to supervise students' scientific activities after regular school time. However, science groups of students (Biology group, Chemistry group, Physics groups, Fab Lab group) are volunteer students that work with coordination of teachers to provide services for their school colleagues after school regular hours. In fact, students' cooperation providing such services has helped overcome the shortage of lab assistants. These experienced students have received training on laboratory safety procedures by STEM teachers at the beginning of the year and therefore spend some of their time in laboratories setting up experiments. Classrooms are also open for students after regular school time to study and work in groups. Experienced students with coordination of teachers have arranged study groups that offer academic guidance and orientations to their school mates usually younger ones after school regular time. Bass (2014)

asserted that boarding school strengthen social ties among students which in turns positively promotes the academic performance of students.

1.4.   STEM Schools' Curricula and Assessment

STEM Schools have specific ministerial decrees for curricula and assessment. Students are assessed based on their performance on projects or capstone as mentioned in the decree which represent 60% of students' total marks in grade one and two (Ministerial Decree 382, 2012). Projects represent 20% of the total marks in grade three. STEM schools exit certificate is equivalent to general secondary school certificate since it allows graduates the right to apply to Egyptian universities and be admitted through criteria different from *Thanaweya Amma* (Ministerial Decree, 308, 2013). STEM school students have flexible percentage for university admission and that means the number of seats assigned for STEM school students increase when the number of STEM school graduates increases. Therefore, STEM students' admission to certain universities is not affected by scores as it is affected by the number of STEM students applying. On the contrary, *Thanaweya Amma* students are admitted to faculties based on their scores. The curricula at the STEM school were designed around Egypt's Grand Challenges (problems that Egypt encounter), such as pollution, overpopulation, finding clean resources of water and alternative energies. These problems are introduced in the curricula as themes and topics in different subjects. Integrated subjects help students gain knowledge and skills that he will use to work on group projects. The school provides themes for projects that students work on such as water treatment, alternative energies and others. This type of in-depth investigations allows students to find out solutions of problems (Basham & Mario, 2013). These curricula have been designed to achieve sequenced learning outcomes that ensure students' internalization of basic concepts and skills required. Teachers assist students conduct research and carryout

projects that challenge their skills. Doing projects also allows students to apply engineering design process (EDP) to propose solutions to Egypt's grand challenges. STEM curricula ensure the quality of graduates and their capacities to pursue university study in STEM majors as well as to introduce scientists to Egypt in the future (Ministerial Decree, 382, 2012). The curricula were developed by MOE subjects' consultants, three National Educational Institutions in Egypt: National Center for Educational Research and Development (NCERD), National Center for Examination and Educational Research (NCEEE) and Professional Academy for Teachers (PAT) as well as three US Institutions specializing in STEM Education. MOE established a STEM Unit, an entity that reports to the secondary education sector at MOE and includes representative from MOE, NCERD, NCEEE and PAT (Ministerial Decree 172, 2014). It is the responsibility of the STEM Unit to coordinate among all the above institutions and to supervise STEM Schools performance. The US experts are from three institutions supporting STEM education in the United States: Franklin Institute (FI), Teaching Institute for Excellence in STEM (TIES) and The 21st Partnership for STEM Education (21pSTEM). Each US institution is accountable for a specific area of specialization. TIES, for example, works on PBL and provides professional development for projects' leaders and instructors in coordination with PAT. 21pSTEM works on the curricula and assessment with subjects' consultants from MOE, curricula experts from NCERD and examination and assessment experts from NCEEE. Experts from Franklin Institute are accountable for leadership professional development training provided to STEM Schools' principals and deputy principals. However, it happens that all Egypt and US institutions work together to discuss and make decisions about crucial issues. One of those issues was putting the presidential decision of starting seven new STEM schools into action.

PBL is the instruction used in STEM Schools. Students in each grade are required to do a project in groups that vary in numbers according to the grade level. Grade one groups are of five students, grade two groups are of four students and grade three groups are of three students. Groups' numbers were decided by the STEM Unit and STEM. Grade one groups are larger because teamwork is something new for students therefore workload on five students will be less. Grade two and three students where students have previous experience of teamwork and can distribute workload among each other have smaller groups. Projects' themes were decided by MOE teachers and US experts. When the first delegation of MOE experts and teachers attended the professional development training in Science Leadership Academy in Philadelphia in the United States, they brainstormed ten grand challenges (problems) that Egypt encounters. When planning for students' projects, MOE and US experts formulated themes for students' projects based on the grand challenges. Examples for themes are "Building" and "Energy" for grade one students, "Water treatment" and "Systems" for grade two students and "Communication" for grade three students. For grade three students, the challenge is presented to them in the first term since it is planned that during the second term students have internship programs. An example for that is Injaz Egypt. It is Non-Government Organization (NGO) that provides leadership program to October STEM School students. However, until the time of the study, the internship programs were only in 2014. In 2015 and 2016, the internship programs stopped without a clear reason. There is a plan to have internship programs with factories and that can service PBL, but they have not started yet. PBL provides a motivating environment to students where they work on their preferred intelligence and collaborate with other colleagues to do projects that help students construct their own learning applying higher levels of thinking according to Bloom Taxonomy (Cziprok & Popescu, 2015). To assess the validity of their scientific ideas, students

working on each project are required to design prototypes and/or testable simulation applications. Through PBL, STEM schools apply both formative and summative assessment. The formative assessment is represented in components such as: reflective journals (online quizzes with transfer questions that each student in the group is required to submit individually once every two weeks. Each student has to submit five journals per semester. Grade one and two journals are evaluated by school teachers whereas grade three journals are evaluated by external evaluators. These evaluators are faculty members from faculties of Science and Engineering as well as scientific research centers. Students receive individual feedback on their performance in the journals usually after one week. Portfolios are - word documents where students in each group are required to document step-by-step the progress they have achieved in each of the tasks assigned for group. The portfolio is a group work and is evaluated in favor of the whole group. Grade one and two portfolios are evaluated by school teachers whereas grade three portfolios are evaluated by external evaluators. As for the summative assessment of students' projects, it is represented in components such as posters. Posters are large final sheets that students from each group present during the final exhibition of their projects. Each group poster should typically include in its layout: an abstract for the scientific ideas of the project, the procedures of the engineering design process of the project, findings and recommendations and finally citation of the references used in the poster. Prototypes or testable simulations, prototypes are small physical models of students' projects that students can use during the final exhibition of their projects to explain the implementation of the scientific ideas of their project. Testable simulations are software programs that students can use on their laptops to also explain the implementation of the scientific ideas of their project. Only students' reflective journals and portfolios of grade one and two are evaluated by STEM schools teachers whereas posters and

prototypes of the same grades are evaluated by external evaluators. All projects' components for grade three that include reflective journals, portfolios, posters, prototypes and testable simulations are evaluated by the external evaluators. Sahin and Top (2015) explained that when students present their projects in front of audience they develop self-confidence, collaboration, career as well as communication. October STEM school academic records in the year 2014/2015 have declared that 96% of the total number of grade one students earned the score of A+ (a score ranges from 95% - 100%) and 4% earned the score of A (a score ranges from 90% - 94.9%). The final scores for grade two students were higher than grade one scores since all grade two students earned A+. As for grade three students, there is a different Ministerial Decree for evaluating students. Students in grade three have to choose whether to join the Science section or the Mathematics one. The Ministerial Decree 308(2013), explained in Table 1 and 2 below, indicates that only two subjects are common between grade three STEM students and *Thanaweya*. These subjects are Religion and Civic. The reason why the MOE did not change these two subjects for STEM students is that, the MOE sees that it is crucial to maintain these two subjects for national identity of all secondary stage students in Egypt. Consequently, in the final exams' schedules for grade three STEM students and *Thanaweya*, students take the exams of these subjects at the same time. However, the two Tables 1 and 2 show that the exams of these subjects, which are the same as *Thanaweya* as explained before, represent only 90% of grade three STEM students' evaluations for the two subjects. The other 10% are assigned for students' attendance and participation that STEM schools add to the total evaluation of these two subjects. Another aspect with the same Mistrial Decree is that, it does not give weight to the project or the laboratories in the students' evaluations for the languages (Arabic, English, French and German) and gives weights of 20% to the project and 5% in the STEM subjects (Biology, Chemistry, Physics,

Mathematics and Earth Sciences). The reason for that is that, the MOE sees both the project and laboratories are based on scientific ideas whereas the languages are not, and that is the reason behind giving the project and laboratories evaluation weight only in the STEM subjects.

A different issue, in the same Ministerial Degree is that, the weights assigned for the evaluations of the University Readiness Tests (URT) (a test prepared by the MOE subjects' consultants that assess students' achievements of the learning outcomes in grade three) in both the languages and the STEM subjects are greater than the weights assigned for them in the Misconception Aptitude Inventory Tests (a test prepared to assess students' understanding of the basic concepts of subjects in preparatory and secondary stages).

The MOE sees that, giving URT greater weight is necessary to assess STEM students' capacities to do well in STEM majors at the university level. Moreover, the weight assigned for evaluating the Research and the Presentation is 10% of the total evaluation of the languages, whereas it is 5% of the total evaluation for STEM subjects. The MOE sees that the Research and the Presentation can be better assessed in the languages especially because the themes of theses research and presentations are scientific that can help STEM school teachers to evaluate both the language level and the scientific ideas. Therefore, the committee, assigned for evaluating the students' research and presentation, include STEM teachers as well as languages' teachers.

Table 1

Ministerial Decree 308, 2013 for evaluating grade three students, Science Section							
Subject	University Readiness Test (URT)	misconception aptitude inventory	Project	Laboratories	Research and Presentation	Attendance and Participation	Total
Religion	The same as *Thanaweya* (90%)					10%	100%
Civics	The same as *Thanaweya* (90%)					10%	100%
Arabic	50%	30%			10%	10%	100%
English	50%	30%			10%	10%	100%
Second Language	50%	30%			10%	10%	100%
Biology	40%	20%	20%	5%	5%	10%	100%
Physics	40%	20%	20%	5%	5%	10%	100%
Chemistry	40%	20%	20%	5%	5%	10%	100%
Geology and Environmental Sciences	40%	20%	20%	5%	5%	10%	100%
Advanced Labs							
Hydraulics			90%			10%	100%
Earth and space sciences			90%			10%	100%
Note. Religion and Civics are the same as Thannaweya Amma and it is 90%. Attendance and participations are 10%							

Table 2

Ministerial Decree 308, 2013 for evaluating grade three students, Mathematics Section							
Subject	University Readiness Test (URT)	misconception aptitude inventory	Project	Laboratories	Research and Presentation	Attendance and Participation	Total
Religion	The same as *Thanaweya* (90%)					10%	100%
Civics	The same as *Thanaweya* (90%)					10%	100%
Arabic	50%	30%			10%	10%	100%
English	50%	30%			10%	10%	100%
Second Language	50%	30%			10%	10%	100%
Applied Mathematics	40%	20%	20%	5%	5%	10%	100%
Pure Mathematics	40%	20%	20%	5%	5%	10%	100%
Physics	40%	20%	20%	5%	5%	10%	100%
Chemistry	40%	20%	20%	5%	5%	10%	100%
Geology and Environmental Sciences	40%	20%	20%	5%	5%	10%	100%
Advanced Labs							
Robotics			90%			10%	100%
Electronics			90%			10%	100%

1.5.   Students' achievement

Students' projects represent 20% of the final scores in grade three distributed across all disciplines whereas the other 80% is distributed among other components such as University Readiness Test (URT); Misconception Inventory Test (MIT); Laboratories' Practical Tests; Research and Presentation; and Attendance and Participation for both Science and Mathematics sections (Ministerial Decree, 2013). October STEM School academic records showed that, all grade three students scored in the projects ranging from A to A+ which is ranging from 90% to

100% from the overall grade. The final results after adding other components required for students' graduation showed that, all the 92 in 2014, were admitted to public Egyptian universities. All the science section students, forty five, were admitted to the following faculties: Faculty of Medicine twenty-six students, Faculty of Pharmacy fourteen students, Faculty of Dentistry four students and Faculty of Science one student. All Mathematics Section students, forty seven were admitted to faculties such as: Faculty of Petroleum Engineering one student, Faculty of Engineering thirty six students, Faculty of Information Technology nine students, and Faculty of Urban Planning one student. However, forty three students from the science and mathematics sections did not register in the public Egyptian universities. Those students preferred to pursue their study either in private universities in Egypt or abroad. Some private universities in Egypt such as the American University in Cairo (AUC), the British University in Egypt (BUE), Nile University, the Arab Academy for Sciences and Technology (AAST), and Zewail University offered partial and full scholarships. These scholarships were offered either by the universities or funded by NGOs such as Misr El-Khair (MEK) and Alfi Foundation. In 2014, fifteen students enrolled in Zewial University, fifteen students in Nile University, three in the American University in Cairo, and one student in the British University in Egypt. Other students, who pursued their study abroad, applied to Calabria University in Italy as well as universities in the United States of America. Three students were admitted to Calabria University and seven students in universities in the United States such as University of Minnesota, University of South Florida, Iowa State University, University of Michigan-Flint, and Utah State University. Communications with STEM graduates in Egypt and abroad showed that students are doing well in their university studies. All STEM students starting in Fall 2014 Semester, got an accumulative GPA of higher than 3.8 at the end of the first year. In Iowa State University a

student got 3.98 and in Utah State University a student got four out of four. Students' studying in private universities in Egypt, at Calabria University, and in the United States, send emails with success stories. They are honored at their universities being outstanding undergraduate students. They express how their study in October STEM School for boys applying PBL helped them with their university studies. The learning community of October STEM School has promoted students active participation in teamwork. Peer learning, where students from upper grades assist others from lower grades, as mentioned before, gives new students keys to understand the system and overcome obstacles. Moreover, teachers from remote governorates accommodate with students in their dormitories. They offer guidance to students in their projects and are available for students who need to discuss any issues related to school. That learning community motivates students to exert efforts and do better and therefore, students are doing well at school.

1.6.   The Researcher's background

The researcher worked for Public and Experimental schools (formal Language schools) as an English language teacher for more than fifteen years. He worked for October STEM School for Boys, the first STEM School in Egypt, in March, 2012. In September 2012, he was assigned the head of the languages department (English language, French Language and German Language). In September 2013, in addition to being the head of the languages department, he was assigned to be Grade three projects' leader and the education coordinator of the school. In September 2014, he was nominated to be the principal of October STEM School for Boys. In the academic year 2015/ 2016, and with the extension of STEM schools all over Egypt, he is sometimes assigned by MOE to coordinate issues related to curriculum and assessment with other new STEM schools. Moreover, he sometimes gives presentations and participates in the training of new principals and deputy principals from new STEM schools. He attended training programs

and workshops on STEM education. In addition, the positions he held and the training he received helped him better understand the philosophy of STEM education as well as the integration among STEM subjects. Moreover, working as grade three projects- leader was a good opportunity for him to identify how students get very engaged and motivated while working on their projects. He was curious to investigate PBL to understand how students perceive it. He used focus group of students doing the same projects. He investigated students' perceptions of PBL throughout their work on the projects, their learning, and their collaboration with their project group members.

1.7.   Purpose of the Study

The purpose of this study is to investigate PBL at October STEM High School for Boys as the first STEM High school in Egypt. Through this case study, the researcher investigated students' perceptions of PBL influence on their learning and their peers' collaborations throughout their group projects. The importance of this study comes from the fact that it is the first study that investigates PBL in the first STEM School in Egypt. Moreover, there are seven STEM schools that have already started in the academic year 2015/2016 and more new STEM schools will start in the year (2016/2017) and through the coming few years. Therefore, it is necessary to understand how October STEM School students perceive PBL as the main teaching and learning method implemented in Egypt STEM schools. Understanding students' perceptions can help to identify their needs and challenges. Such useful information can help school administrators and teachers to work towards improving the quality of education provided to students. Moreover, teaching in all STEM schools all over Egypt is central. All STEM Schools in Egypt apply the same curricula, the same teaching strategies, the same assessment and even the same themes for students' projects. Findings from this study at October STEM High School

for boys can help decision makers from the STEM Unit to better understand Students'

perceptions of PBL and therefore will be able to work towards providing better learning

environments to STEM Schools students. Some findings of this study can also help experts while

making decisions about STEM Education in Egypt.

1.8.   Research Questions

The research questions

1- How do students perceive PBL as a pedagogical strategy?

2- What are the similarities and differences found in students' perceptions towards PBL

according to the grade level and exposure to PBL?

3- How do students perceive team collaboration in PBL?

CHAPTER 2 LITERATURE REVIEW

In this chapter, the main key terms of the study will be presented in how the researcher refers to them as the main framework for this study. These are constructivism, STEM, PBL, and collaboration.

2.1.   Constructivism and STEM Education

 Constructivism is the first term to be tackled since it represents the theoretical framework of this study. Constructivism places great importance on the role of learners and how a learner makes use of his previous experience to construct his learning (Bofill, 2013). Therefore, the theoretical framework of the constructivism is the guide for collecting, describing and analyzing data as shown below. The history of learning theory claims that human factors are more influential in learning rather than environmental ones. Constructivists recommend that teachers involve students actively in the learning environment and to introduce activities that help them reflect on their previous experience and challenge their thinking (Schunk, 2012). Constructivism highlights the role of individuals' contribution of what they learn (Schunk, 2012). Piaget and Bruner declare that learning is an active process where learners apply past knowledge as a tool to understand the current learning situation and construct new ideas and concepts (Sharma, 2014). Vygotsky's theory stresses on the importance of social environment in the interaction. Schunk elaborates on that, when persons interact in collaboration that "stimulate developmental processes and foster cognitive growth" (Schunk, 2012, p. 242). Therefore, PBL where students conduct projects that reflect their understanding is an implementation of constructivist method in learning (Cziprok & Popescu, 2015). Constructivist learning and teaching strategies such as collaborative learning and PBL have theoretical support for successful achievement (Cziprok & Popescu, 2015).

Teaching K-12 students using STEM integration is still one of the challenges for teachers since few examples and models exist for them to follow (Wang, Moore, Roehrig, & Park, 2011). STEM integration requires highly qualified teachers who are capable of moving among STEM disciplines and find connections. STEM education in its true sense is the relationship among four integrated disciplines; Science, Technology, Engineering and Mathematics. However, success of STEM learning is not easy as it might appear. It requires challenging students with higher cognitive levels such as critical thinking and problem solving and to avoid low cognitive levels such as memorizing to help students to gain deeper understanding of the content (Basham & Marino, 2013). Making connections among STEM disciplines and designing learning experiences that support such connections require planning from teachers and more investigations on how to design such a learning environment; however, there is little research on whether more integration among STEM disciplines could help to improve students learning (NRC, 2014). Integrating disciplines may represent a challenge for teachers. STEM teachers are expected to take the challenge to find connections between STEM disciplines and provide required guidance for their students to figure out such connections (Revee, 2015). Therefore, STEM education requires highly skilled STEM teachers who have strong content knowledge as well as essential skills required to organize projects for their students. In addition, to be capable of assisting students in their projects, teachers should have broad multidisciplinary knowledge that supports their navigation among disciplines to support their students (Ruggirello & Balcerzak, 2013). Teachers can also promote students' understanding of STEM disciplines in general and engineering in particular through involving students into activities that apply engineering concepts into classrooms.

Among the challenges that teachers may encounter while teaching integrated STEM is teachers' perceptions. Equipping teachers with various tools to support their students and encourage them do activities that apply critical thinking and problem solving may improve teachers' perceptions towards integrated STEM (Nadelson, Seifert, Moll, & Coats, 2012). Supporting students in STEM education is more of ensuring a motivating environment through which students can be active problem solvers and work in groups to propose solutions to real-life problems and challenges which in turns requires teachers who are proficient in their subject areas and well trained to challenge students to discover connections among subject areas and to apply all these to make their own learning (Rider-Bertrand, 2015). Constructivists highlight the importance of the roles that a teacher plays as a guide and a facilitator (Sharma, 2014). The supportive social learning environment is essential for ensuring integrated STEM learning where teachers and students are interacting effectively to construct students' learning. Therefore, when the Ministry of Education in Egypt (MOE) made the decision to start STEM schools, the ministerial decree highlighted the importance of nine goals to ensure the motivating learning environment and the effectiveness of both the teacher and the learners to achieve required learning outcomes; these goals are:

1. "To take care of high achiever students in Science, Technology, Engineering and Mathematics and to promote their abilities

2. To value the role of Science, Technology, Engineering and Mathematics in the Egyptian Education

3. To spread new education system that is STEM education in Egyptian Schools

4. To encourage more students in high schools *Thanaweya Amma* to take scientific majors

5. To apply new curricula and methodologies that depend on inquiry projects and integrated approach in teaching

6. To acquire and promote students' interests and skills, and to increase their participation and understanding of Mathematics and Science

7. To achieve integration among the curricula of Science, Technology, Engineering and Mathematics to figure out connections among these disciplines to prepare a student who has the ability to design, innovate and think critically

8. To help students acquire skills of collaborative learning

9. To construct a distinguished scientific base of students who are qualified for university education and scientific research" (Ministerial 382, 2012, p.1).

In these nine goals, the ministerial decree focuses on the importance of integration among STEM curricula and to prepare students think critically and to work collaboratively applying PBL.

2.2. STEM Learning Principles and Students' Achievement in Mathematics and Science

Recent studies on STEM high schools have indicated that they usually provide students with challenging curricula and high cognitive level courses through which students can get opportunities to participate in specialized research (Bruce-Davis et al., 2014). Hansen and Gonzalez (2014) asserted that surveying across the research, they discovered that practitioners and STEM advocates often cited four instructional principles as essential for STEM learning. Those principles include integration among disciplines in general and technology in particular, to help students connect their learning to real world problems, to encourage students apply higher levels of thinking and work through PBL tasks. What could

make learning meaningful for students is the relationship between it and their daily life and that is why reflecting on real-world problems and conducting projects to propose solutions to those problems is what makes STEM learning "authentic". Connecting the learning content with real world can "incorporate habits of mind and practices" for students which in turns facilitate their understanding of that integrative content (NRC, 2014, p.20). STEM principles have strong relation with students' performance. Hansen and Gonzalez (2014) note that applying technology in classrooms helped students to better understand Science and Mathematics which in turns indicates the effectiveness of the learning principles and the necessity to consider them when applying STEM learning environment.

STEM Education promotes students' skills to think critically and be trained through problem-solving techniques as well as improving teamwork and communication skills (Roberts, 2013). Moreover, there is a strong connection between STEM Education and the skills that a leaner needs in the 21st century. "21st Century Skills and STEM education are companions in the journey to ensure all students are educated to become productive, technologically literate citizens of tomorrow" (Jones, 2014, p.11). The Committee on the Assessment of 21st Century Skills at The NRC agreed on three broad clusters of skills needed for individuals to interact positively in the 21st century. These clusters are "Cognitive skills: non-routine problem solving, critical thinking, systems thinking, Interpersonal skills: complex communication, social skills, teamwork, cultural sensitivity, dealing with diversity Intrapersonal skills: self-management, time management, self-development, self-regulation, adaptability, executive functioning" (NRC, 2011).

2.3.   Project-Based Learning

2.3.1. Defining Project-Based Learning PBL

Aufdenspring (2004) defines PBL as, "a model for teaching that focuses on the major

concepts of a curriculum, involving students in meaningful investigations of those

concepts. Concepts may be introduced by a teacher and supported by texts, speakers, and

other sources. Students then work autonomously to create projects that demonstrate their

learning to teachers, peers, and the community" (p.15).

In PBL, students are challenged with an extended inquiry process through which they work

on a challenge or a problem usually that requires teamwork where team members are assigned

with tasks that collaborate with the whole work (Chua, Yang, & Leo, 2014). Assigning tasks and

distributing the workload requires equipping teachers with PBL skills. Research suggests that

skilled PBL teachers have promoted students' learning whereas teachers who ineffectively

implemented PBL in their classroom resulted on negative effects on students' performance (Han,

Yalvac, Capraro, & Capraro, 2015). Moreover, Han and Carpenter (2014) stated that "STEM

PBL is used to refer to an instructional strategy having five factors: self-regulated learning,

interdisciplinary content, technology, collaboration, and hands-on activities" (p. 29).

For the purpose of the study STEM PBL is defined as the process through which students

work in groups to study a problem applying engineering design process (EDP) to propose

integrated solutions to that problem, test their solution and redesign another solution in ways that

enhance their deep understanding of the content and support their critical thinking and problem

solving skills.

2.3.2. Project-Based Learning promotes Students' Collaboration and Academic Achievement

"STEM PBL is used to refer to an instructional strategy having five factors: self-regulated learning, interdisciplinary content, technology, collaboration, and hands-on activities" (Han & Carpenter, 2014, p.29). It is the duty of classroom teachers to encourage collaborative learning activities. However, sometimes teachers encounter a student who takes over, students who are demotivated to participate and sometimes collaboration breaks down. At the time, the teacher as a facilitator should ensure that every member within the group is doing his task(Chapman & Roberts, 2015).

In STEM PBL, students need to collaborate to do tasks and that allows for more interaction, sometimes junior with senior students and that facilitate the transfer of experiences in a social learning environment (Sahin, Alpaslan and Top, 2015). The pedagogic concept of PBL that distinguishes it from traditional learning is that it tries to improve students' participation and interaction to acquire basic content of knowledge required to understand problems and to think critically to try to find solutions for them (Tseng et al., 2013) . PBL has enhanced students' achievements of Science and Technology teaching course and increased beliefs about self-efficiency when compared with traditional instructions (Bilgin, Karakuyu, & Ay, 2015). Promoting students' achievement in Science and Mathematics, as mentioned before, is one of the main goals of STEM schools. MOE (2012) stated that "The instructional method applied in STEM schools is based on using PBL and the integrated approach" (Ministerial Decree, 382, p.7) that aims at promoting students' understanding of math and Science and encourage more high school students to take the Science section (Decree, 382). Providing students with learning environments related to their life and working on their life problems such as "a traffic congestion problem that is affecting the flow of commerce" increases students' connection with their real

world (Marino et al., 2013). In a study on the attitudes of Korean middle schools students towards PBL, the results suggested that students had positive attitudes towards PBL and that they have participated effectively in tasks that included hands on activities and the use of technology (Han & Carpenter, 2014). Therefore, PBL motivating students working on real life problems could help improve their understanding of STEM disciplines.

2.3.3.   *Implementing Constructivism through Project-Based Learning*

PBL, as mentioned before, empowers students to participate effectively in the learning environment. Ciuperca (2015) indicated that "PBL, through Constructivism, provides the motivation that many learning theories cannot. It allows the learner to take charge of their own learning, creating their own knowledge in a complex, engaging and relevant way." (p.7). Social interaction among learners is required as a means for them to create their own knowledge and to encourage them to reach higher levels of thinking (Helle, Tynjälä, & Olkinuora, 2006). The role of teachers implementing constructivism through Project-Based Learning is not to teach students, but to provide the conditions through which students construct their leaning. Methods such as simulations and projects would involve students as active participants into the process of learning (Sharma, 2014) .

Project-Based Learning maximizes students' responsibilities of their personal learning (Cziprok & Popescu, 2015) . Therefore, it is necessary that teachers make sure that the learning environment is engaging for students and students are challenged to use higher level thinking skills. To ensure that motivating and social learning environment, MOE saw that it would be better for STEM schools to be boarding and that is why the existing nine schools are boarding. In the following section the researcher highlights some thoughts about the relation between boarding schools and students' academic achievement.

2.3.4.   Boarding Schools and Students' Academic Achievement

Parents send their children to boarding schools for many reasons: some of these reasons are the benefits of boarding schools on social, discipline and academic achievement. Parents in favor of boarding schools believe that they are centers of excellence and that their structure promotes not only students' academic skills but also their discipline (Bass, 2014). However, reviewing the literature sometimes gives contradictory recommendations about boarding schools. At the time when some educators call for boarding schools, others believe that home might be better for students' achievement since students find difficulty adopting with the boarding life (Bozdogan, Günaydin, & Okur, 2014). Although previous studies on the relation between boarding schools and students' academic achievement did not provide supporting evidence that this type of schools promote students' academic achievement, students' academic achievement at October STEM School, as mentioned in Chapter One, is very high.

In Chapter Three, Research Methodology, the researcher discusses the research design, participants, the research questions, as well as tools the techniques used for collecting and sorting the data.

CHAPTER 3 RESEARCH METHODOLOGY

The goal of this qualitative case study is to investigate students' perceptions of PBL in 6th of October STEM High School for Boys to better understand how students perceive this pedagogical strategy (PBL) in their learning and peer collaboration throughout their group projects which represent 60% of the total grades for students in year one and two (Ministerial Decree 382, 2012, Article 24) and 20% of the total grades for students in year three (Ministerial Decree 308, 2013, Article 9).

3.1. Research Design

The research design for this study is a descriptive and interpretive case study that is analyzed through qualitative methods. Qualitative researchers are concerned with "accessing and entering settings; selecting, collecting, and analyzing data; and building a case for conclusions" (Freeman, deMarrais, Preissle, Roulston, & St. Pierre, 2007,p.27). Case study design allows for close communication between the interviewers and students of the focus groups. Focus group is a homogenous sampling where participants belonging to subgroup are purposefully chosen (Creswell, 2012). For the purpose of this study, the representatives of this focus group will be students of the same grade working as on team in the same group. Students were asked to respond to open-ended questions. Open-ended questions allow participant to voice their opinions and tailored their options for a question (Creswell, 2012). To ensure validity and reliability issues and avoid any ethical issues related to the study, being 6th of October STEM School principal where the study is conducted, three of the school teachers collected the data: a female Biology teacher, a female English Language teacher and a male Physics teacher, these three volunteers had neither current nor previous academic relation with the students of the

sample. The three teachers had a training session before collecting the data. The three teachers have worked for 6th of October STEM School for three to four years. The reason for choosing experienced teachers to conduct the focus group was because their experience in 6th October STEM school familiarized them with project-based learning at school and the technical expressions that students might use during the focus groups which helped professionalism of collecting accurate data.

The researcher did not have any direct communication with the students participating in the research. Upon obtaining the approval from Institutional Research Board (IRB), the researcher asked the coordinator responsible for the projects at 6th of October STEM School to communicate with three volunteer teachers to collect the data. The researcher asked him to make sure that the three teachers did not teach to the classes in which the focus groups were chosen from. The parents of the students participating of the study were asked to sign the consent forms before collecting any data from the students. In the consent forms (see attached English and Arabic samples appendix E & F), parents were informed that participation of the children in the research is optional, and that their sons can withdraw at any time during the research without any circumstances.

3.1.1.   Participants

The sample for the data collection consists of twenty-four students: Ten students from grade one, eight students from grade two, and six students from grade three. Each grade was represented by two groups of students in addition to a pilot group (a group of four students from grade two that one of the interviewers assessed the reliability of the questions on). All students participating in the study are not from the same educational background. The Ministerial Decree 369 (2011), for establishing STEM schools in Egypt ensured that right to every student despite the type of school they are coming from (governmental Public Schools, Language schools and private schools), the

right to apply for the STEM Schools. Therefore, students who met the admission criteria of STEM schools, which is to have a score of 98% in the middle school with full grades in two of the three subjects: Science, Mathematics and English as well as an IQ test, can be admitted to 6th of October STEM School. Therefore, in the groups participating in this research, some students came from Arabic preparatory schools and some came from Language schools. Also, there was a variety of the governorates: for grade two and three, students were from governorates all over Egypt. Examples for these governorates were Alexandria, Sharkia, Sohag, Dakahlia, Giza and Cairo. For grade one students participating in the research, after starting new STEM schools in the governorates, Alexandria, Assuit, Dakahlia, Kafr El-Sheikh, Ismailia, Red Sea and Luxor in 2015/2016, the MOE made students' admission to schools is based on the students' geographical regions. Therefore, grade one students who were admitted to 6th of October STEM School were only from the governorates of Giza, Cairo, Qalioubia, Al-Fayoum and Beni Swaif. Moreover, students participating in the research in three grades came from different social and economic background. The educational background of students' parents ranged from primary school certificate to Doctoral level. Participating students were selected based on two factors: 1) students had to be working in the same group project and 2) all students of the group agree to participate voluntarily in the focus groups. Before starting the process of collecting data, students in the pilot group were interviewed by the physics teacher to review the wording and the comprehensiveness of focus group questions.

The pilot group was chosen from grade two as they have one-year experience at the time of this study and that makes them familiar with working with projects .Responses of the pilot group reflected students' understanding of the questions and seemed comfortable with them as a whole. Accordingly, no editing was needed in the working of the focus group questions. During

the proposal of the qualitative research, the researcher should make sure that both the research questions and the design are clear so that the reader can evaluate its applicability and on the other hand ensure the flexibility the remarks the qualitative research (Creswell, 2012) . After reviewing responses of the pilot group, the three teachers carried out the focus groups interviews. During the focus group, students were asked to answer the questions as groups meaning that all members within the group had opportunities to add, agree or disagree within any of the other students' responses. The focus groups of grade one and two lasted about thirty minutes. However, grade three focus groups interviews took longer periods of time as students gave very long answers to questions with detailed examples. A group took more than forty minutes and the other group took more than an hour. The focus groups met in the library during the times when no one would expect for the interviewer and focus group members were there. Therefore, times during the school day, when there were no sessions in the library were selected for the focus group interviews. The librarian was also asked to leave the library during the recordings to give students sense of comfort and freedom of speech. Moreover, to ensure confidentially, the three interviewers used the recorder on the researcher's mobile phone to record the focus group interviews. None of the students knew the owner of the mobile phone. Students were informed that the recordings would to be transcribed and coded and that their names would be anonymous.

3.1.2.   Research Questions

The goal of the research questions was to investigate students' perceptions of project-based Learning in October STEM High School for Boys.

The research questions are;

RQ1: How do students perceive Project-Based Learning as a pedagogical strategy?

RQ2: What are the similarities and differences found in students' perceptions towards Project-Based Learning according to the grade level and exposure to Project-Based Learning?

RQ3: How do students perceive team collaboration in Project-Based Learning?

3.1.3.   Research Tools

Focus group discussions (as mentioned in 3.1) were used for collecting data. The recordings were transcribed by a university student who graduated from the school two years before. Transcripts were reviewed in terms of the recordings and missing parts were completed. Fifteen (15) open-ended questions were used for the focus group interviews. The researcher formulated eight questions to investigate the first theme of students' perceptions of PBL since it is the main theme of this study, whereas three questions were formulated to investigate the second theme on students' learning and four questions on the third theme investigating students' collaboration as follows;

How project-based learning is perceived by students

1. From your experience in the STEM school, how do you define project-based learning?

2. How do you think it is different from lecturing?

3. What do you think of the processes of assessing the journals, the portfolio, the poster and the prototype?

4. What difficulties do you usually have while working on your projects?

5. What do you usually do to overcome the difficulties that face you?

6. What advice can you provide new STEM school students while working on their projects?

7. Would you suggest to have schools apply PBL? Elaborate on your answer.

8. Is PBL what you expected to be? Elaborate on your initial perceptions and those that have developed after experiencing PBL in your learning.

   The researcher formulated eight questions to investigate students' perceptions of PBL since it is the main theme of the study, whereas for the other two themes; students' learning and students' collaborations, the researcher used only seven questions to investigate them being less important than PBL.

Students' learning

9. Explain the process of choosing / defining your project?

10. Have the projects helped you in your learning (elaborate on your response)?

11. Do you think you can apply what you have learned in the project in the real world? How?

Students' collaboration

12. How do you cooperate with your peers throughout the project?

13. What role(s) does the projects' instructor play during your learning process throughout the project?

14. Explain the dynamics taking place with your peers during working on your projects?

15. Do you have any suggestions that might enhance group work during the project?

3.2.   Research data collecting and sorting

Focus groups have been carried out over two days. The first day was conducted with the pilot group and the second was for the other six groups (two groups from each grade as mentioned in 3.1.1). Recordings were transcribed and reviewed to which the transcriptions have been corrected for any typing errors and other data has been checked for errors. Responses of the pilot group ensured that questions were accurate and proper for students. The data was organized from the three grades regarding each question. Using the thematic analysis of three themes (students' perception of PBL: represented through the first eight questions, of the focus group structured

questions; students' learning: represented through the second three questions; students' collaboration: represented through the last four questions), it was easier for the researcher to compare between students' responses. The three themes were decided based on the researcher's background as a project leader for grade three in school year 3013/2014. This was mainly as projects seemed an opportunity for students to promote the collaboration as well as their learning. Therefore, he decided that the three themes that he wanted to investigate students' perceptions on, would be PBL, students' learning and students' collaboration. The researcher did not use sub-themes with the three themes mentioned.

Arabic was the language was the language used for the focus group discussion with all groups of students. Table 3 below, presents the coding of all twenty-eight students participating in the research. Students from the three grades were coded according to their grade level, group and number of the student in the group. An example for the coding system is, "G2-2S6". This reflects a student from grade two, group two and his order in his group is number six. The four students in the pilot group are referred to as P1 to P4, was used as mentioned before, to assess the validation of the focus group questions. In the consent forms assigned by the students' parents, the researcher confirmed that all data regarding the study would be confidential. For that reason, the coding strategy in the table below was used. Coding students participating in the study in that way helped the researcher to quote the actual words from students' discussion with the interviewer while keeping the identity of students anonymous. Informing students that their perceptions would be confidential gave them freedom of speech.

To ensure validity of responses, data triangulation was used. Through this type of triangulation, the researcher uses different sources. In this study, having students from different groups from the three grade levels and comparing the responses within and across grades

determining agreements was the means of triangulation to increase confidence in the data

(Creswell, 2012).

Table 3

Focus Groups Students' Coding					
Grade One (10 students)		Grade Two (8 students)		Grade Three (6 students)	
Group One		Group One		Group One	
Student One	G1-1S1	Student One	G2-1S1	Student One	G3-1S1
Student Two	G1-1S2	Student Two	G2-1S2	Student Two	G3-1S2
Student Three	G1-1S3	Student Three	G2-1S3	Student Three	G3-1S3
Student Four	G1-1S4	Student Four	G2-1S4	Group Two	
Student Five	G1-1S5			Student four	G3-2S4
Group Two		Group Two		Student five	G3-2S5
Student six	G1-2S6	Student Five	G2-2S5	Student six	G3-2S6
Student seven	G1-2S7	Student Six	G2-2S6	Pilot Group /Grade Two (4 students)	
Student eight	G1-2S8	Student Seven	G2-2S7	Pilot 1	P1
Student nine	G1-2S9	Student Eight	G2-2S8	Pilot 2	P2
Student ten	G1-2S10			Pilot 3	P3
				Pilot 4	P4

CHAPTER 4 RESEARCH FINDINGS

For the purpose of the study, three themes were used: students' perceptions of PBL, students' learning, and students' collaboration. Determining these three themes, as mentioned before, came through the researcher's previous interactions with grade three students who were projects' leaders at 6th of October STEM School in the academic year 2013/2014. He saw how PBL could be involved in promoting students' collaboration; engaging them into a productive, motivating learning environment where students' , as the Constructivism Theory explained in Chapter Two, construct their learning; and helping them to have high scores in their projects, as mentioned in Chapter One.

Vygotsky's theory stresses on the importance of social environment in the interaction. Schunk (2012) elaborates on that, when persons interact in collaboration "stimulate developmental processes and foster cognitive growth" (Schunk, 2012, p. 242). Therefore, PBL where students conduct projects that reflect their understanding is an implementation of a constructivist method in learning (Cziprok & Popescu, 2015). Therefore, Schunk (2012) thought that investigating students' perceptions about PBL, as a pedagogical strategy, could reveal the reasons for students' collaboration and high academic achievements. To investigate students' perceptions about these three themes, the researcher formulated fifteen questions that were answered by focus groups. After that, a thematic analysis was carried out, the findings from which are presented below.

4.1.   Research Findings

Focus group discussions were carried out by the three interviewers (the three volunteer teachers from 6th of October STEM School, a female Biology teacher, a female English

Language teacher and a male Physics teacher). Each interviewer had two focus groups representing a grade level. The interviewers encouraged participating students to elaborate on their answers and to comment on the responses of other members at any time. The researcher asked the interviewers before collecting the data to make sure that responses from individual members are approved by other members of the group or not. Therefore, students' quotations represent the whole group responses unless one of the group members contradicted what was said by the rest of the group. The researcher also compared between the students' responses in the two groups representing the grade level to know students perceptions of each question at the grade level.

Theme one: How PBL is perceived by students

1. From your experience in the STEM school, how do you define PBL?

Grade one students defined PBL as a problem they try to find solutions to and that will help them understand subjects related to that problem but in an indirect way. A student mentioned that, "PBL is a simple and interesting idea that to transfer a piece of information to a student I give him a task and through that task he learns a skill or a topic" (G1-1S3, personal communication, November 23, 2015). Grade two students explained that PBL can be defined as an educational system that is based on scientific theories and how to apply these theories. A student mentioned that, "We study things in the project very deeply and we do things hands on so we will never forget them and we discover that theories can be applied sometimes with high efficiency and other times with low efficiency so we learn about details" (G2-2S1) . Grade three students defined it as a new style of learning that they have been using for three years. It makes students learn and search for information and ask teachers or do researches on the internet. It is different from traditional learning in the idea that traditional learning usually forces students to learn

specific topics that they may not be interested in. Moreover, they explained that before doing projects they could not understand the idea of integration. Now, they can understand the relation among different subjects through applying them in their projects. They can also go beyond the classroom level and learn more about the topic of their project. A student said that, "Our project was on communication and we needed to learn more about some topics in Chemistry that we did not study at school. We did hard work and we found that was interesting" (G3-3S3). A higher level of engagement is clear in the student comment "interesting".

2. *How do you think it is different from lecturing?*

Grade one students explained that in their traditional schools, teachers used to lecture all the time and they have to memorize information, however exams in traditional schools supported that way. A student noted that, "In traditional schools a teacher keeps providing information, information, information and that is it, however here teachers discuss this information with students" (G1-2S3). In STEM school, teachers encourage students to search for information, present it, and have discussion about it therefore, students do not feel bored. Grade two students said that in lecturing the teacher is the center of the learning process and students are listening all the time. A student explained that, "In the lecturing style, the main factor is the teacher while students remain receivers. However, here when students teach each other, the interaction is better and students understand each other better than the teacher because their minds are paired. The role of the teacher here is a guide and facilitator. Also, to remove the misconception students might have about some concepts" (G2-1S4). Grade three students explained that traditional lecturing do not provide space for interaction among students, however PBL supports teamwork since students work hands on in groups. In lecturing, teachers try to make students copies of what they know, but in projects students search for information and may reach more information

than the teacher know about specific topics. A student noted that, "In traditional schools, when you ask some teachers about how they reached a piece of information, sometimes you get the answer, recall it as it is" (G3-1S2). PBL allows for a place for discussion between teachers and students.

3. *What do you think of the processes of assessing the journals, the portfolio, the poster and the prototype?*

Grade one students claimed that journal evaluation is not an accurate tool for formative individual assessment. Students think that the journals reveal the amount of effort exerted by individuals. A student said that, "When we take a journal assessment, a student who is not working hard as other members do in the group but can write well and express ideas clearly may also get the full mark….that is blue" (G1-1S3). Grade two students indicated that journals motivate students to work hard throughout the project. They added that the journal questions assess students' progress in the project according to the school calendar. A student noted that, "The journals do not allow any delay from students' side, as I should be working according to the calendar; for example during the sixth and seventh weeks I should complete the project's test plan as I expect to have journal questions assessing the steps taken and the results of my test plan" (G2-1S1). Other students in grade two mentioned that not all journals' questions are connected to students' work on their projects. A student said that, "My group is doing a project related to Biology and a question we had during the journal evaluation was asking about concepts in the Physics, so we talked about Physics and I got blue, although the question was not connected to our project" (G2-2S4). As for grade three, some students complained that the wording of the questions in some journals are sometimes is not clear enough and sometimes are not aligned with the rubrics the questions would be evaluated against. A student stated that, "In

one of the journals, we had two questions that were almost the same. I knew the evaluator would be expecting me to give two different responses. I did not know what to do, so I wrote two different responses based on the learning outcomes we had in this subject, that was not connected to my project however, it worked" (G3-1S1). Grade three students, as explained before, believe that the journal is a good formative assessment tool that can help them to improve their quality of work and be strictly following the school calendar. However, grade three students gave feedback on the connection between their projects and the journal questions similar to grade one and two: they think that there are no strong connections between journals' questions and students' projects and that journal questions should be modified to motivate students reflect their understanding and implementations of the projects.

As for students' perceptions of the assessment of the other components of the project: the portfolio, the poster and the prototype, which are evaluated as group assessment tools. Students' responses varied based on the grade level. Grade one's students thought that evaluating the above components of the project as group work, would not differentiate between the different amounts of efforts exerted by individual members. A student noted that, "The capstone teacher should make sure that all members in the group are working together, for some of my colleagues they do not do the same amount of effort and get the same grade the group would get at the end" (G1-1S2).

As for grade two and three, students became more familiar of some ways that could facilitate of workload distribution among them. However, they referred to another challenge regarding poster and prototype evaluations they had when they were in grade one. Grade two students explained that some projects' evaluators are not familiar with students' posters or prototypes until the day of the final exhibition of the projects. Accordingly, the ten or fifteen-

minute assigned for poster and prototype evaluations is not enough to familiarize the evaluators with them. Grade two and three students suggest submitting soft copies of students' posters to evaluators before the day of the exhibition to familiarize them with the ideas on the day of the exhibition. A student said that, "Sometimes an evaluator is looking for a specific piece of information in the test plan for example and if it is there that is enough without listening carefully to the whole idea of the project" (G3-2S2). Grade three students also asserted the idea that posters should be distributed among external evaluators according to their area of expertise.

A student from grade three tried to explain a situation happened with an evaluator:

One of the problems we had during poster evaluation last year was the evaluators; some evaluator asked questions on something whereas our project was something different. He was trying to apply his area of expertise on our project. I wish that worked, I would not have minded at that time (G3-2S1).

The above response from the student showed that, he wanted to explain that if evaluators are not of the projects background, they might not be focusing on the students' presentation.

4. *What difficulties do you usually have while working on your projects?*

Grade one students mentioned three difficulties. The first difficulty is time management: Students find it is not easy to manage their time working on their projects, doing school assignments and studying school subjects. Time management was even harder for grade one students who came from Arabic schools in middle schools. The reason is that STEM schools language instruction is English and that requires more time and efforts to study Science and Mathematics in English. A student said that, "Time is limited, first we have a lot of study to do, most of us came from Arabic schools to study English curricula and that requires to double your effort to understand these curricula and at the same time you need to manage your time to work

on your project to have a good project at the end" (G1-1S). The second difficulty is teamwork: for grade one students, it is the first time to work in teams. Students explained that sometimes it is not easy to reach an agreement among group members.

> To explain the challenge that new students might face with time, a student noted that:
>
> At that moment we are working on the design of the building and we have more than one design and have not agreed on one. We have only one week for the design and that is very hard for us. A real architect needs more than one week to design a house. (G1-1S2)

The third difficulty students referred to is the validity of online resources they sometimes use. A student complained that, "Sometimes it is not easy to find trusted resources to get the information you need for the project and that takes time" (G1-2S2). Grade two students explained that one of the difficulties they have while working on their projects is materials needed for the project. It is not easy to find vendors for some scientific materials. A student said that, "It is very difficult to get the chemical materials required for the prototype of the project. Sometimes these materials are not available in the market even it is not dangerous" (G2-2S4).

Students also added that visiting scientific institutes or universities to consult professors about their project is not an easy process. Although STEM schools issue formal letters addressing particular departments at universities indicating the aim of students' visit, many scientific entities are still out of reach for students. A student complained that, "Last semester I went to Cairo University to meet a professor in the faculty of agriculture. I had a formal letter for him, but the security on the three gates refused to let me in. Luckily, I saw a professor I knew and he asked the security to let me in" (G2-2S1). Students think if the problem of materials was solved that would be perfect especially because 6th of October STEM School is in a remote area and transportation is not easy. Grade three students also thought that obtaining the projects'

materials represent sometimes one of the main challenges. A student said that, "Some materials are not available in Egypt or very expensive that is why students change the whole idea of the project or tend and sometimes use simulation rather than a prototype" (G3-1S2). Considering grade level and experience within projects, time management that represents a difficulty for grade one students is not one of grade two or three students who gained experience about time management. However, the availability of some materials that students need as well as communicating with university professors are still two main difficulties. Students proposed the idea that STEM schools should have protocols with some reputable scientific institutes and universities to facilitate the process of communicating with professors.

5. *What do you usually do to overcome the difficulties that face you?*

The goal of this question was to assess how far has PBL promoted critical thinks and problem solving skills of students and to what extent students were able to propose solutions for the challenges they believed they had. Grade one students explained that to overcome time management difficulty: they assign tasks and help those who are lagging behind doing their tasks. A student said that, "We try to manage time, I mean when we assign tasks if we have someone who is not good at research we ask him to do other things that do not require research" (G1-2S1). They also try to find an agreement among group members. A student mentioned that, "There are two graduate classes from school before us who worked on the same themes of these projects and we can find what we need in a short time" (G1-2S3). Grade two students mentioned that the difficulty of materials can be sometimes solved by trying to find other alternative materials. A student gave an example for looking for alternative solutions, said that, "I needed Lithium in my project; I could not get it so I took it from an old battery" (G2-1S4).

When asked about ways they use to overcome difficulties they might have with projects, grade three students explained that they try to classify the problems in ways that help them reach solutions.

A student in grade three noted that:

When I have problem, I try to calm down and think: Is it personal problem, team problem or a problem finding some materials. If the problem among members in the group for example, we discuss it to find solutions. (G3-2S1)

Grade three students' responses showed that students gained experience from their projects in the last two years. Moreover they had rationale addressing their problems.

6. *What advice can you provide new STEM school students while working on their projects?*

Grade one students think that they can advise other students on what worked for them to manage their time. They also advised new STEM schools' students that when they work on their project they should not panic if all members of the group cannot do a specific task. They should think about their projects and try various solutions until they reach results. A student mentioned that, "All team members should work together, it is not acceptable to have five members while only two are doing everything for example" (G1-2S5).

Grade two students' responses also showed that, teamwork is one of the most important aspects of their projects. They wanted to let other STEM schools' students know the importance of taking accountability for their actions. Grade two students also highlighted the importance of doing research applying science to find out answers for the questions they might have about their projects. A student noted that, "The most important thing about projects is engineering design process (EDP), it is the core of any project and it requires that you think about the problem

before you start" (G2-2S3). Grade three students advise other school students to value their

projects. It is not only to get high grades. It should also be a learning experience.

A student in grade three added more advantages for the projects. He said that:

Some of the school projects have participated in national and international competitions

such as ISEF and others. Students who travelled abroad met people and learnt new

experience and when we listen to these experiences we learn a lot about other cultures.

(G3-1S2).

The above quote from students indicates how far STEM students value their projects. They also

think that the projects they carried out over three years have changed their personalities

especially those students who travelled abroad and participated in international competitions.

7. Would you suggest to have schools that apply PBL? Elaborate on your answer.

Grade one students refer to STEM education in general as an effective system that requires

budget to apply. It might be a challenge for the MOE if it does not increase the assigned budget

for STEM to achieve the desired goals. A student said that, "I think that we need to wait until we

overcome any challenges in the current schools before starting new schools" (G1-2S3). They

also think that since the nature of learning is based on research, they should be taught how to do

that research in a very organized way. A student said that, "We should learn about research in

other schools and not to take two stages without research and then to use it in high school" (G1-

2S1).

Grade two students believe that PBL helps students to learn. However, they also

recommend that STEM system should start from primary school and to extend to university. A

student said that, "I think this type of education should start from an early age as it is the time

when you form the scientific basic for students" (G1-1S2). Grade two students added that public

universities may not be a good place to pursue their education after they had studied at STEM schools. Students think that PBL has helped them to think critically and therefore switching back to traditional education in Public Universities would be a decline.

Grade three students do not suggest the idea of extension of STEM schools until the MOE is ready for that. Students at 6th of October explained that, some STEM students in the new schools have been communicating with them. STEM students in many of the new schools complained that the Science laboratories were not working because there was no equipment or materials in the laboratories. Therefore, grade three students believe that extension in STEM schools would not be a good idea unless there are the proper preparations for that extension. On the other hand, grade three students think that PBL is an effective methodology that can be applied in other schools since it motivates students to think critically. However, grade three students see that PBL requires new students, especially those coming from Arabic schools, to improve their English Language. Improving English Language would help them to search the internet for information and investigate previous solutions about their projects in English. They should also learn how to share information with other students, which is something familiar to students in the traditional education. Grade three students also agree that STEM education should start from an early age. A student noted that, "It is a good idea to start STEM from KG , primary stage, preparatory stage and when students come to secondary stage they are prepared and do not find it difficult when we started school in the first year" (G3-2S2).

8. *Is PBL what you expected to be? Elaborate on your initial perceptions and those that have developed after experiencing PBL in your learning.*

Grade one students mentioned that before joining 6th of October STEM School, they thought that they would work individually and not in groups. Grade one students think that it is not easy to

work in groups; however collaboration with other students helped them to get more information.

Before they come to school, grade one students thought that doing projects is something very

difficult. A student said that, "I could not understand how I can solve a great problem in Egypt,

but when I started my project and used EDP, I learnt that I can work on a problem step by step

until I understand it and then think about solutions" (G1-2S1).

Grade two students explained their previous thoughts about projects. They had the

thoughts that carrying out projects would be something difficult. Students explained that, they

heard the projects would be related to Egypt's Grand Challenges such as over population.

However, when they started working on projects they did not find it difficult as they thought

before. They found out that the projects are interesting and that they learned a lot from carrying

out them.

A student in grade two noted that:

When someone told me that you will be working on Egypt grand challenges, I asked what

Grad Challenges means? …I was informed that they are big problems such as over

population. I thought I would not be able to do so, but when I started working on my

project and I did some research I realized that step by step I would be able to do that.

(G2-2S3)

Grade three students said that when they joined the school they had no idea about projects. They

could not think that doing projects could help them learn. However, after some time and after

carrying out some projects they felt that they became more confident. However, some students

thought that one project per year is fair enough. A student said that, "I think one project per year

is enough to be a good one and to be able to apply it" (G3-1S2). Students in the three grades,

think that Project-Based Learning has changed their way of thinking and that they have learnt a

lot from doing projects. The most important thing they learnt is that they applied knowledge when they worked hands on.

Theme two: Students' learning

9. ***Explain the process of choosing / defining your project?***

Students' responses indicated that, choosing and defining the project for grade one was just the idea that the school required students to work on a specific theme that is "building". Since it is the first time for grade one students to do projects, they think that their project instructor should let them know what to do step by step. They did not have accurate vision on how to identify and define a specific problem under the big theme.

Grade two students mentioned that they start to do some research about the problem and examine these solutions to see if they are applicable to apply in their project. As for grade three students, they indicated that their choice of the projects' problems is based on Egypt's grand challenges which, in turns, give evidence that students gained experience over the first two years regarding identifying and defining problems. Despite the fact that all grade three students do their projects around the same theme that is "Communication", they presented a variety of projects' ideas.

To illustrate the process of identifying and choosing their project's problem, a student from grade three said that:

> We work on grand challenges that Egypt has. We start by identifying the problem that we want to find solutions to. We examine previous solutions to see previous trials. We think about the availability of materials and the prototype of the project. It is important to apply what I have learnt. (G3-2S2)

10. Has the projects helped you in your learning (elaborate on your response)?

Although grade one students mentioned that the projects help them with their learning they did not provide a strong connection between doing projects and learning. A student said, "If a student is not interested in a specific subject that is in the project for example, he will have a problem and will have to study that subject" (G1-1S1).

Grade two students explained that some topics they study in different subjects help them with their projects and at the same time working on their projects helps them understand some topics within subject areas.

A student in grade two noted that:

The idea is some of the scientific theories that we study in books look something but when you see them working in your project they are something different, I mean you understand them, you know their uses and you will never forget them. (G2-1S2).

Grade three students showed how they try to find integration among their projects and the subjects they study.

A student in grade three said that:

If I am working on the filtration of Nile water, I would use Physics to learn about the phase of water, its pressure and temperature. The same if I am working on energy, I would use Chemistry to learn how to reduce the harmful effects of carbon dioxide by a neutralization process using other components. (G3-1S2).

11. Do you think you can apply what you have learned in the project in the real world? How?

All students participating in the research from the three grades thought that they can apply what they have learnt in the projects in the real world. Grade one students said that they have

learned through the project about (Building) some useful information about (Housing) as one of Egypt's Grand Challenges. A student said, "We are doing our project to be applied in the real world. We have prepared 2D and 3D designs. We also considered sources on energy and water" (G1-2S5).

Grade two students explained that they have worked on projects that can help find solution to problems in Egypt such as (Building) and (Energy) in grade one. They also learnt about (Water treatment) in grade two. They asserted that they had feasibility studies for their projects and that the results of such projects can help in the real world. A student commented on his project on water treatment that, "Based on my experience with this project, I have a feasibility study and I have estimated the cost and it is applicable to be applied in the real world and my future plan is to apply it" (G2-2S7).

Grade three students explained that before doing projects for their study they could not think that problems that Egypt faces such as (Overpopulation), (Water Treatment), and (Electricity) can be part of their interest for study. However, now since they study the Grand Challenges that Egypt has, they can apply it to the real world. Moreover, concepts that students use through projects such as the concept of "feedback", became part of everyday language as they learned how to reflect even on daily issues and give feedback to each other. A student said that, "Also the project can be a life style which meaning that when I face a problem, I try to identify what causes that problem and take steps like the ones I take while doing my project and try to solve it" (G3-2S4).

Theme three: Students' collaboration

12. How do you cooperate with your peers throughout the project?

Grade one students explained that they meet together to discuss the distribution of workload and to assign tasks for the group members. They also said that since the project represents 60% of their total evaluation scores. It is a big portion that requires students to cooperate with each other.

A student in grade one noted that:

First we all meet together to decide the part that we need to work on, then we try to discuss based on our capabilities what everyone can do. If I finish my part, I try to help other people with the group and if I cannot do my part I ask other members who finished their parts to help me. (G1-2S3).

Grade two students also explained that they work as a group where workload is distributed among team members based on agreement from all members. After that, all members are committed to achieve their tasks. A student said that, "No one can change what we have agreed on unless he has a strong reason for that, and that should be based on reasonable justifications" (G2-2S4). Another student from group one gave an example of cooperation while working on the portfolio. He noted that, "When we write the portfolio, every member works on a specific section and then we review the work of each other and that help the group to reach the best formulation" (G2-1S3).

Grade three students explained that they have developed a strategy to organize their work together: Everyone is assigned specific tasks that should be done within time frame. They declared that sometimes there is disagreement on some points of the project; however, they learnt not to take things personal and to how to overcome problems. They have also explained

that it is important to choose a leader for the project, and that all members should listen to him and respect him.

13. What role(s) does the projects' instructor play during your learning process throughout the project?

Grade one students think that the project instructor should provide guidance required by students throughout the whole process of their project. He should also give students feedback on their work. However, most of the students in grade one see that do not often happen. Grade one students do not feel the effective role of their project instructors. Students see that, since it is their first year to carry out projects, more guidance to facilitate and assist their work on the project should be provided. A student from group one gave an example, "I asked my project instructor how to learn about the cost of material and the answer was "search" he did not even ask me what I need in details" (G1-1S4).

Grade two students also see that the role of the project instructors should include guiding them throughout their project and providing the academic feedback. However, they think that what their project teacher does not make sure that the groups are working according to the project calendar provided by the school, and usually the academic guidance is related to the teacher's academic background and whether it is relevant to the projects that students are working on. A student explained that, "The project's instructor main role is that it helps all groups in the class to be working according to the project's calendar" (G2- 1S3).

Grade three students see that the project instructor usually helps them manage the length of time assigned for each phase of the project according to the school calendar. He also sometimes coordinates the communication of students with other STEM teachers. That communication with STEM teachers, provide scientific feedback on students' projects. However,

the project instructor's subject area might be Arabic language or social studies so he does not have relation with scientific projects and cannot provide help on the academic level.

A third grade student said:

A project instructor may have no connection with the topic of your project at all since his subject area might be Arabic language or Social Studies. Therefore, he can help you manage your schedule and discuss with you some problems related to the organization of your work. (G3-1S2).

14. *Explain the dynamics taking place with your peers during working on your projects?*

Grade one students mentioned that they usually start to brainstorm together to assign and distribute workload among each other. A student said that, "We try to choose together the design of the building and then do the research on other points according to tasks and if anyone finds some online information that might help another member in the group, he emails him" (G1-1S4). Moreover, on the social level students working on the same project often became closer to each other that they sometimes spend their free time and weekends together.

Grade two also explained that they distribute workload among group members and give examples. A student said, "A member in the group may be better than the others at a specific program that we need in the project. Another member be can do online research better than the others, a third one can buy some of the required materials" (G2-1S1).

Grade three students provided a response similar to grade two related to the idea that group members make use of the skills that some members could have and added that might extend to the scientific content of the project. A student said that, "One of the group members may be good at Physics or Electronics so he can explain to the" (G3-1S3). Another student is the

in the second group explained that they set agenda of priorities they need to discuss before their

project meeting. Sometimes they meet before the journal evaluation time so as to discuss

accomplishments on their project so as to be able to write effectively of their individual

reflections in the journal.

   15. Do you have any suggestions that might enhance group work during the project?

Grade one students summarized three suggestions they see could help enhance work on the

project; (1) time management; that ensures students have enough time to work on their projects

as well as assigned tasks required for other subjects. (2) Effective teamwork; where each

member has a role and the leader as a role model for the group. (3) School administration

understanding and support; so as to organize with teachers the number of quizzes that students

take and the amount of assignments since time is usually very challenging for students. A student

mentioned that, "Time management is one of the challenges that we face at school, we work on

tasks required for our project and at the same time work on school subjects and that is a pressure

because it is the first time for us to work in groups and do projects" (G1-1S3).

   Grade two students explained that teamwork is the most important part in the success of

PBL. Students said that when classes are divided into groups at the beginning of the school year.

Students have the right to choose each other to form group work. At that time, students have to

agree with each other on the role that every member will play and that promotes the mutual

understanding between group members. Therefore, students suggested the careful choices of

team members to help each other achieve tasks.

   Grade three students also explained that an effective teamwork is the key to high quality

projects. They mentioned that each group give presentation and get feedback from the whole

class as part of informal peer evaluation. They said that helped them reflect on their projects and

improve it. Moreover, they have recorded videos to help new students on how to work effectively on their projects. Grade three students declared that when they were in grade one they did not find the proper guidance even from teachers since the idea of PBL was new to everyone including teachers. Grade three students are willing to help students in lower grades on their projects. A student explained that, "When we started working on projects we had a lot of problems and after some time we were able to overcome those problems and we realized that we would not have leant if we had not had such problems" (G3-2S1). They also suggested that grade one project instructors should be very qualified on PBL and willing to help students overcome their challenges.

In the following chapter, Chapter Five, the researcher discusses the research findings in terms of the three themes of the study: students' perceptions of PBL, students' learning, and students' collaboration and relates the findings to the conclusions derived from the literature review in Chapter Two. Limitations of the research and recommendations for future studies and program implementation are also discussed.

CHAPTER 5 RESEARCH DISCUSSION

In this chapter, the researcher discusses the findings of the research. It goes beyond that to presenting its limitations and recommendations for further studies to get a deeper understandings of students' perceptions of PBL as the pedagogic strategy that the MOE applied in STEM Schools in Egypt. Research data collection and discussions focused mainly on the three themes of the study: students' perceptions of PBL, students' learning, and students' collaboration. Creswell (2012) explained that interpreting qualitative research is where the researcher draws a lager image of the phenomena through comparing data, personal views as well as past studies. Therefore, the researcher interprets the findings by connecting them with these three themes to provide an overall ides of students' perception of PBL and how far it promoted students' learning and students' collaboration 6th of October STEM school.

5.1.   Research Discussion

Findings from the study suggest that students at 6th of October STEM School for boys see that applying PBL promoted their understanding of STEM subjects and made their learning more meaningful. Students' believe that working hands on through their projects to propose solutions to real life problems which represent Egypt's Grand Challenges, such as (Energy), (Water treatment) and (Communication) helped them apply the theories they learn. In addition carrying out the projects in group work promoted students' collaboration with each other. The better communication among students supported peer learning and peer evaluation where students collaborate with each other. In STEM PBL, students need to collaborate to do tasks and that allows for more interaction, sometimes junior with senior students and that facilitate the transfer of experiences in a social learning environment (Sahin, Alpaslan and Top, 2015). Moreover, students think that PBL helped them understand the integration between subjects through real examples. Students see that PBL promoted their academic achievement. In PBL, students are

challenged with an extended inquiry process through which they work on a challenge or a

problem that usually requires teamwork where team members are assigned with tasks that

collaborate with the whole work (Chua et al., 2014). Students see that they are participating

effectively in the learning process and that they have assigned tasks to achieve.

Theme one: Students' perceptions of PBL

Students' perceptions of PBL represented the cornerstone theme of the study and the first

research question. RQ1: How do students perceive Project-Based Learning as a pedagogical

strategy? Eight questions were formulated around that theme to investigate how students

perceive PBL. Students' responses in the three grades suggested that PBL is motivating their

learning and promoting collaboration among projects' members. Grade level and previous

exposure to PBL were among the reasons that resulted in different students perceptions. For

example, grade one students' responses showed that PBL is a challenge for them. Students

referred that teamwork is something new to them, as in their middle schools, they are not used to

collaborate with other students. Students said that in the middle school they used to work

individually and also evaluation was only through individual summative evaluation based on

recall of knowledge presented in the final paper and pencil exam. This is not surprising because

in the Ministerial Decree, 369 (2011), students who get 98% or more can apply to STEM

schools. Such high scores allowed only high achieving students to join STEM schools.

Therefore, when it comes to collaboration and higher cognitive level of thinking through PBL

and where students are required to take responsibility for their learning through the assigned

tasks by the team members, not all of these high achievers were able to adapt. Social interaction

among learners is required as a means for them to create their own knowledge and to encourage

them to reach higher levels of thinking (Helle, Tynjälä, & Olkinuora, 2006). Therefore, the MOE

should consider factors in relation to students' admission to STEM schools other than final grades. For example, adding means that can assess students' abilities to work in teams and to think critically might help provide STEM schools with students who are better able to adapt to a system which is different to that experienced in their middle school education.

Grade two and three students' responses showed that, their previous experience with projects helped them reach a better level of mutual understanding among group members. Therefore, students explained that distributing workload, group discussions and presentations became easier for them than when they were in grade one. PBL has enhanced students' achievements of Science and Technology teaching course and increased beliefs about self-efficiency when compared with traditional instructions (Bilgin et al., 2015)

As for students' perceptions of the processes of assessing the journals, the portfolio, the poster and the prototype, students throughout all three grade levels had some common perceptions. These perceptions can be summarized as follows:

Journal evaluation

Students in the three grades agree that the ideal image of the journal evaluation, as an individual formative assessment tool that aims at giving evidence of individual learning of students throughout the project, is not perfectly achieved. Students see that the transferred questions of the journal (questions connecting STEM disciplines and assessing students' understanding of integrated STEM) should reflect their deep understanding of STEM subjects applied in their projects; however, these questions are not achieving that goal. The cognitive level of formulating the transfer questions should be revisited. It is necessary that MOE experts improve the quality of these journal questions. Quality journal questions are supposed to be connecting STEM disciplines with students' work and also reflect the accumulative progress of students'

knowledge and skills throughout their projects. Making connections among STEM disciplines and designing learning experiences that support such connections require planning from teachers and more investigations on how to design such a learning environment; however, there is little research on whether more integration among STEM disciplines could help to improve students learning (NRC, 2014). Therefore, preparing high quality transferred questions required STEM teachers in different disciplines to work in groups to find connections between projects' themes and their subjects' areas.

The portfolio

Students' responses explained that the project portfolio is a tool to document their progress in the project step-by-step. It is a summative assessment tool as it is evaluated for the whole group at the end of each semester Students see that the portfolio helps them to be working according to the project's calendar. The project's teacher follows-up students' documenting the procedures of the project. Students in the three grades explained that they are willing to document their work throughout the project so as to use these as evidence in their posters to help evaluators identify the efforts exerted in the project and get higher grades. Piaget and Bruner declare that learning is an active process where learners apply past knowledge as a tool to understand the current learning situation and construct new ideas and concepts (Sharma, 2014).

The poster and the prototype

The poster and the prototype are also summative assessment tools. Findings suggested that, grade one students see that the project teacher should make sure that workload is distributed fairly among all members within the group. More investigations on this part showed that, some grade students who do not work hard on their task. The result was that other students in the group work harder to make sure that the final product of the whole group was done properly. The

challenge of workload vanished in grade two and three for two reasons; 1) students' selections to join group work came through the students themselves. Therefore, all group members were keen to select active members, 2) students in grade two and three are more experienced in projects, so they could distribute workload among each other properly.

Findings about students' perceptions and how they overcome them suggested four common problems. These problems can be summarized in the following:

Time management and teamwork

Findings showed that the problem of time management and teamwork are mainly for grade one. As discussed before, carrying out the projects is something new for grade one students. Therefore, it sometimes takes time from students to assign tasks. Also, with the challenge that grade one students have with teamwork the situation becomes hard for students. Assigning tasks and distributing the workload requires equipping teachers with PBL skills. Research suggests that skilled PBL teachers have promoted students' learning whereas teachers who ineffectively implemented PBL in their classroom resulted on negative effects on students' performance (Han, Yalvac, Capraro, & Capraro, 2015). Therefore, professional development programs provided to teachers working at STEM schools should focus on preparing teachers to lead the projects.

English as the Language of instruction

STEM schools conditions of admission, as discussed in Chapter One, allow students from Language and Arabic public and private schools to admit to the STEM schools (Ministerial Decree, 369, 2011). Findings showed that those from previous Arabic schools find English as the language of instruction is a main challenge. During the focus groups many students in grade one explained that all the terminology of STEM subjects is totally new for them. It takes them longer time than students of Language schools to work on their projects and to study. In a study

on middle schools in Kingdom of Saudi Arabia (KSA), students with lower level in English explained that using English as a medium of instruction (EMI) to study Mathematics and Science was a challenge. They added that sometimes they had to translate word by word from English into Arabic to make it easy for them to understand the content (Shamim, Abdelhalim & Hamid, 2016) In addition, some students complained that, some project teachers give attention to students with higher level of English. They ask those students to give presentations and lead the project discussions. It is the responsibility of classroom teachers to encourage collaborative learning activities. However, sometimes teachers encounter a student who takes over, students who are demotivated to participate and sometimes collaboration breaks down. At the time, the teacher as a facilitator should ensure that every member within the group is doing his task (Chapman & Roberts, 2015).

However, for grade two and three students, English as the language of instruction is not a challenge any more. Grade two and three students were offered English Language afternoon courses. These courses helped students improve their English language especially because the content of some of these courses were STEM content in English.

With the extension of STEM schools all over Egypt, these English Language courses are no longer offered. Students in grade two and three explained that these courses should be offered again to help grade one students from Arabic schools.

Scientific consultancy for students' projects

Finding of the study showed that students perceive obtaining scientific consultancy for their projects is one of the challenges they have. During focus group discussions students in the three grades complained that sometimes they had to go to professors at universities and research centers to consult them about their projects. Not all university professors are available all the

time. This is time consuming for students especially because 6th of October in a remote area. Therefore, the MOE should coordinate with the Ministry of Higher Education to provide some professors from universities and research centers to assign some office hours for STEM students to offer scientific consultancy required for students' projects.

Material required for the projects

Students in the three grades perceive providing materials required for the projects among the problems that they face. Students explained that some materials are not available at local vendors and that sometimes for students to change their projects or even use other alternative materials that might not be of the same quality. Moreover, the remote area of the school away from local vendors in the city center makes the situations even worse. Students believe that finding solutions to these problems can help value the positive role of PBL promoting students understanding of STEM subjects. Addressing the problems that students perceive as obstacles on their way towards quality projects can result in improving PBL as a pedagogic strategy at 6th of October STEM school.

Theme two: Students' Learning

Findings suggested that students in the three grades value PBL as instruction and assessment in STEM schools. Although students explained, as mentioned before, that some of the project's components, such as the journal evaluations, need to be better connected to their work on the projects, they believe that applying PBL promoted their learning of STEM subjects. During the discussions with students in the focus groups, especially students in grade one, they explained that PBL empowered them and motivated them to participate. The pedagogic concept of PBL that distinguishes it from traditional learning in that it tries to improve students' participation and

interaction to acquire basic content of knowledge required to understand problems and to think critically to try to find solutions for them (Tseng et al., 2013).

Findings supported that students in the three grades believe that their projects can be applied in the real world. Students' responses showed that students appreciated that PBL gave them opportunities to work on real life problems and to propose solutions to Egypt Grand Challenges. Project-Based Learning maximizes students' responsibilities of their personal learning (Cziprok & Popescu, 2015). Students perceive PBL as an effective pedagogic tool that promotes their participation in constructing their learning. Constructivism highlights the role of individuals' contribution of what they learn (Schunk, 2012). Therefore, STEM students in the three grades participating in the study suggest that PBL should be used in all schools not only STEM Schools. In the following section, the researcher will discuss students' perceptions about their collaboration in PBL.

Theme three: Students' collaboration

Findings of the study suggested that PBL increased students' participations with each other through their projects. Collaborating with other students represented a challenge for grade one students, as explained before. Grade one students explained that in traditional schools they were not used to team work, and that it was something new for them until they joined 6th of October STEM School. Moreover, students in grade one explained the importance of the project teacher to help them in their projects. In STEM PBL, students need to collaborate to do tasks and that allows for more interaction, sometimes junior with senior students and that facilitate the transfer of experiences in a social learning environment (Sahin, Alpaslan & Top, 2015).

Findings of the study suggested that the most qualified teachers in PBL should be assigned for grade one where students are not familiar with PBL and needs teacher's assistance at many

times. Moreover, students think that the teachers as a facilitator could help them collaborate effectively with each other. It is the duty of classroom teachers to encourage collaborative learning activities. However, sometimes teachers encounter a student who takes over, students who are demotivated to participate and sometimes collaboration breaks down. At the time, the teacher as a facilitator should ensure that every member within the group is doing his task(Chapman & Roberts, 2015). Therefore, PBL is not minimizing the role of the teacher inside the learning situations, rather than assigning new roles for him as a guide and facilitator. Providing a motivating learning environment to students where all students participate effectively promotes students learning.

> Sharma (2014) notes that the role of teacher in constructivism theory is to empower learners, as follows:
>
> The learner-centered approach does not reduce the importance of the teachers. So we can say the role of teachers becomes more complex, difficult, and pivotal. They have to get prepared for this new responsibility by creating new insights, outlooks, and competencies.(Sharma, 2014, p. 16)

These roles assigned to teachers, and STEM teachers in particular, can help provide the learning environment. Equipping teachers with preparation and professional development could help teachers play these roles.

5.2.   Research Limitation

The discussion of the findings of the study showed that students at 6th of October STEM school perceive PBL as an effective pedagogic strategy that helps them promote their understanding of STEM subjects. The MOE plans on opening STEM schools all over Egypt to have one STEM school in each Governorate, which increases the importance of the present study. Investigating PBL in 6th of October as the first STEM school in Egypt could increase our understanding of and

insights into STEM in Egypt . Moreover, the students' perceptions elicited in this study reflected

student opinions that requires attention from decision makers and education planners

However, the researcher would also appreciate that those considering this study as the first

specialized study carried out about STEM school in Egypt to consider the following limitations:

- The study was applied on just 6th of October STEM High School for boys (two

  groups from each grade).Therefore, generalizing some of results should consider

  the nature of the other governorates where the new STEM school is located.

- October STEM School is supervised by MOE which gives it faster responses

  when issues at the school arise. Other STEM school schools are supervised by

  Moderia. Therefore, instructions and responses go through two levels: MOE level

  and *Moderia* level and that can cause some delay.

- PBL has been applied in 6th of October STEM School for boys for four years and

  that has given teachers and projects' leaders' expertise that might not be of the

  same in other STEM schools.

- October STEM School is only for boys whereas other STEM schools are mixed

  (boys and girls) and that might affect students' level of collaboration, which

  require further study of the possible impact that mixed gender classes might have

  on the learning process in STEM schools in Egypt.

5.3.   Suggestions and future studies

The researcher has worked for 6th of October STEM School for boys for four years. During one

of these four years, he served as the project leader for grade three, prior to being the principal of

the STEM school. He believes that all of the responsibilities he has carried out were worthwhile

experiences for him. Investigating PBL based on students' perceptions helped being in the shoes

of students and view PBL as they see it. He learnt a lesson that if introducing STEM education in Egypt can result in positive change, it is important to start that change from inside. This would mean that educators should also change. It is the time to listen carefully to students and to let them suggest and propose solutions to the problems they perceive they have.

Students are no longer passive receivers; they are positive partners in a learning community where everyone learns: students learn, teachers learn, and also school principals learn. In fact, the researcher was captivated by the students' ability to voice their perceptions very clearly and to propose important suggestions and recommendation. He values these suggestions and recommendations as very important to be taken into consideration: some of these can be summarized as follow:

- Provide a preparation course for grade one students on PBL and how students can collaborate to work effectively through teamwork to overcome the difficulty of adopting to team work especially for grade one

- Provide English Language courses for students from Arabic school to help them overcome their challenge with English as the instruction language

- Coordinate with Ministry of Higher Education so that some university professors and research centers visit the STEM schools on a regularly basis or have office hours for STEM students to offer scientific consultancy required for the projects.

- Assign STEM teachers with scientific backgrounds as the first priority to be project instructors especially for grade one where students need guidance on their projects at that grade, Humanities teachers they can be assigned for coordination

- Equip pre-service teachers willing to work for STEM schools and provide in-service STEM teachers with professional development programs that help them better lead students' projects.

- Provide students with lists of material vendors where they can purchase materials for their project and arrange for some of the school teachers and student union as contact persons. Moreover, the school can arrange for some vendors to come to school to save students time and effort.

- Propose the idea that external evaluators should receive students' posters within sufficient time before the day of the exhibition so as to familiarize themselves with these posters.

- Propose the necessity that assigning evaluators for students' projects and posters should be based on evaluator's scientific background and specialism so as to give students effective feedback on their projects.

- Ensure the connection between journal questions and students' projects so as to make these questions more reliable tools that assess students' deep understanding of the integration between disciplines.

While this study investigated PBL on the students' level only, the researcher suggests that further studies should consider teachers' and administrators' levels. He would also suggest including other STEM schools in Egypt in such studies, since the MOE will extend to establish more STEM schools in addition to the nine STEM schools that are in Egypt at the present time. He would also call for studies that investigate the effectiveness of professional development for pre-service and in-service STEM teachers.

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APPENDICES

Appendix A IRB Preliminary Approval or Waiver for Graduate Thesis

THE AMERICAN UNIVERSITY IN CAIRO
الجـامـعـة الأمـريكيـة بالقـاهـرة
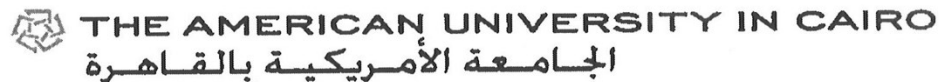
IRB Preliminary Approval or Waiver for Graduate Thesis

Before you start your research

All research involving living human beings or bodily tissue samples requires advance approval from AUC's Institutional Review Board (IRB). Each student's thesis advisor is responsible for ensuring that this form is filled in accurately. The IRB approval or waiver form should be signed once your thesis proposal/topic has been approved by the department. It is very important to submit this form before starting data collection for your research. This could take place prior to, or while, being enrolled in any of the following: 590, 591, 598, 599 on the MA level or 691, 699 on the PhD level.

Student Name: Hamada Ahmed Fahmy Ahmed Elfaragy   **Email:** hamadafahmy@aucegypt.edu

AUC ID # 800130136   **Mobile #** 01125696012

Department/Unit: Comparative and International Education
School: Graduate School of Education
Thesis Title: Investigating Project-Based Learning in a STEM School in Egypt: A case study

Date: 2/11/2015
Name of Thesis Advisor: Heba EL-Deghaidy
Thesis Advisor's Email: h.eldeghaidy@aucegypt.edu
The advisor should check one of the following boxes.

☑ IRB approval is necessary for this thesis.

☐ IRB approval is not necessary for this thesis, since the research is not concerned with living human beings or bodily tissue samples.

Signature of Student: _Hamada Ahmed Fahmy_
Date:

Signature of Thesis Advisor: _H. EL-Deghaidy_
Date: 2/11/2015

Name and Signature of Chair /Graduate Program Director:
_____ 11/2/2015
Date:

Name and Signature of the Dean of the School:
_____ 11/2/15
Date:

Student submits to Department/Program which sends to the Office of the Dean of the School
(1) Copy of this IRB preliminary form to be included with (2) The thesis proposal and (3) The thesis proposal approval form.

Appendix B IRB Approval of Study

CASE #2015-2016-038

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

To: Hamada Elfarargy

Cc: Dena Riad & Salma Serry

From: Atta Gebril, Chair of the IRB

Date: Nov 12, 2015

Re: Approval of study

_____

This is to inform you that I reviewed your revised research proposal entitled " **Investigating Project-Based Learning in a STEM School in Egypt : A case study**" and determined that it required consultation with the IRB under the "expedited" heading. As you are aware, the members of the IRB suggested certain revisions to the original proposal, but your new version addresses these concerns successfully. The revised proposal used appropriate procedures to minimize risks to human subjects and that adequate provision was made for confidentiality and data anonymity of participants in any published record. I believe you will also make adequate provision for obtaining informed consent of the participants.

This approval letter was issued under the assumption that you have not started data collection for your research project. Any data collected before receiving this letter could not be used since this is a violation of the IRB policy.

Please note that IRB approval does not automatically ensure approval by CAPMAS, an Egyptian government agency responsible for approving some types of off-campus research. CAPMAS issues are handled at AUC by the office of the University Counsellor, Dr. Amr Salama. The IRB is not in a position to offer any opinion on CAPMAS issues, and takes no responsibility for obtaining CAPMAS approval.

This approval is valid for only one year. In case you have not finished data collection within a year, you need to apply for an extension.

Thank you and good luck.

Dr. Atta Gebril
IRB chair, The American University in Cairo
2046 HUSS Building
T: 02-26151919
Email: agebril@aucegypt.edu

Institutional Review Board
The American University in Cairo
AUC Avenue, P.O. Box 74
New Cairo 11835, Egypt.
tel 20.2.2615.1000
fax 20.2.27957565
Email: **aucirb@aucegypt.edu**

Appendix C CAPMAS approval of Study

جمهورية مصر العربية

الجهاز المركزي للتعبئة العامة والإحصاء

قرار رئيس الجهاز المركزى للتعبئة العامة والإحصاء
بالتفويض
رقم (١٦٢٦) لسنة ٢٠١٥

فــى شــأن قيــام الباحــث / حمــادة أحمــد فهمــى أحمــد – المســجل لدرجــة الماجســتير بكلية الدراسات العليا فى التربية – الجامعة الأمريكية بالقاهرة – بإجراء دراسـة ميدانيـة بعنـوان (دراسـة إستقصائية عن التعلم القائم على المشروعات بمدرسة المتفوقين فى العلوم والتكنولوجيا بالسادس من اكتوبر).

رئيس الجهاز

- بعد الإطلاع على القرار الجمهوري رقم (٢٩١٥) لسنة ١٩٦٤ بشأن إنشاء وتنظيم الجهاز المركزىللتعبئة العامة والاحصاء (مادة ١٠).
- وعلـى قـرار رئيس الجهاز رقم (٢٣١) لسنة ١٩٦٨ في شأن إجراء الإحصاءات والتعدادات والاستفتاءات والاستقصاءات (مادة ٢).
- وعلي قرار رئيس الجهاز رقم (١٣١٤) لسنه ٢٠٠٧ بشأن التفويض في بعض الاختصاصات .
- وبعد الإطلاع علي مذكرة العرض علي رئيس الجهاز وموافقة سيادته علي ما ورد بها .
- وعلى كتاب كلية الدراسات العليا فى التربية – الجامعة الأمريكية بالقاهرة الـوارد للجهـاز فـى ٢٠١٥/١١/١.

قـــرر

مـادة١: يقـوم الباحـث / حمـادة أحمـد فهمـى أحمـد – المسـجل لدرجـة الماجسـتير بكلية الدراسات العليا فى التربية – الجامعة الأمريكية بالقاهرة – بإجـراء الدراسـة الميدانيـة المشار اليها عالية.

مادة ٢ : تجـري الدراسـة علي عينـة حجمهـا (٣٥) خمسة وثلاثون مفردة من طلاب مدرسة المتفوقين فى العلوم والتكنولوجيا الثانوية بنين بالسادس من أكتوبر والتابعة للإدارة المركزية للتعليم الثانوى بديوان عام وزارة التربية والتعليم وذلك بمحافظة القاهرة.

مادة ٣: تجمع البيانات اللازمة لهذه الدراسة طبقا للاستمارة المعدة لهذا الغرض والمعتمدة من الجهاز المركزي للتعبئة العامة والاحصاء وعدد صفحاتها (صفحتان).

مادة ٤: تقوم الإدارة المركزية للتعليم الثانوى بديوان عام وزارة التربية والتعليم بمحافظة القاهرة وتحت إشراف إدارة الامن بها بتيسير إجراء الدراسة الميدانية – مع مراعاة الضوابط الخاصه بتقييم درجة سرية البيانات والمعلومات المتداولة مسبقا بمعرفة كل جهه طبقا لما جاء بخطة الامن بها.

مادة ٥: يراعى موافقة مفردات العينة وأولياء أمورهم – مع مراعاة سرية البيانات الفردية طبقا لاحكام القانون رقم ٣٥ لسنة ١٩٦٠ والمعدل بالقانون رقم ٢٨ لسنة ١٩٨٢ وعدم استخدام البيانات التي يتم جمعها لأغراض أخري غير أغراض هذه الدراسة.

مادة ٦: يجري العمل الميداني خلال شهرين من تاريخ صدور هذا القرار .

مادة ٧: يوافي الجهاز المركزي للتعبئة العامة والإحصاء بنسخة من النتائج النهائية لهذه الدراسة.

مادة٨ : ينفذ هذا القرار من تاريخ صدوره.

صدر في : ٢ / ١١ / ٢٠١٥.

عام الإدارة العامة للامن

Appendix D Ministry of Education (MOE) Approval of Study

الإدارة العامة للتعليم الثانوي
وارد برقم ٤١٧ +
٢٠١٥/١١/١٥

وزارة التربية والتعليم

مكتب الوزير
الإدارة المركزية للأمن
الادارة العامة لأمن المعلومات
ووسائل الاتصال
‒‒‒‒‒‒‒‒‒‒

الصادر : ٢ / ٤٢٨٢
التاريخ : ١٠ / ١١ / ٢٠١٥

السيد الاستاذ الدكتور/ رئيس قطاع التعليم العام

تحية طيبة وبعد ،

أتشرف ان ارفق مع هذا الكتاب الوارد للإدارة من الجامعة الأمريكية بتاريخ ٢٠١٥/١١/٩ بشأن طلب الباحث / حمادة أحمد فهمى أحمد – المسجل لدرجة الماجستير بكلية الدراسات العليا فى التربية – الجامعة الأمريكية بالقاهرة – باجراء دراسة ميدانية على عينة حجمها ٣٥ مفردة من طلاب مدرسة المتفوقين فى العلوم والتكنولوجيا الثانوية بنين بالسادس من أكتوبر تحت عنوان

(دراسة إستقصائية عن التعلم القائم على المشروعات بمدرسة المتفوقين).

نفيد سيادتكم انه ليس هناك مايمنع من وجهة نظر الأمن من الموافقة على ذلك وبعد التأكد من شخصية الباحث ومطابقة عينة البحث وتحت إشراف التعليم الثانوى بالوزارة وبالتنسيق مع مدير المدرسة محل التطبيق ومراعاة الموافقة الكتابية لأولياء أمور مفردات العينة وبما لا يؤثر على سير العملية التعليمية وطبقا لما جاء بقرار الجهاز المركزى للتعبئة العامة والأحصاء رقم (١٦٢٦) بتاريخ ٣ /١١/ ٢٠١٥ ،،،

وتفضلوا بقبول وافر الاحترام .

المـديـر الـعـام
(يـاسـر محمـود)

رئيس الادارة المركزية للأمن
(لواء / محمد عمرو الدسوقى)

Appendix E Documentation of Informed Consent for Participation in Research Study (English)

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

Documentation of Informed Consent for Participation in Research Study

* If you have pertinent questions about the research and research subject's rights, and whom to contact in the event of a research-related injury to the subject, please contact the principal investigator directly. Hamada Ahmed Fahmy ,Email: hamadafahmy@aucegypt.edu Mobile phone: 01125696012

Appendix F Documentation of Informed Consent for Participation in Research Study (Arabic)

الجــامــعــة الأمــريكيــة بالقــاهــرة

استمارة موافقة مسبقة للمشاركة في دراسة بحثية

عنوان البحث : (دراسة إستقصائية عن التعلم القائم على المشروعات فى مدرسة متفوقين للعلوم والتكنولوجيا بمصر : دراسة حالة)

الباحث الرئيسي: (حمادة أحمد فهمى ، باحث مسجل للماجستير بكلية الدراسات العليا فى التربية بالجامعة الأمريكية)

البريد الالكتروني: hamadafahmy@aucegypt.edu

الهاتف: 01125696012

انت مدعو للمشاركة فى دراسة بحثية عن (دراسة إستقصائية عن التعلم القائم على المشروعات فى مدرسة متفوقين للعلوم والتكنولوجيا بمصر : دراسة حالة).

هدف الدراسة هو (إستقصاء التعلم القائم على المشروعات بمدرسة المتفوقين فى العلوم و التكنولوجيا الثانوية للبنين بالسادس من أكتوبر. و سوف يتناول هذا الإستقصاء ثلاثة مستويات هى : تعلم الطلاب ، تعاون الطلاب ، إدراك الطلاب للتعلم القائم على المشروعات .

نتائج البحث : ربما تنشر نتائج هذه الدراسة فى مقالات أكاديمية أو تعرض فى مؤتمرات فى المستقبل .

المدة المتوقعة للمشاركة فى هذا البحث (أسبوع واحد)

اجراءات الدراسة تشتمل على أن يقوم مدرس أو مدرسة من مدرسى المدرسة التى لم يسبق لهم فى الماضى و لا فى الوقت الحالى أى تعامل معك على المستوى الأكاديمى ولا أيا من أقرانك المشاركين فى هذا البحث ولم يقوموا بالتدرس لكم من قبل بعمل لقاءات جماعية معك أنت والطلاب المشاركين فى المشروع الخاص بالصف الدراسى والذى كلفتكم به المدرسة . ومن المفترض أن يكون هناك لقاء واحد و ربما يتم دعوة المجموعة للقاء ثانى خلال يومين عمل بالمدرسة إذا تطلب الأمر إستكمال بعض المعلومات ، و سوف يتم التسجيل الصوتى لإستجاباتكم وسوف تحول هذه التسجيلات إلى نصوص مكتوبة لكى تستخدم فى البحث ، علما بأن كل هذه التسجيلات الصوتية والنصوص المكتوبة لإستجاباتكم سوف يتم الإحتفاظ بها فى خزينة آمنة كما أنه سوف يتم مسح التسجيلات الصوتية و تقطيع النصوص الورقية بمجرد الوصول لنتائج البحث.

المخاطر المتوقعة من المشاركة فى هذا البحث : لن يكون هناك أية مخاطر ولا أية مضايقات ناتجة عن المشاركة فى هذا البحث.

الاستفادة المتوقعة من المشاركة في البحث: لن يكون هناك إستفادة مادية من المشاركة فى البحث ، ولكن قد تفيدك المشاركة فى هذا البحث من حيث أن المشاركة فى نقاشات مع مجموعات قد تساعك فى أن تفكر بشكل تأملى حول دراستك ، كما أن تعبيرك عن رأيك و التغذية الراجعة التى سوف تقدمها عن التعلم القائم على المشروعات من الممكن أن تساعد المدرسة فى تقديم خدمات تعليمية أفضل للطلاب الحاليين وفى المستقبل .

Appendix G Focus Group Protocol

Focus Group Protocol

Teacher's Name:

Appendix H Focus Coding

Table 3

Focus Groups Students' Coding					
Grade One (10 students)		Grade Two (8 students)		Grade Three (6 students)	
Group One		Group One		Group One	
Student One	G1-1S1	Student One	G2-1S1	Student One	G3-1S1
Student Two	G1-1S2	Student Two	G2-1S2	Student Two	G3-1S2
Student Three	G1-1S3	Student Three	G2-1S3	Student Three	G3-1S3
Student Four	G1-1S4	Student Four	G2-1S4	Group Two	
Student Five	G1-1S5			Student four	G3-2S4
Group Two		Group Two		Student five	G3-2S5
Student six	G1-2S6	Student Five	G2-2S5	Student six	G3-2S6
Student seven	G1-2S7	Student Six	G2-2S6	Pilot Group /Grade Two (4 students)	
Student eight	G1-2S8	Student Seven	G2-2S7	Pilot 1	P1
Student nine	G1-2S9	Student Eight	G2-2S8	Pilot 2	P2
Student ten	G1-2S10			Pilot 3	P3
				Pilot 4	P4

Appendix I Focus Group Questions (English)

Focus Group Questions

Theme One: How project-based learning is perceived by students

Appendix J Focus Group Questions (Arabic)

THE AMERICAN UNIVERSITY IN CAIRO
Graduate School of Education

الجـامـعة الأمـريكيـة بالقـاهرة

إستمارة مقابلة شخصية

لطلاب مدرسة المتفوقين فى العلوم و التكنولوجيا بنين بالسادس من أكتوبر

حول التعلم القائم على المشروعات و معرفة تصورات الطلاب حوله

أسم الطالب: .... (رياضيارى) .....

الفصل: ....

تعلم الطلاب

1- أشرح عملية تحديدك و إختياركللمشروع ؟

....
....
....

2- هل ساعدتك المشروعات فى تعلمك (إشرح إجابتك)؟

....
....

3- هل تعتقد أنه يمكنك تطبيق ما تعلمته فى المشروع فى الحياة الواقعية ؟ كيف؟

....
....
....

العمل التعاونى للطلاب

4- كيف تتعاون مع أقرانك خلال المشروع؟

....
....

5- ما الدور أو الأدوار التى يلعبها مدرس المشروع أثناء عملية تعلمك خلال المشروع؟

....
....

6- شرح الديناميكيات (أشكال التفاعل) التى تتم مع أقرانك أثناء العمل فى مشروعات؟

....
....

7- هل لديك أيه مقترحات يمكن أن تحسن العمل الجماعى أثناء المشروع؟ إشرحها .

....
....

التاريخ ٤ / ١١ / ٢٠١٥

THE AMERICAN UNIVERSITY IN CAIRO

Graduate School of Education

الجـامـعة الأمـريكـية بالقـاهـرة

كيفية تصور (إدراك) الطلاب للتعلم القائم على المشروعات

8- من خلال خبرتك فى مدرسة المتفوقين فى العلوم و التكنولوجيا ، ما هو تعريفك للتعلم القائم على المشروعات؟

....

....

....

9- كيف تعتقد أنه مختلف عن أسلوب المحاضرات ؟

....

....

....

10-   ما هو رأيك فى عمليات التقييم من خلال الكتابات التأملية و ملف الإنجاز و البوستر و نموذج المشروع؟

....

....

....

11-   ما الصعوبات التى تجدها عادة أثناء العمل فى مشروعاتك؟

....

....

....

12-   ما الذى تفعله لمواجهة الصعوبات التى تقابلك أثناء العمل فى مشروعاتك؟

....

....

....

13-   ما هى النصيحة التى يمكن أن تقدمها لطلاب مدارس المتفوقين فى العلوم و التكنولوجيا الجدد أثناء العمل فى مشروعاتهم؟

....

....

....

14-   هل تقترح وجود تطبيق المدارس للتعلم القائم على المشروعات ؟ أشرح إجابتك.

....

....

....

15-   هل التعلم القائم على المشروعات هو ما تصورت أن تجده؟ إشرح تصوراتك المبدئية و كذلك تطور تلك التصورات بعد ممارستك للتعلم القائم على المشروعات فى تعلمك.

....

....

التوقيع

د/ رزان حرب

التاريخ ٤ / ١١ / ٢٠١٥

يعتمد