



A Study on Effect of Problem solving on student's achievement

دراسة حول تأثير المسائل الرياضية التحليلية على أداء المتعلمین

By
Dana Musbah Dannawi
Student ID: 100098

Dissertation submitted in partial fulfillment of
MEd of International Management and Policy Studies

Faculty of Education

Dissertation Supervisor
Professor Clifton Chadwick

April-2013

Chapter No.	Title	Page Number
	Abstract	I
	Acknowledgement	II
1	Introduction Learning and Teaching experience in Lebanon Education in U.A.E Setting and Teaching Pedagogy of School X Description of the Content and Yearly Plan Adopted from California's standards Curriculum Analysis Importance of this topic Aim of the research	1 2 3 4 5 6 8
2	Literature Review Gender and Mathematics Cooperative learning and its effect on critical thinking Critical Thinking for a Rapid Changing World Problem Solving Approaches Problem solving and its effect on student achievement	11 13 14 15 18
3	Methodology Participants Ethics Consideration Reliability and Validity Action Study Question type and Correction	24 24 25 26 33
4	Analysis and findings Case study 1: Did problem solving strategies affect on student achievement? Case study two: Does word problems affect on gender achievement? Case study 3: Cultural effect on students achievement Case study 4: The effect of Problem solving in student's thinking style	35 36 38 39
5	Conclusion Recommendations and Limitations	42 44

6	References	45
7	Appendix	
	Appendix A	48
	Appendix B	50
	Appendix C	51
	Appendix D	53
	Appendix E	56
	Appendix F	63
	Appendix G	68

Acknowledgement

Saying thank you is not enough, but appreciation and love that I get when you surround me is what I owe you for a lifetime.

A great gratitude to my professors Dr. Clifton Chadwick and Dr. Sufian Forawi for their cooperative support.

I dedicate my work to my parents, my husband, and my friends.

Abstract

The investigation is about the importance of teaching problem solving and critical thinking in schools and including it in the curriculum, to prepare students achieve the best quality of thinking in the society and be more involved in the society. The study focuses on the gender difference and the use of cooperative learning in teaching problem solving, how it affects on their performance. The study was on 10th graders in U. A.E., Dubai private school, under the implementation of cooperative learning. A comparative data collected by pre-test and a post-test to study the student's achievement as well as a questionnaire to study the cultural background of the students. The study showed there is significance in performance in aspects, gender and student's achievement, but no significance in culture.

Links: Cooperative thinking, Critical thinking, Mathematics, U.A.E

تدور هذه الدراسة حول أهمية تعليم المسائل الرياضية التحليلية في المدارس و أهمية دمجها في المنهج التعليمي و ذلك لمساعدة المتعلمين الوصول الى أعلى مستوى في درجات التفكير و التحليل في المجتمع.

هذه الدراسة تركز على تأثير المسائل الرياضية التحليلية على تطور مستوى المتعلمين باستعمال الوسائل التعليمية الحديثة. تمت هذه الدراسة في الصف الأول ثانوي، في مدرسة خاصة تتبع المنهج الأمريكي، في دولة الإمارات العربية المتحدة، دبي. قد تم استخدام النتائج عبر امتحانين (ما قبل و ما بعد) لنقديم أداء المتعلمين إضافة إلى نموذج الاستطلاع لنقديم وضعهم الاجتماعي. لقد بيّنت نتائج هذه الدراسة أن هناك تأثيراً إيجابياً بمستوى تقدمهم و بتفوق المتعلمات على المتعلمين أكاديمياً دون تأثير ثقافي- اجتماعي.

Introduction

Learning and teaching experience in Lebanon:

Most of the time students in Lebanon find mathematics as a challenging subject, it shows how complex situations can be solved in different and convenient ways; it is a thinking puzzle game. Although the teaching process in Lebanon was lecturing in the early nineties , rarely were there any activities or real life applications provided in the curriculum except in middle school such as percentage, fractions and operations at the late nineties the government unified its curriculum including more problem solving and activities. However, student's intrinsic interests in mathematics lead few students to select their career major in pure mathematics at Lebanese University (LU) and Beirut Arab University (B.A.U) for four years because it qualifies them to get teaching diploma. Both universities had different approaches to teaching content of mathematics. In Lebanese university, most of the courses were purely theoretical while in Beirut Arab University, it was a mix of theoretical and applied mathematics, which is theoretical physics in other words, as well as it included some labs and programming lab courses. On the other hand, the learning experience in Beirut Arab University includes applied mathematics that practice students on , reasoning algorithm, and realistic approach to an abstract subject such as mathematics.

Due to better offers and experience overseas most of the graduates travel to work in schools in UAE which follows mostly Arabic/US curriculum. In the private schools in UAE , students are of mixed genders in each classroom having mixed abilities. It is found out that the culture to work there different from Lebanese home culture. Some schools were built with high-tech -well equipped resources such as laptops and smart boards as well as activities, others were of normal old basic buildings. The secret of succeeding in teaching there is the liaison with multicultural students keeping teacher-student respect and rules of the class with minimum supervision. In a classroom having one teacher, teaching different cultures of different mentalities in one medium is challenging for many reasons. It requires more than one preparation to differentiate the

teaching instructions, thus more creativity and a greater challenge to find different approach to cover the maximum knowledge. Another reason is keeping your pace work of each student under strict time and class management throughout the whole year. However, the main challenge with the students was word problems ,critical thinking problems and approaching mathematics into real life and the student's interest. Most of the students failed to answer such problems, they used either to leave them empty or to write the given using one rule. Most of the students lacked the idea of relating two or three rules with each other to solve the required hypothesis. There are other private gendered schools with boys and girls each taught separately in old-fashioned classrooms. It is more as a conservative school than the previous one.

As Dubai is known with its rapid change and progress, the world requires a generation that is ready for research, complex thinking; the world is in information age and knowledge economy. On the other hand, teachers evaluated students as individuals who depend on their memory, lacking analysis and reasoning. The students usually found it hard to solve any problem that is outside the book or the exercises solved in class. They considered any new problem whether analytical or application is difficult as long as the teacher did not guide them first with steps or solved it in class. If a word problem was presented to them, their direct answer was they did not understand the problem. If it was explained, a facial description of opened eyes as an attitude represented along with boredom and anxiety. The problems averaged around one hour for explanation and solution. Teachers presumed that students should be acquainted with word problems by learning how to organize their data, think and then solve.

The challenge was for the teachers who were at the same time postgraduates in education. They focused how to build students' thinking mode whenever they face any complex situation by reason rather than memorization. Mind set the students for research-oriented universities ready to deal with their recent informational environment in a high self-esteem and atomicity.

Education in UAE

Through the 40 years, UAE lately has shown rapid change in private and public educational sectors. The education in UAE was evolved from typical education to systematic education through four types of education; Informal education, scientific circular education, developed education and the systematic education. Dubai does not differ from the education overall in UAE, in 2006 for the purpose to advance the quality of education in Dubai, KHDA(Knowledge of Human Development Authority) was introduced to give license and accreditations to schools. Yearly check-up and reports are announced on their website giving the ability for the public to review the schools in their teaching and learning pedagogy. Keeping the yearly follow up on its pace, their objective is to enhance the schools environment as possible and guide them to better emergence with the rapid change in the world (MOE, 2012).

School X Setting and teaching pedagogy

The setting of the research was in a high school following US/Arabic curriculum in Dubai, U.A.E, established in 1985, “School X” represents the name of the school due to ethical considerations. School X, as an educational organization, accredited by CITA, Commission on International and Trans Regional Accreditation, it participates in SAT, Scholastic Aptitude Test. English is a second language and all the scientific subjects are taught in spoken and written English Language. It accommodates about 2,484 students of 31 nationalities (appendix A-Table -1-). Emirati's constitute 46.8% of the students in the school. Ninety seven percent of the teaching staff is of Arab nationalities holding qualified teaching diplomas. By the end of every year, each department revises its curriculum to adjust with the schools development plan and the KHDA inspection report. The parallel teachers sit and discuss the yearly plan for the next year by revising the initial plan and their weekly plans supervised by the head of the department. Through the year, the teachers prepare a well-organized daily plan with all the required material as worksheet activities and power points. The weekly plan constitutes of objectives, vocabulary, and brief description about learning and teaching outcomes, assessments and required resources.

Every school is aware of the changes in developing the school's educational perspective that comes along with the international standards. The administration is trying to orient the teaching pedagogy into one stream that is required for the knowledge economy, the student centered learning. However, the teaching methodologies used by various teachers in School X vary from direct teaching to student centered learning. The teachers' motivation varies with respect to the way they evaluate their job. Some of them find out that teaching is just a temporary period , they are waiting for the better chance or a better job. Others find out that the job is just like any normal job where u are supervised, dealing with pressure from duties to school inspections and parents involvement. Others look at the job as a tool to be an important role in developing society and culture. They consider themselves as the bridge to share knowledge, support motivate the students learning outcome for the benefit of the society. Most teachers in the school believe that the student's skills that is obtained by the end of every learning outcome can be tested by how much the student know and not how the student thinks, what skills the student has learned. In this case, teachers plan their work on the idea that the students attainment is by the students' average score. Recently, some statistical studies were asked by the teachers to respond at the end of each term where they check what are the most pages and questions in the progress test has not been answered.

The School X, has three terms, in each term the students start all over again with new lessons that might or might not be related to the previous term. All taught subjects have to cover specific rubrics. The rubrics are participation, assigned homework, individual group work; class work, in class-test that are announced quizzes, pop quizzes, and independent assignment which is a final project they submit at the end of the term. At the end of each term, the students perform summative assessments that are exams cover 50% of the material explained throughout the term with some selective elective courses for the elementary and middle school.

Description of the content and yearly plan adopted from California Standards

The school follows an American California state's curriculum. Using Glencoe Mc-Graw Hill, the book has scope and sequence of Algebra 1 and Geometry that are used to teach

grades through 7, 8 and 9 that are closely correlated to the standards of California and the common core standards. The Scope and sequence follows thirteen topics each topic includes solving, evaluating, and learning techniques of solving word problems. Teachers having a good experience in a specific level as a committee revise the design of the yearly plan. The topics are covered and modified according to the level of the students catering their needs. However, there are core topics like teaching how to simplify radicals, rational exponents, similarity in triangle etc...

At Grade 9, Algebra-I- is considered as preparations for the higher school (G10-11-12), while Geometry ends in Grade 9, where students after mastering the knowledge of basic geometry they are introduced to complex shapes such as sphere, cone, pyramid; three-dimensional shapes. In Algebra I the topics covered are: solving linear inequality, solving system of linear equations and inequalities, exploring rational and radical expressions and equations. While in Geometry which ends in grade 9, the topics are about similarity of polygons and triangles and their properties, exploring circles and its parts properties, and finding volume. The following topics are shown its correlation with the scope and sequence of California Standards. The other strands like algebra two, probability statistics and Trigonometry are not included in the yearly they are shifted to higher level as grade 10 and 11. In lower level such as grades 7 and 8 the topics covered are solving linear equations with one variable in multi-steps, factoring, exploring monomials and polynomials, basic operations in polynomials, special products which are the fundamentals of Algebra. In addition to Algebra I, Geometry introduces new basic concepts of geometry, parallel and perpendicular lines, classifying triangles, congruent triangles, and exploring quadrilaterals. It is the content it focuses on based on one resource which is the Glencoe McGraw-Hill.

Curriculum analysis

Following the curriculum analysis of the school X under the umbrella of Bloom's taxonomy, the topics chosen are non-spiral in the curriculum. Comparing the curriculum of school X with California adopted standards and with Bloom's taxonomy, the findings showed strengths and limitations. The curriculum of school X with respect to California

standards and strands do not cover all the topics. However, it covers parts of algebra, arithmetic and geometry ignoring statistics and trigonometry. These last two conceptual domains are required for the upper grades such as Grade 10. Another aspect that pays the researcher's attention is that in Geometry students' deeper knowledge in proofing and in the properties of special types of quadrilaterals is not adhered properly. Bloom's taxonomy focuses on two domains, the knowledge domain and the cognitive domain. California standards approach those two domains fully while the topics chosen in school X to cover from California's curriculum do not approach fully. The cognitive domain of Bloom's taxonomy can be divided into two categories, the first category which includes understand, comprehend, and apply are of the lower thinking order, while the second part which is the higher order thinking contains the following cognitive domains : analysis, evaluation and creativity. At this stage/grade, the students are not aware of how to solve problems or think of an identified algorithm simply because the curriculums of school X in both algebra and geometry does not approach fully the higher order thinking. In addition, the curriculum is inconsistent because the students are promoted to the other level and are introduced to non familiar topics in their previous level in grade 9 such as trigonometry and statistics (Dannawi, 2012).

The importance of this topic

The need to reform education is because of the rapid change in the world. As the technology is in advance and everyday there is something new, disposition in knowledge and even in creating new knowledge requires a mind ready to face complex situations, ready to investigate and question deeper. Policies are also affecting on universities, as they are oriented to research demand by all faculties. The knowledge is expanding due to technological and discoveries appearing every day. Sir Ken Robinson (2006) in his video sets two factors to change education paradigm. The first reason is "economical" and the second is "cultural". Although the economy is unpredictable according to Sir Ken Robinson, but education needs a change so students can be familiar with the economical needs of the twenty first century. In addition, there is a need to keep the cultural identity and carry it on to the next generation in the period of globalization.

Schools were built in the nineteenth century, during the industrial revolution, and there has been a change in the industry since then. However, the schools are still with the same behavior as the factories; bell ringing, periods, standing in a line, constituting the behavior of the factories during the industrial revolution where employees had to wait for the bell to ring to have their break time. They find some interest in subjects and boredom in others. Sir Robinson comments that students no longer believe success and having a degree will be the main target to find a job; they know that university degree is not the main issue to find a job. With all the advances in technology and the international exchange in information the huge amount of knowledge that exists in the world, education has to follow up with educators believe to higher the standards, instead of lowering them so that students are challenged keeping the pace of the evolution of new information.

Sir Robinson sees that to higher the standards is not the solution to create uniqueness in knowledge that represents one identity, instead by “divergent thinking”, that is for one question there are multiple ways to answer it or different ways to solve. With the interference of technology and the various options students to choose what they think, it is the most convenient solution. It is no longer this is the right answer and do not look at others answers because this is considered as cheating. What matters now is the human capacity in information age, the age of sharing, and expanding knowledge in groups to solve critical situations that requires critical thinking.

For the purpose in reforming education in UAE, Dubai was the first participant in PISA, program for the international assessment. During 2009, PISA is an international assessment done in English, mathematics and Sciences. The questions in PISA are real life applications that students most probably are not accustomed. Students are not acquainted with how to solve word problems or not familiar with the sense of the topic in the described problem. Among the Middle East region and the Arab countries, Dubai ranked the top. Both English and mathematics scores were below average compared with the 65 countries, which requires studying the causes and the consequences for such a result. Another comparison observed between two genders. There was significance in

genders results in mathematics and English. Part of the assessment was a questionnaire showed that the participant's environment has an influence on the results. Mike Helal (2009), in his report analyzing PISA scores concluded out that there is problem in the national curriculum in the public schools. There is a need to reform teaching and learning in schools.

In school X, one of the administration's policies in the development plan of 2011 was to emphasize on higher order thinking questions, which includes critical thinking and word problems in the summative assessments. From the researcher's point of view, the students missed those questions due to the fact they do not know how to solve such problems, because they don't understand them. The students neither understand what to do nor they don't understand the given itself. Looking at Polya's steps in solving problems, to start with the problem is to understand the given and what is required to be found to plan how they are going to solve it; what steps they are going to follow, what rules or theorems using their memory or their understanding to connect it with the plan.

Aim of the research:

Between April and May 2009, as an attempt to reform education policies in U.A.E, Dubai participated in Program for International Student Assessment (PISA). PISA measures the level of knowledge attained by school and how do students correlate it to their environment. The participants were 5,620 students from 134 schools (public and private) assessed in English, Math and Sciences. Dubai out of 65 countries who participated in 2009, ranked as 42 in reading proficiency of a score 459, 41st in mathematics of a score 453, and 41st in science of a score 466. Above the Mena (Middle East and North Africa) region, Dubai ranked as top of the participants who enrolled for the international assessment (appendix B-Table-1). The assessments showed that in English reading and sciences there was gender differences were female students' outnumbered male students. However, in mathematics there were no differences between both genders' scores. The other part of the assessment that was questionnaire showed that

the environment outside the school and their culture influence students' performance. Parkville Global Advisory, Mike Helal (2009), in his analysis of PISA's Dubai assessments considered that Dubai ranked number one over the Mena region, hoping in the future those students will be among the world's best students drive the economy of Dubai towards knowledge economy and leading the Arab world (Gulf News, 2009). PISA results also showed that the national curriculum of mathematics in public schools is internationally below the curriculum of other countries. Comparing the national curriculum of the public schools with the private schools in Dubai following curricula of the Baccalaureate UK, Indian or US, shows that they need to reform and enhance teaching and learning. The results of TIMSS proved that (Trends in International Mathematics and Science Study) in 2007, were Dubai national curriculum scored 374 in mathematics and science skills for grade 4 and 378 for grade 8.

Looking deeper in the kind of questions PISA and TIMSS offer, they focus on the exchange of knowledge with the real life in a form of word problems, graphs, diagrams where unfortunately, students are not acquainted with. The students from the researcher's experience, panic when they see word problem and complain that it is impossible to be solved. They reply that they didn't know how to solve it, they show anxiety, and they describe it as hard. Another aspect that shows the purpose of this investigation that during the researcher's experience in Dubai private schools, it was found out that most of the problems given are direct problems which require practice skills and memorization; not examining the students understanding of the relation of their knowledge with the real life. However, the students are basically used to direct questions; they are expected to cover content to get grades but not assessed to questions where it evaluates their understanding of the general concepts. They are not challenged enough to be evaluated for problems they have not seen before.

Research questions:

- 1) How does learning problem solving strategies affects on students thinking style?
- 2) How does learning problem solving affects on students' achievement?
- 3) Are there any differences in achieving problem solving strategies regarding

a) Gender?

b) Culture?

Literature Review

Gender and Mathematics

There is student diversity in culture and gender in learning. Many factors affect the student's uniqueness of interaction and learning in classroom so the teacher has to develop various strategies seeking various cognitive approaches to keep them with high self-efficacy. In general, girls are emotional, thus verbal advices by teachers can improve self-efficacy by convincing communication and feedback to guide them through the task thus encouraging them to make their best effort (Kirk 2011). Recently, the study of brain development in each gender is the interest in neuroscience research, where they focus by studying the brain on how females and males perform differently in each subject. In psychology of education, there is no rule in which gender attains more grades or experience but general stereotypes. Such general stereotype is for some reason girls choose more lenient domain such as Literature in their higher education than boys do. The fact girls achieve academically better in subjects such as English, philosophy, arts while on the contrary, boys achieve better in the scientific subjects such as physics, math in their early education (Logan & Medford, 2011). Forawi S. (2011) in his lecture on 12 February 2011, demonstrated that what plays a role in students' reaction in classroom for specific subjects are classroom climate, teacher characteristics and management instructions. The outcome of effective management produces effective instruction that might increase students' achievement and motivation. Questions may rise if there is any significance between genders and their thinking especially in the scientific field. The data in Larwin's (2010) study revealed teachers predicted high scores in English is favored to girls than boys. This sort of divergence suggests for a recent investigation to take place on the occurrence and effectiveness of math-related gender stereotypes where girls might face low achievement because they lack motivation due to their negative experiences. Throughout these researches, Intrinsic motivation especially competency and belief in accomplishing their task affects the students' interaction in English subject. What about another subject that is totally opposite to English or literature such as Math or sciences?

First, there is a need to understand the students learning diversity as Forawi (2011) mentioned in his previous lecture. Diversity in learning comes from gender and ethnicity on student performance. In an article in journal of engineering (Fedler M.R., Brent R. 2005), the study was concerned with three factors for student diversity. The factors are:

“Learning style, Approaches to Learning and Orientations to Studying, and intellectual development.” Borromeo and Kaiser (2003) focused on the cultural effect on students’ performance in mathematics. The qualitative study was set in a middle class area in Germany where a total sum of 12 students (6 boys, 6 girls) from grades 9 and 10; in addition, eight participants from higher type of secondary schools and 4 form higher comprehensive schools. The participants were arranged in a pair of boys, girls and mixed. The data was collected during math classes under problem solving process, video tapes and interview. Throughout the research, it has been shown that there is no gender difference with respect to the mathematical learning style. Three thinking styles that divide the mathematicians are visually, analytical and analytical-visual styles. The analysis could show two thinking styles; however, there was no observation of a relation of the mathematical thinking styles with problem solving strategies. The experiment didn’t distinguish any gender differences although during solving mathematical problems the girls tend to discuss more than boys, while boys showed competitive attitude. The study did not stop at this stage however, it also related that the math teachers thinking style affects on the students’ understanding and solving problems. Thus to provide an efficient understanding to various thinking styles that exist the teacher has to be aware of their own thinking style during instructions. In this case, it doesn’t mean that teachers do not explain well, but not all the pupils thinking style matches with the teacher’s thinking style. Zhang & Sternberg (2001,p. 204) who emphasize: “Findings from a third study indicated that teachers inadvertently favored those students whose thinking styles were similar to their own.”

The reason that students who were taught by their teacher for more than a year were highly tend to adopt the teacher’s style because they are simply “stamped” by their thinking style. In this case, teachers should provide all the possible thinking styles in their

instructions to benefit large number of students, otherwise students will rise difficulties in the subject especially mathematics. Students who are learning mathematics should be given an opportunity to use their own thinking style to express their thoughts rather than their teacher's thinking style. Therefore, student diversity requires diversity instructions in mathematics.

Cooperative learning and its effect on critical thinking

Cooperative learning is an instructional method used to involve an active engagement within the students. Cooperative learning outcomes in various instructional forms, one of the known forms is the collaborative learning, a learning process in groups. The importance of cooperative learning is to engage students together through a unique experience in academic and social learning. It enhances their communication skills, learn to honor and respect, listen to each other. It engages and improves students of different backgrounds and cultures in respecting and sharing their skills. It involves all learning styles such as oral, and verbal learning styles as well as it allows students in making decisions and comprehends to use their academic skills. It creates a better instructional management and reduces the stress to the teacher from becoming the only source to a facilitator (Orlich, Harder, Callahan, et al.p.274, 2009). However, setting the group to achieve the most of an effective instruction is setting the groups into heterogeneous members. Usually each group fits all of the mixed abilities of below average, average, to above average students, or difference cultural backgrounds, or of same interests. Cooperative learning, according to Johnson and Johnson (1992), requires "time management, organization, structure, positive interdependence, face-to-face interaction, individual accountability, development of social skills, and group evaluation".

One of the cooperative learning methods used in higher order thinking is problem-solving instructions. John Dewey defined problem as setting that raises the question of doubt and skeptic. Since critical thinking is important to enhance technology education, a study was done to investigate the outcome of collaborative learning on college students solving problems under two types, drill and practice, and critical thinking problems through pre-test and post-tests (Gokahale 1995). The study showed that under the critical

thinking items there was no significance of the tests for the students who worked individually, while there was significance for students who worked in-group work. The teacher's instruction on group work was to make sure that students understood their role in the group. The students had the chance to write and discuss with their peers by analyzing more the items that required critical thinking that students learned how to think differently from each other.

Critical thinking for a rapid changing world

R. Paul's book (1995), asked an important question, "Can we deal with incessant and accelerating world change and complexity without revolutionizing our thinking?", the sense of the question implies that since the world is changing rapidly that no more our routine industrial mode of thinking that can fit with the required thinking today. The answer to this question is yes. For many reasons, as evolution occurred humans thinking evolved too. Human as they first had a problem with the cold they started igniting fire through friction of stones and now they ignite fire with many technical methods to get warm. For this reason, human can revolutionize their thinking but it requires many factors and environmental effect that would referred to be problems at start. As the problems got complex the person had to think more to find a solution under determination and will. Most of the time human has evaluated their jobs their choices but they never evaluated their quality of thinking. Important researches showed that there is a need to study this issue for policy in changing education quality; what policies are practiced in our educational for improving thinking? Five findings showed that student can compute but cannot reason, they can write meaningful sentences but cannot write arguments, textbooks as resources offer only big ideas no challenging questions, teachers teach only content and avoid thought provoking work activities, teachers teach how they were taught, teaching the procedural way not how to evaluate and think.

Thinking with awareness through chain of self-evaluation under not just systematic network but rational one describes critical thinking. It does not help only in education but also in one's personal life. Six characteristics that relate in a dynamic network start by identifying the problem to create the best choices or solutions with reasonable

explanations were identified in less than thirteen years of critical thinking (appendix C-Table 1). Thinking is the guidance to intellectual standards, supporting the intellectual traits of the thinker. He/she can relate their element of thought to the problem under logical algorithm. With the assistance of identifying their intellectual standards, the thinker is able to assess their thoughts routinely thus evolving the skeptical sense and is able to divide their thinking into small parts treating it individually. Such mode of thinking where the thinker can utilize the limitations and the strength of the solution can lead to predictable choices and well reasoned answered, that is, rational expectations(Paul, 21-23,1995).

In each of the fields of learning and working critical thinking takes a definite shape. The process starts in schools because it develops the thinker's critical thinking characteristics. In schools, teachers are not well trained how to teach thinking in subject matters and aren't well instructed how to develop their questions to the elements of the problem they are reading. Of course, instruction alone is insufficient; self-discipline and intellectual awareness are required at this phase. Students are learning under a systematic procedure, it identifies their thinking barriers and commonly known as memorization leading to an easy success. As students learn how to use critical thinking in finding the solution in each subject matter, then students will be able to use their critical thinking at work through reasoning. With the rapid change of inconsistent world we are now in, the work place requires workers with intellectual standards to access work and face the challenging problems using their critical thinking. Critical thinking after all, is an abstract process that affects on the thinker's choice, intellectual standards and ethical reasoning.

Problem solving approaches

Problems are everywhere and any approach in real life human has to approach, have to think about the most efficient solution. Problem solving is a part of the critical thinking. Critical thinking includes problem solving but the not the opposite. Considering the Definition of problem solving and critical thinking, there will be a slight difference; problem solving is a reasonable logical method taken to solve a structured problem while the critical thinking suggest a reasonable solution structure to an ill-structured problem.

Students usually feel anxious about problem solving and critical thinking in general. They get worried that their exam has any higher order thinking questions, challenging questions or any of this. It takes more time for the students to learn how to solve problem solving than learning how to solve applications. A study (Keller and Concannon 1998) done showing the obstacles students face when solving problems and suggests what strategies should instructors consider while teaching problem solving. The study identified that the obstacles teachers usually ignore are the students' anxiety and worry while solving problem, the learning style differs from one student to another. Some of the learning styles that students can achieve better are visual, auditory, or aurally. In addition, the thinking styles in gender difference that the study has also deducted in its research. However, the psychological and emotional events the students pass through affects on their performance in problem solving. Such cases affect on the logical structure or their skills that are not well employed as the requirements to solve the problem.

The study offered two strategies to overcome the obstacles in problem solving, the “pedagogical strategies” and the “methodological strategies”. The pedagogical strategy suggests that when the teacher is introduced to the class, opens a discussion with the class bringing the chance for the students to express their fears and their worries about problem solving, and encourage students to work on problem solving and express their thoughts in problem solving with no marks. Opening discussions with students through various ways, like essays, journal can encourage students to express their solutions and sharing those solutions can lead them to learn from each other and solve the problems in different ways. Such attempt can help the student to express their mathematical ideas in better analogical ways and at the same time faces their anxiety and their worries.

Considering “methodological strategy” as a technique for (Keller and Concannon 1998) problem solving, a constructivist model in instruction, it was identified by Dewey first then by Polya who considered problem is a setting that arise doubt to inquire. He considered that the problem to be solved, it has to be adequate for the culture and related to the students. The problems are to be from the experience carried by the students. The experience should contain two criteria, “content and the process of knowing”. The

teacher's job at this stage is to clarify and clear out how to think of the problem and how to follow the steps in solving a problem. The teacher assists in showing how to investigate by collecting the best information out of the given, test and evaluate to find conclusions. Students are not necessary to follow the investigation systematically; the students have the freedom in creating their own technique that suits in solving the problem. Dewey created steps in problem solving that the teacher can use in teaching how to solve the problem. The steps are:

- “1) becoming aware of a situation or even that is labeled as a “problem”,
- 2) Identifying the problem in exact terms,
- 3) Defining all terms,
- 4) Establishing all the limits of the problem,
- 5) Conducting a task analysis so that the problem may be subdivided into discrete elements for investigation,
- 6) Collecting data that are relevant to each task,
- 7) Evaluation the data for apparent biases or errors,
- 8) Synthesizing the data for meaningful relationships,
- 9) Making generalizations and suggesting alternatives to rectify the problem,
- 10) Publishing the results of the investigation.”

Cambridge handbook of thinking and reasoning (2005) defined thinking as follows: “A systematic transformation of mental representation of knowledge to characterize actual or possible states of the world, often in service of a goal.”

The process in constructing a course of action that can achieve a goal is represented as a problem solving. The conceptual relation between a problem solving and an individual is relative. In other words, each problem varies for each individual because it is either no blocking or no acceptance of the goal that exists for an individual. Throughout history,

solving a problem comes into many categories depending on the situation the problem is set and the individual's cognitive level. The strategies differ according to the type of the problem thus creating different techniques or strategies. According to Malouff J. (n.d.), he listed the types as follows:

“ Types to help understand the problem, to simplify the task, to determine the cause of the problem, involving the use of external aids to help you identify possible solutions, involving the use of logic to help you identify possible solutions, using a possible solution as a starting point to help you solve a problem, to determine which possible solution is best, using a geometry of problem solving, to help you use your maximum capacity while solving a problem, and to help you solve different problems.”

To carry out the solution correctly and to simplify how to solve problem solving, different models were unidentified yet, in 1957, Polya broke down the problem solving strategies into stages mainly used in mathematics by experts (Reardon, 2001).

- Understand the problem,
- Devise a plan,
- Carry out the plan, and
- Look back (verifying)

Recently, the field of problem solving in education is becoming an interesting subject to investigate due to its compatibility with the requirements of the information age; it requires graduates with high complex thinking skills that can work under pressure and vague situations. Problem solving is important element in teaching mathematics because it enhances the logical thinking, contributes in increasing curiosity, organization, and analysis to interpret communication of information. Research on mathematical problem solving explains the importance of problem solving in improving the potential of the students in mathematics, it improves reasoning over intuition, and in addition, it increases the students' motivation and enthusiasm in solving math problems.

Problem solving and its effect on student achievement

A study done in Pakistan, 2010 on grade eight students from Girl's public school investigated the effect of using problem solving strategies in teaching mathematics on their achievement. Seventy-six female students divided into two groups controlled and experimental participated in the research. The control group was of 38 female students where traditional teaching methodology implemented and experimental group consisted of 38 female students instructed by problem solving method. A pre-test, post-test and a self-developed test were used which was reviewed by experts. The results of the students' achievement showed there is significant difference between the students who were taught problem solving method as compared to the student who learned through traditional method. The research concluded that problem based strategy enhances the students' achievement who have same educational background (Ali et al, 2010).

Another research investigated on the effects of problem solving strategies on students' achievement, attitude and motivation in physics. It was experimental research designed for two groups control and experimental, constitute altogether of 46 students where 20 females and 26 males. Pretest and posttest used in this study and data was collected from five achievement tests. The controlled group was instructed using the traditional teaching strategies while the experimental group was instructing problem solving methods in cooperative groups. The results showed that there was significant in students' achievement, attitude and motivation but there was no gender difference in the medium where problem solving strategies was applied in cooperative group (Gok & Silay, 2010).

In presenting previous work, it is important to highlight some data reviewed as strengths and weakness, compare and contrasts of their findings. First, both articles discuss the same issue but are different in subject and culture. A quantitative critique research Table-1-(see Appendix D) was done to compare and contrast the strengths and weaknesses of each research using ASRT (American Society of Radiological Technologists) quantitative research manuscript checklist. The checklist comparing it with the other another article that is a guide to critiquing research, "Part 1- critiquing quantitative and qualitative research" validates similar ideas. However, some parts were omitted from ASRT checklist manuscript due to the fact of inappropriateness with the research field.

The table discusses what is valid and invalid in each research. In both researches, the title indicated of the content of the topic. The abstract was brief, coherent to the reader where he can know what sample is tested, under what method, for what purpose, and its findings. The main purpose of writing a literature review in a research is to identify and construct a research question. In both articles, the literature review illustrated conceptually in the introduction, covering all the aspects of the research questions; the articles covered the importance of problem solving, the problem solving strategies applied in each subject, and how does new teaching strategies enhance the student achievement in problem solving. The introduction included two things the literature review that gave enough points that were used as a guide to the study, giving enough boundaries to the research. The research question was correlated to the literature review and it clearly identified the problem that lead to the investigation of this research. In the method and research design, it included the material, the data analysis and the procedure used illustrating a brief description and clear comprehension of the investigation route. Though it differs in the procedure, however, both articles went into comparing between two groups, controlled and experimental. The sample taken in the first article was small to be supportive in generalizing the results. The research designs in both articles were appropriate to the research questions and it was adequate with the nature of the investigation. Due to the nature of the research as experimental where two groups get different treatments, it requires to compare between two groups to show significance thus pretest and posttests was being followed in those researches where they studied the mean, standard deviation, and the t-tests. The students were chosen randomly and the analysis did not require any sophisticated program, but in the first article, the sample size consisted of 25 students for the experimental group (12 female and 13 male), the controlled group consisted of 21 students (8 females and 13 males). Relating the sample size of the first article with the research question number three which was focusing on gender difference in student achievement, it does not give equilibrium in the results. The sample size in general is small and specifically the sample size of females in the controlled group. Thus, this might fall the third question as a weak irrelevant question. The small size representation that might increase the error, however, who and what

criteria were used to exclude population was expressed clearly and its reason to the connected concept. The first article (Gok & Silay, 2010) supported the sample size by sample error tests and analysis to validate and assure its credibility. The 2nd article (Ali R. et al, 2010), had equal sample size in each group (38 student), which support and reduces the sample error to test only the validity of the instruments that will be used. The students were chosen at random in both articles where the 2nd article the random students were chosen based on the pretest, thus this shows that there is no randomness but under certain criteria that was not mentioned in the article. This raises a question: what background do the students come from? Does this affect on the students' achievement?

In case of adopting instruments on a new population, the researcher should show reliability and validity of the instruments to show it is accurate measure that studies the required goal. In case of article one, since they adopted the instruments to apply on this small population, validity and reliability test were taken showing the statistical tools. Instead, the 2nd article went into validity test and pilot test to ensure the change in the sampling strategy later and support the instrument measures taken. Ensuring the authenticity of the procedure taken they have described chronologically how the group work was done in the 1st article and the teaching strategy taken in 2nd article.

The findings in both articles were not conceptually different. In the first article, explaining the data analysis shows the researcher using inferential statistics that can identify the difference between variables and whether these variables are statistically significant. The results overall hold all the significance of the literature review in addition to the research questions except the significance of gender difference which was obtained by variance analysis. Of course, with respect to the sample size it is not enough to show any difference. This sample size was a weakness in the research because it generalized the connection of the students' achievement of problem solving in gender difference. An important point to mention is that the research could have been investigating in achievement and attitude motivation. In spite, the research was focusing on the students' achievement academically and behaviorally the 3rd question research was meaningless to give it an attention. Another aspect is that the investigators didn't mention future suggestions in the study; instead it was a summary of the findings. While in the 2nd

article, the analysis of the results was done by the t-test. The conclusions were pointed out as the final result correlated to the literature review, those three results mentioned could have been structured under one idea. The article succeeded in giving recommendations but no limitations of the study. Limitations in such research can be established regarding the period of the investigation taken and the teaching procedure taken, what obstacles occurred during the investigation so it can protect any further research from falling into same mistakes. There was no need to study gender difference due to the nature of the school; a high school for girls in Pakistan. The references in 2nd article were more up to date than the first article.

Such results show that problem solving strategies can be implemented in schools for several reasons. It organizes the student's logical thinking; it enhances the behavior of the student. Teaching problem solving strategies by either group work or problem solving based technique enhances the students' achievement in problem solving, their attitude and motivation. It helps develop their mathematical ability, their intuitions and their reasoning. It develops the students' motivation and enthusiasm with respect to mathematics. Both researches showed those results above but in different samples one that is a small sample in Turkey and the other a sample in Pakistan of same gender. Looking from the cultural perspective, the gap in the first articles is the gender difference and in the other the contextual background of the students especially knowing the students in this school are all girls. It raises the interest of the research in the gender difference in achievement of problem solving, the cultural effect of problem solving in mathematics, and the effect of cooperative learning of problem solving in mathematics.

Methodology

The research studied group of students of Grade 10 in School X under different phases the elaborated in this section.

Participants

Students: Since part of the investigation is interested about the gender difference in student achievement two classes of different gender and grade level, grade 10 were chosen. One teacher was conducting the mode of the research.

Students: The participants were of 27 males, and 30 females aged between 14 and 15 years old. The nature of the class consisted of mixed abilities and of Emirati (48% males, 66% females) and Arab nationalities (52% males, 34% females). This helped to investigate the students' achievement cultural effect during the research period. The chart below shows the nationality of the students in each gendered group.

Nationality	UAE	Lebanon	Syria	Palestine	Iraq	Jordan	Europe
Male(27)	13	6	3	2	1	2	0
Female (30)	20	4	0	2	2	1	1

Teacher: The investigator was the teacher following the mode of instruction that included collaborative learning instruction and participated in collecting the data.

Ethics considerations

The investigator has sent a formal letter (See appendix E) while collecting data to the participants and the administration of school to confirm on proceeding the investigation and remaining confidentiality. The information used in this research approved and used under certain identifications or codes to maintain the secrecy of the participants. The codes used in this research are:

-School Name: School X

-Students in the boy's classroom: S (b1), S(b2)...

-Students in the Girl's classroom: S (g1),S(g2)...

Reliability and Validity

Quantitative research develops a hypothesis under certain measurements to analyze relationships between variables. Studying and testing all the effects and variables to attain its credibility of a research questions is this quantitative research reliable are the variable related to the topic do the test fit in the topic ?

According to Joppe (2000), he defined that the research is reliable if the results are stable and were developed under similar methodologies over a period. Although the researcher can confirm the reliability of the instrument by test and retaking the test it can be invalid. However, validity determines if the instruments used in a research can hit the target and can cover the topic. Reliability and validity can show to what extent the instruments converge to it forming compatible instruments with respect to the quantitative study that can lead to generalizing the hypothesis.

In this research, the pre-test and post-test questions were selected from the PISA assessment 2003. The PISA is an international assessment that studies the standards between countries with respect to the international standards. International assessments are reliable due to the fact. In addition, PISA problems are problems that include real life applications and concepts that are valid to the rationale of the investigation, problem solving. Thus, the pre-test and post-test confirm the reliability and validity for the methodology used.

The aim of the questionnaire is to study the background of the student and evaluate their culture. The questionnaire (appendix E) was collected from different sources inquiring the same topic, culture and economical background of the studied variables. The pre-existed questionnaires since used previously for the same objective, thus they are reliable and valid. The questions included about personal and family background of the participants that studies the socioeconomically the participants. The questionnaire(appendix E) contained closed ended questions related to multiple choices.

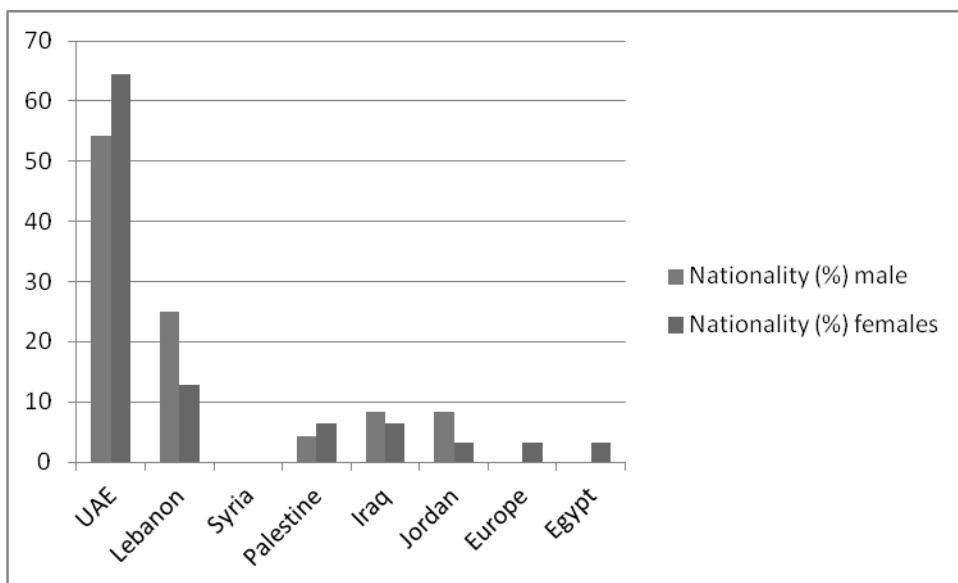
Action study

The study passed through four phases in collecting the data. The data was collected by survey studying the economical and sociological background of the students. The reason behind the survey is connect it with the results of the other stages and as a factor to study the relation between the students' achievement with their culture. Phase two was the collection of knowledge of students in solving problem.

Phase 1 (collecting information; homogeneous group)

The first phase of the study was to collect data about their background and some personal data. Before distributing the questionnaires, a letter (appendix E) was designed to take permission from the principal of School X to proceed with the research. To conserve the students' privacy and ethical consideration, a letter was distributed to the students to read and sign as an agreement to be participants in the investigation and to affirm their confidentiality. The student replied with 31 participants form the girl's section and 24 from the boy's section as an approval. The participants then answered the questionnaire (appendix E) that included their personal background about their nationality, parents education and occupation, number of brothers and sisters, size of the family , their pocket money and other data required to give a brief idea about the level of education that existed at home. At this stage, the investigator was looking at traits of culture and the nature of the participants. The nature of the participants were in the following graph where

Figure -1- The percentage of participants in each nationality and comparison between males and females in each nationality



The diagram shows that the both genders' average constitutes the total size 59% UAE nationals and 19% are the majority Lebanese. The other Arab nationalities constitute of 22 % of the total size of participants.

The questionnaires(see appendix E) also studied the background of their parents as in occupation and educational degree they achieved. The data shows that the father's highest degree achieved of both genders is the university college degree scoring as an average 54.05% and their occupation is basically the professional and managerial that constitutes as an average of 80% . Looking at the graphs below that represents the father's highest degree and occupation, the data shows that both genders have almost have equal percentage in university and college and as in occupation is : professional and managerial ,(male 50% , female 58%, average 54.04%). Similarly, looking at the mother's state of education and occupation, the mother's highest degree is university/ college degree (male 75%, female 64.5%) leaving an average of the total population approximately 70%. However, the mothers as an occupation are semi-skilled or unskilled. In this questionnaire semi-skilled/unskilled means that the mothers were either unemployed in the society or they have simple chores that the family does not depend on its support. This sample forms an average of 61% of the both genders are semi skilled/unskilled (males 54%, females 67%). This shows that in this sample the basic dependant is the father were mostly are in high positions as professional or managerial.

Although the mothers are mostly well educated but they almost do not work. However looking at the other cases the results almost the same, thus the parental background of both genders is almost homogenous.

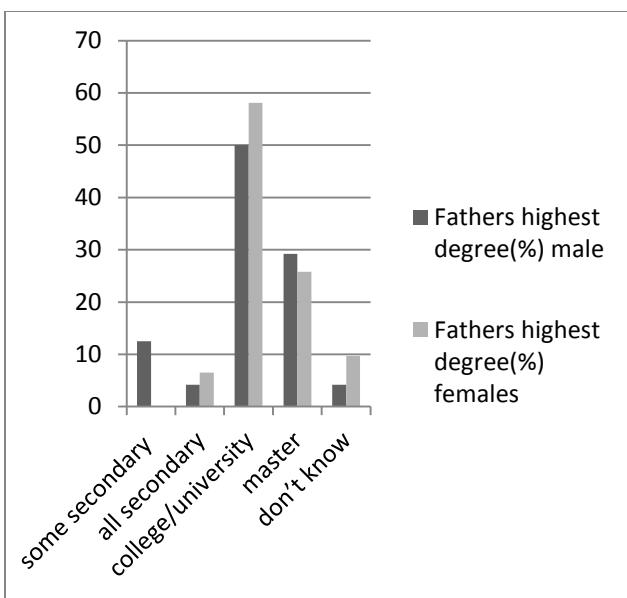


Figure a- Comparison between the level of educational degree of the father of the participants(males V.S. females) in percent.



Figure c-Comparison between the level of occupation of the father's of the participants(males V.S females) in percent.

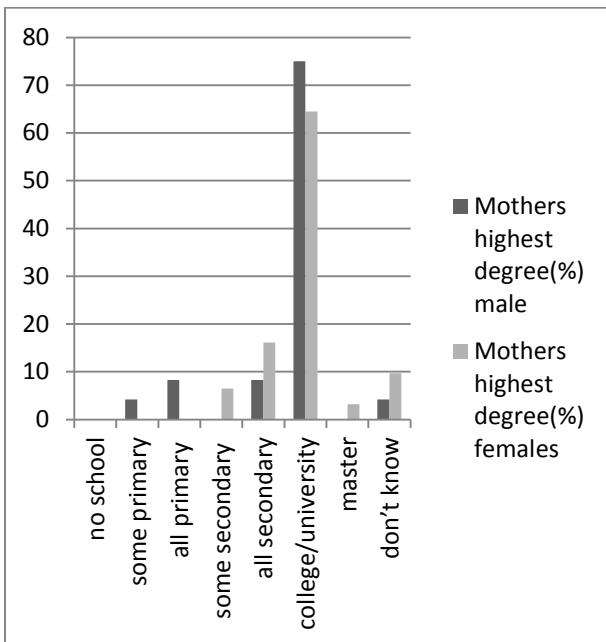


Figure b-Comparison between the educational degree of the mothers of the participants(males V.S. females) in percent.

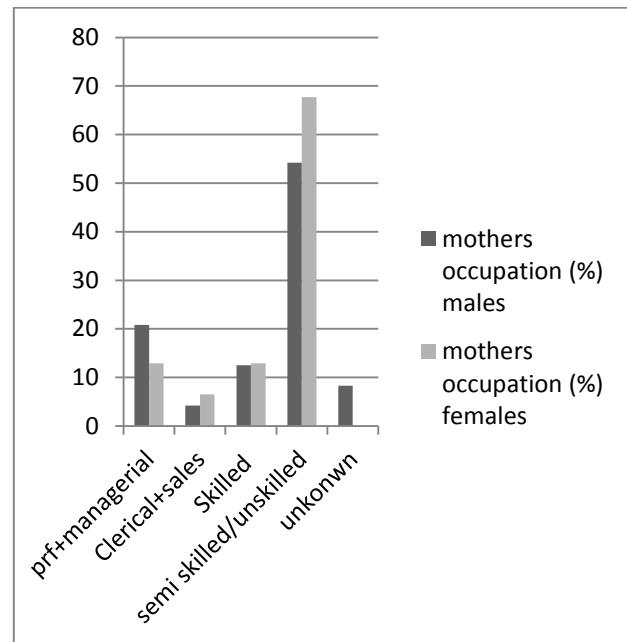


Figure d- Comparison between the Occupation of the mother's of the participants(males V.S. females) in percent.

Looking at the students' spending money, it was found that the parents can afford to their children the range of amount that is 50 and Dhm100 for an average 35% and 55% of both genders get paid above 100 Dhm/week. Both genders have cell phones thus they can afford charging it, 96 % of both genders have phones while only 3.25 don't have phones are females. The reason that girls might have phones is due to basic restrictions and gender differentiation in the region.

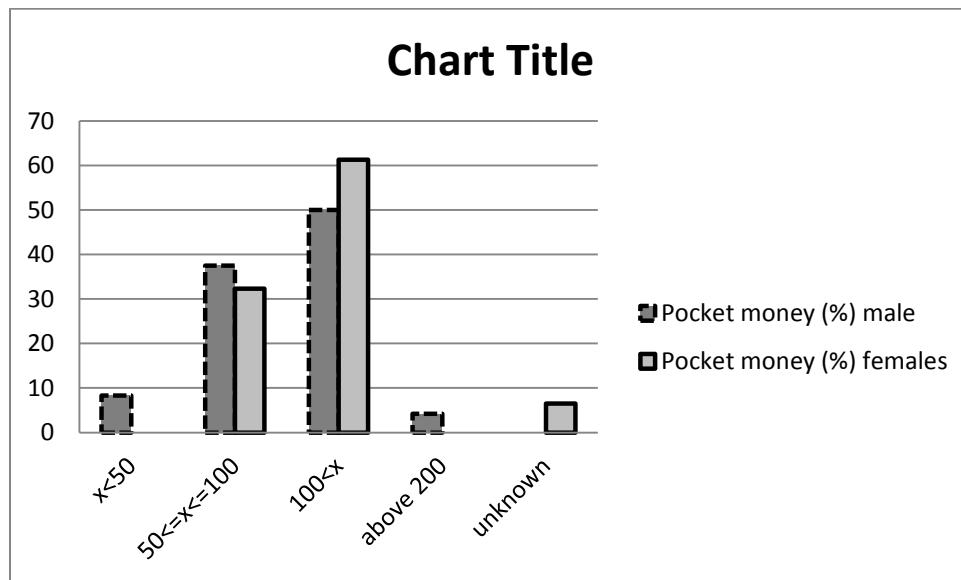


Figure e-The amount of money participants (male V.S. females) spend per one week.

The questionnaire (see appendix E) other than it included the social background of the participants; it included the use of mathematics at home outside the school medium. The results showed three ideas; the first idea is the use of technology for school especially the math subject, the communication by English language and about school with parents and last is their understanding and motivation to math subject in school. Knowing that all the participants have internet at home, when the participants were asked if they do they use internet for mathematics homework the results showed that quarter of each gender in the sample 12.5% of males and 22% of females do use internet. Significantly, the females sample were 51.6% who use internet to learn math while 66.7% of the males don't use internet to learn math but the males outnumbered in using

the internet for math home work , that is the males basically use internet as another support resource. However, 8% of the males and 29% of the females use external support as private tutoring.

Language is a means of communication that can enhance the person's expression and analogy in thoughts. Communication about school and problems that the student passed through can increase the persons understanding and develops a better thinking of the issue that occurred during their day. The survey (see appendix E) showed that the communication with parents about their studies in school it showed that 45% in both genders " twice or three times per week" they communicate something about schools which is the highest among all the other options. A significant percentage of females (12.5%) tend to communicate more with their parents every day than males while they do not communicate or they often communicate once or twice per month. The means of communication can vary however the average of students who communicate in English language as 23% most of the time and 5.53% all the time is slightly significant. This means that the students use other languages the non-formal Arabic language to express their thoughts and their ideas about their day at school.

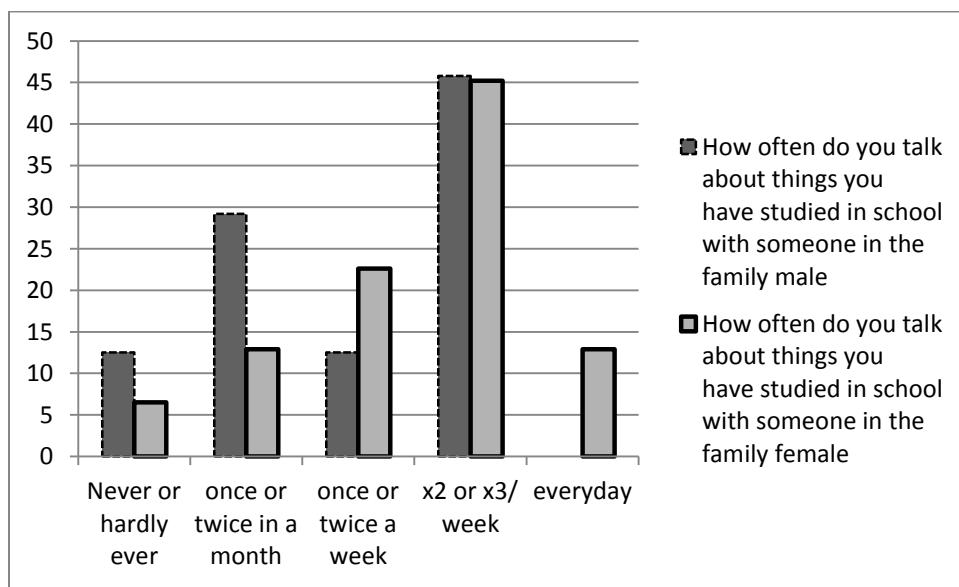


Figure f-The percentage of the answers of the males and females "How often do you talk about things you have studied in school with someone in family.

The students interest in the subject can increase the student's responsibility attention in class thus can affect on the students' achievement. If the students find the class work hard they will not be that interested in working more or liking the subject. The survey investigated how often they find math class work hard, it showed that there is significance between both genders, 9.7% of the females find it always hard while none of the males find it always hard, but both genders found it hard sometimes (64% females and 70% males). To check the student's self confidence in solving mathematics there has been found that females (32.3%) feel more confident than males (12.5%) by 19.8%. in favor to females. However almost both genders feel sometimes they do well in mathematics.

Phase 2 (worksheets)

To maintain the follow up with the students understanding on Polya's problem solving a practice phase was taking part in the research for 8 weeks. This practice instructional phase, between the pretest and posttest, included three sub-stages, introducing Polya's problem solving strategies, solving worksheets under group work and cooperative learning, and assigning homework. The students were informed that there will be a part of extra-curricular objective covered during 8 weeks that can help them out solve word problems. Through student centered learning the students by research were asked to identify Polya's Problem Solving strategies. The students did a small research and through discussion, they had to find out the stages in solving Polya's problems solving. The general observation is that students were interested to learn because most of them knew they are weak in problem solving and they used to inform the instructor that they freak out when they see a word problem. The students suggested to create a poster included some tips in solving word problems covering Polya's strategies concepts and hang it on their front wall beside the whiteboard. After the conceptual part was done the students had to start practicing their understanding on some ideas. During their math periods, and following up with their curriculum and yearly plan, students were practicing

on their lessons on Polya's problem solving strategies by the end of each lesson. Students saw an example on board and then they tried to solve similar one.

The students on the other hand were provided with extra worksheets to solve in a group work. The group work was designed covering all the mixed abilities under instructions on board to follow up as tasks. The group work consisted of five roles represented by each student from high achiever to low achiever, team leader, assistant to the team leader, representative, researcher and the writer. The teacher had to follow up with the groups and support them as possible. The tasks were mainly the time they have and some tips of how to start with the worksheet as an efficient way to consume time. The group work was mainly one period of 45min per week. After the groups finished open discussion between the groups helped out identifying the problem and discussing its solution and correlation of Polya's problem solving strategies in solving word problem using the tips on the poster. Then students had papers to take at home and try to solve it alone. The worksheets consisted of problems of general math skills they have studies previously when they were in lower grade. For the students to be familiar with the PISA questions, collected problems from the PISA previous exams they had to be solved in class as a group work.

Phase 3 (Pre-test and Pos-test)

The pretest and the post-test (see appendix F) were a sample of PISA questions assigned in the previous years. To maintain consistency and study the effect of learning how to use Polya's problem solving in solving word problems the pretest the students did it before learning the strategies and post test were the same questions which is done after they passed the 8 weeks and studied Polya's problem solving strategies.

Question types and correction

In purpose to check the students' ability in solving word problem and to analyze their own knowledge in solving word problems, one sample of questions was chose. The students did the tests before and after learning Polya's strategies (pretest and pos-test).

The pre-test and pos-test were to be represented into four corrected categories represented as variables “a, b, c ,d”. The categories defined as “ a”= fully correct answers,” b”= partially correct answers,” c”=wrong answers, “d”= did not answer.

Analysis and findings

The data were collected and represented using SPSS under T-test for several reasons. To see to what extent did the treatment affect in the investigation, T-Test was chosen to compare the means between two groups especially if two tests were done; one before the treatment and the other after the treatment. Another reason, is that the t-test can show the correlation between both tests (Pre-test and Post-test) and identifies its significance (Trochim, 2006).

In the following chapter the findings and the analysis will be written as study cases to determine whether the process done has met the aim of the research.

Case study 1: Did problem solving strategies affect on student achievement?

Ignoring the gender difference for now, the data was collected from each pre-test and a post-test to determine whether there was a progress. Applying T-test on SPSS program, and identifying the variables as a, b, c, d, that is, total amount of which the students in the questions from 1 through 6 answered correctly in each test , category "a", partially correct, category "b", wrong, category "c", and category "d", didn't answer, the results are illustrated in the table -1- below. It showed the highest mean was in category "a" of the post-test, where the students answered the questions correctly scoring 32.17 and lowest mean was for category "d"(≈15) of the post test. knowing the correlation of both tests in each category is strong as shown in table-1-, the significance appeared in category "a", where the students answered correctly ($0.042 < 0.05$).

category	Mean Pre-test	Mean Pos-test	Correlation "r"	T	Df	Significance
"a "-All students answered correctly	21.83	32.17	.902	2.719	5	.042
"b"-students answered partially correct	10.83	6.5	.818	1.725	5	.145
"c"-Students	15.0	13.17	.949	.885	5	.417

answered wrong						
"d"-Students didn't answer	6.17	4.50	.946	1.685	5	.153

Table 1- The mean of Pre-test and Post- test of each category (a, b, c, d) that males and females scored Collected from the SPSS test appendix G

This implies that the students got more correct answers in the post-test than the pre-test ($M=32.17 > 21.8333$, $r=0.92$). The student's average is higher in the Post-test than the average of the Pretest. Hence, students have learned effectively how to use Polya's strategy in solving problems. In addition, the teaching strategy used has been useful by practicing once per week and using Polya's problem solving strategy on posts to help them remember using it. The teacher has used more than one strategy through a small period of time to differentiate the teaching instruction and follow up with the different thinking styles in classroom. In the literature review, the "methodological strategy" was identified as a technique that has an effect on the student's achievement through Dewey and Polya's strategy. Using cooperative learning, through group work and discussion, to solve critical problems has an effect on the student's performance as shown in this research. The student has experienced and shared his thoughts with his group members of different abilities through oral discussions, thus using their oral skills, which is by means is a pedagogical strategy confronting his fears, experiencing the problem with others of the same age that is a relief for them than discussing it with their teacher. In addition, the student has to share their academic skills with their classmates indirectly. The diversity of learning styles was overcome by the posters and worksheets employed in appealing the students mind to logical structure of thinking. Using such posters and worksheets as well as giving the chance for students to share their thoughts with each other and with the teacher out loud, the visual and oral thinking styles were enrolled.

Case study two: Do word problems affect gender achievement?

Although Larwin, Logan and Medford's study in the literature review stated that males in scientific subjects perform better than females, and that females are more lenient in

subjects such as English, and liberal arts, however, in this study it just proved the opposite. To compare between the performance of males and the females in both test, the T-test on SPSS was done by taking the mean of the females and males in each test and comparing the results then looking into the significance to check the performance of each gender in each test. The two tests helped verify the performance of each gender which showed that the results are significantly different. The mean of the females was better in both tests than the males in both tests. The table 2-a- below shows that in both tests the females maintained their higher mean than the males (Mean Pretest= 46.25> 36, Mean Post-test= 46.5>35.5) of correlation strongly high. This implies that the females have done as well as the males in both tests. The paired sample test showed that in the post test there is a significant difference between females and males in the table 2-b- ($t=3.479, df=3, sig.=0.04$). So the correlation in gender results before and after doing the test has been significant. This result also supports for the teaching strategy applied on the experimental group, for the study done in Germany showed that there is significance for mathematical thinking style in girls' attitude through discussion although the mathematics requires competitive and skeptical thinking that mainly shows in males attitude.

Table 2a- Mean of the results of the females and males in each of the tests.

		Mean	N	Std. Deviation	Std. Error Mean
Pretest	Females	46.2500	4	21.51550	10.75775
	Males	36.0000	4	16.55295	8.27647
Post-test	Females	46.5000	4	37.27823	18.63912
	Males	35.5000	4	33.82800	16.91400

Table 2b- Correlation of the males and females scores in each test.

	N	Correlation	Sig.
Pre-test Females and males	4	.966	.034
Post-test Females and males	4	.989	.011

Table 2c- Paired Samples Test-The table shows the significance of each test ignoring gender.

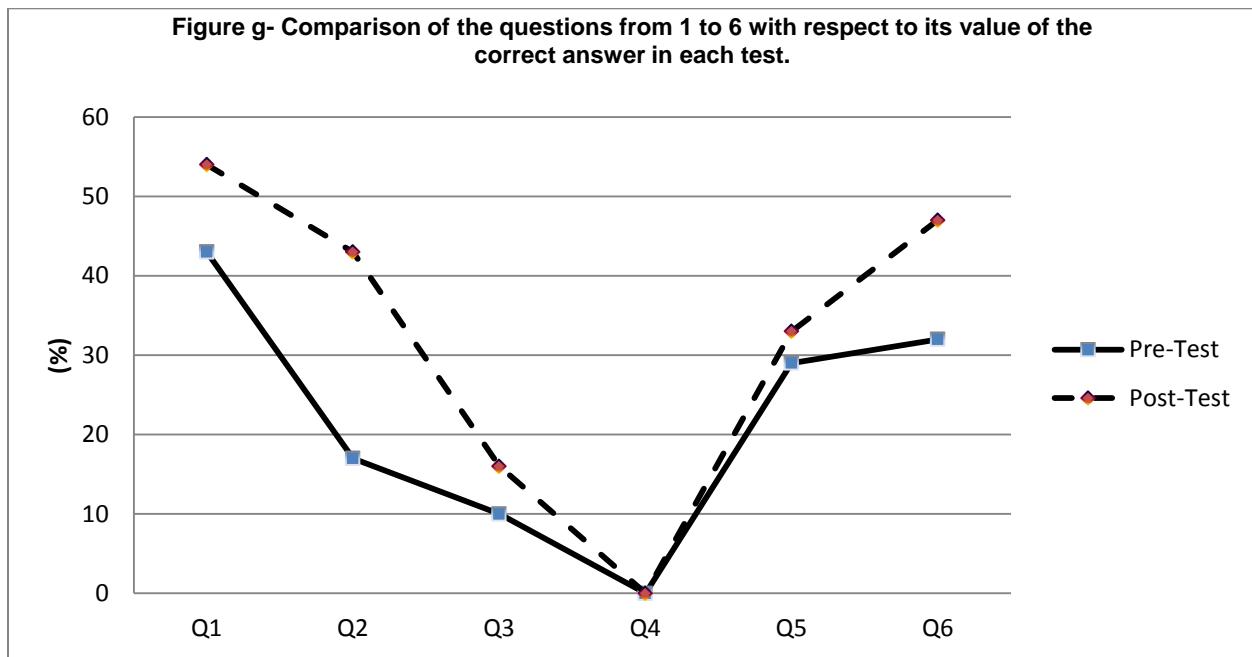
	95% Confidence Interval of the Difference					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
pretest Females V.S. -males	10.25000	6.99405	3.49702	-.87909	21.37909	2.931	3	.061
Post-Test Females V.S. males	11.00000	6.32456	3.16228	.93622	21.06378	3.479	3	.040

Case study 3: Cultural effect on students' achievement

As the result of the questionnaires that were investigating the socio-economical background of the students showed that both groups, males and females, are homogeneous groups. This implies that both genders come from same culture, of well educated parents; fathers working and mostly mothers are house wives, a high societal culture where everything is afforded for the participants. they hold least responsibilities, thus, not affecting on their performance in school and did not help to show the variance of different cultures but was able to show that although there were of two main nationalities (U.A.E and Lebanon) they had the same socio-economical background. In this case, the culture has no effect on the study due to the fact that all nationalities in this study were non-native English speakers.

Case study 4: The effect of Problem solving in student's thinking style

Considering the significance was observed where the students has answered correct answers, a statistical study was done on collecting the total numbers of each question that was answered fully correctly from both genders comparing between the Pretest and Post-test scores of each question on the linear graph as shown in figure g-below.



a	Q1	Q2	Q3	Q4	Q5	Q6
Pre-Test	43	17	10	0	29	32
Post-Test	54	43	16	0	33	47

Table 3a- Comparing between the two test, the total number of category a (all correct answers).

Identifying the type of questions the students answered , each was chosen accordingly using the characteristics of Bloom's taxonomy in order,i.e, "Q1" tests the knowledge of the student. it requires reciting or a call from the memory. Q2" tests an understanding of the problem to identify the situation and interpret it by reciting the rule and use their skills. "Q3" is an application process that requires the application of the solver's

knowledge from the environment and the use of the rule. The first three categories in Bloom's taxonomy require memorization and skills acquired by practice. "Q4" is considered the point where the solver is at a state of transfer from using the knowledge and applying it directly to the process of using the knowledge acquired and analyzing and interpreting the problem in a logical form. The solver has to link between the problem and the knowledge acquired in order to find a pattern that can be the clue for the solution. "Q5" in order to be solved requires some synthesis. The solver has to put all the parts together and create a new problem using their own understanding to create a new meaning. The solver in this case has to modify the problem and analyze it in order to solve. "Q6" the most critical question where the solver has overcome their cognitive skills and is in a situation where they can create their own solution in various ways. At this stage the solver has the chance to express their solution and is able to structure the problem in order to solve in various ways.

Looking at the chart (figure-g-) above, It is observed that the total number of questions answered correctly in post-test was higher than the pre-test. This implies that the cognitive thinking of the students after learning Polya's problem solving strategies was beneficial and at the same time it succeeded in changing the student's thinking style. Observing Q4 the part where the student is moving from applying their knowledge in the problem to analyzing and using their own effort to link their ideas with their knowledge. It's a process where the solver practices his thinking style to be organized and well structured to overcome hard problems. The remarkable point in the graph is that in both tests there has been significance in all questions except Q4, which means not all students have passed this stage. It might be that not all solvers can overcome this stage in a short period; knowing that the period of the investigation was one term, i.e., three months. It requires a long period process which is actually acquired by teaching process that accumulated years and years affecting their thinking styles. The impact of solving problems as Paul mentioned in his critical thinking book, understanding the strategies can shape up the student's logical thinking, increase their curiosity and prepares them to work under complex situations, thus, empowering their critical thinking which is needed most in the society structural changes. However, this stage was a catalyst for some students to

use their higher cognitive skills. Of course individual's thinking varies from one another depending on their intrinsic motivation and their intelligence. To solve the problem requires the readiness of the individual's cognitive skills. In this case, the purpose of the educators to cater students through various teaching techniques teaching how to reason instead of applying content.

The teaching instruction was an impact also on enhancing the student's thinking. The use and the constant practice of one hour per day of multiple word problems succeeded not to solve the problems correctly but how to think of the problems strategically, thus as in the literature review, the student overcame computing instead he can reason better.

Different problems put the student into a position where he is not acquainted to the situation of the problem, however, urging him to think about the problem from different perspective which the student answered the question differently in the post-test than the pre-test. At last, the problem solving strategies, were the basic algorithm for solving problems that the students used it as habitual act that came from training and computing, the students solve involuntary by using the process through reasoning.

Looking at figure -g- again, it is noticed that the score of correct answers was the same at one question, Question four, in both tests. Question four was designed according to Bloom's taxonomy where the student has to use both application and little analysis. -In process of reading the diagram, it is noticed that the students in questions five and six answered in the post-test more correctly than in pretest. This is due to challenging factors that the students have passed through as said before. When the students were given the pretest, two questions they kept wondering how to solve during the first week of investigation by asking each other or asking the math teachers.

It is to be concluded that some students can perform better when they are challenged; they tend to work harder forcing themselves to use all their skill abilities as shown in questions five and six (figure -g-) where the questions were in the form of analysis, synthesis and evaluation.

Conclusion

Education is not a constant system that preserves itself through the change in the world. Education is part of the society that is involved in everyday life. The better we educate ourselves using better quality the better quality of society you create. The technology and rapid change from industrial culture to technological and informational cultures requires a deviation in all systems and individuals' thinking styles. As Sir Ken Robinson mentioned that the 21st century requires higher standards of thinking to keep the pace of the change and development. These standards require meta-cognitive skills acquired by individuals and hence to prepare the coming generations for complex thinking.

As Arab countries are part of this world , the most Arabian country that is seeking to be the best technological country in the region and part of the knowledge economy and globalization , Dubai has been always seeking to enhances its quality of education to prepare its generation for the work field that requires complex thinking. The study took place in Dubai for the reason that the atmosphere there is a city in U.A.E that gives an importance through research to education and ready for such study that requires students who are familiar with the international educational benchmarking such as PISA and TIMSS.

Schools as the basic educational system requires change in their process of teaching. A change where they focus on how to make the new generation, reason and structure their logical thinking , be active rather than passive. The medium of the study in school X of segregated pupils, gives the opportunity to study the gender difference in using Polya's problem solving strategies as well as compare the performance of its pupils who are from different nationalities. Thus, giving the chance to investigate in the effect of problem solving in students thinking style, student's achievement, whether there is gender difference and cultural aspects that affect on students studying Problem solving.

Although the articles chosen that interested the researcher done in Pakistan, an Islamic country, and the Turkey, the country of rich civilization and is known by the connection between two civilizations, Europe and Asia, showed that problem solving, has

an effect on student's achievement through cooperative learning but no gender difference. However, this study showed that although the study was done on two classes of same level, of different nationalities, but same homogenous socio-economical backgrounds, there has been a significance in student's achievement and gender difference under cooperative learning and. Cultural significance was barely figured in this study due to the fact that students were of different nationalities but similar background. The cultural background cannot figure out whether student's socio economical status affects, however, it can strengths the study. Students result better achievement in the post-test than in the pre-test after they have been practicing on problems that required analysis, synthesis and evaluation through group work. They have structured methods like creating models or figurative language to understand the problems. They had learned how to share and discuss their ideas and express it as well.

The teaching strategy followed in this research that included group work on worksheets containing word problems under the umbrella of Bloom's taxonomy, the students were able to learn the pedagogy of reasoning. The total of correct answers of the questions in the post test were higher than the questions that involved, the cognitive skill of Bloom's taxonomy except the 4th cognitive skill of Bloom's taxonomy ,Analysis. When students acquire new skill of higher cognitive skill, it takes time not all students can pass this stage easily; it requires time that was against this investigation. However, some students accomplished this step and proceeded with the harder questions.

Two definitions correlate the reason of evolving societies, that is, thinking and critical thinking. As the process of constructing a purposed action or area defines the term thinking, it is a process that is used daily and cannot be ignored. Critical thinking, on the other hand, is term defined as thinking with awareness under logical self-evaluated process to reach the purposed action, creating intellectual standards for an individual. The process of creating an advanced thinking that contains observation rather than seeing, and evaluation in an individual is learnt through schools. Teachers do not need to assist students how to think because it is the obvious process done when the student is in need to find an answer. Instead, teachers have to teach them how to observe, analyze,

hypothesize, and experiment to understand why and how the answer of the purposed action exists, such that the student reaches at the highest level of awareness.

Recommendations and Limitations

The aim of the research has triggered different aspects, the importance of the involving problem solving in the curriculum of school, the primary educational organization, as well as focusing on problem-based learning through various instructions could be part of the world's evolution and change. However, the study of culture differences and its effect on the students' achievement as well as the use of language did not reveal anything. The sample size that participated in this research was of same cultural background, more periods needed to investigate deeply in the aspect of culture effect. Taking the fact that the student's native language is Arabic, where they learn their scientific subjects in English there is a need to study whether if the problems were explained or translated into Arabic would the students apply better results, than the students have done? Nevertheless, there are still Arabian countries that teach scientific subjects in Arabic, such as Syria and the public schools in some Middle Eastern countries, but no study showed how language, as the student needs language in order to understand the problem and formulate it, can affect on student's achievement in word problems.

References

- Ali, R., Hukamdad, Akhter, A., and Khan, A. (2010). Effect of using problem solving in teaching mathematics on the achievement of mathematics students. *Asian Social Science*, vol. 6(2), pp.67-72.
- Borromeo Ferri, R., Kaiser,G.(2003). *First Results of a Study of Different Mathematical Thinking Styles of Schoolchildren*. [online]. [Accessed 4 August 2002] Available at: <http://www.erzwiss.uni-hamburg.de/personal/gkaiser/pdf-publist/borromeo-kaiser.pdf>
- Dannawi, D. (2012). Mathematics curriculum analysis under Bloom's revised taxonomy: A case study.British University in Dubai, Dubai on 3 April 2012.
- Fedler, M.R., Brent, R. (2005).Understanding student differences, Journal of Engineering Education, vol.94 (1), pp.57-72.
- Gokahale, A.(1995), *Collaborative Learning Enhances Critical Thinking. Journal of Technology Education*[online].vol. 7(1) [Accessed 17 October 2012]. Available at: <http://scholar.lib.vt.edu/ejournals/JTE/v7n1/gokhale.jte-v7n1.html>
- Gok, T., and Silay, I. (2010). The effects of problem solving strategies on students' achievement, attitude and motivation. *Latin American Journal of Physics Education*, vol. 4(1), pp.7-21.
- Gulf News. (2009). *School ratings body to share results: Knowledge and Human Development Authority's aim is to boost performance further* [online]. [Accessed 23 November 2011] Available at: <http://gulfnews.com/news/gulf/uae/education/school-ratings-body-to-share-results-1.870541>
- Helal, M.(2009).*Educational Benchmarking: Dubai the Trends in Mathematics and Science Study 2007*.Dubai: Dubai Government School.

Holyoak, J.K., and Morrison, G.R. (2005). *The Cambridge Handbook of Thinking and Reasoning*. New York: Cambridge University Press.

Joppe, M. (2000). *The research process*. [online]. [Accessed 30 September 2012].

Available at: <http://www.ryerson.ca/~mjoppe?rp.htm>

Kaufman, C. J., Gallagher, M. A.(2005). *Gender differences in mathematics: An integrative psychological approach*. Cambridge: Cambridge University Press.

Keller, R., Concannon, T.(1998). Suggestions on teaching and learning . *Teaching Problem Skills*: Center for Teaching and Learning . University of North Carolina at Chapel Hill. June 1998.Wilson Library.

Kirk K.(2011). Self Efficacy: Helping Students believe in themselves. *Science Education Resource Center* [online]. [Accessed 12 March,2011] Available at:
<http://serc.carleton.edu/NAGTWorkshops/affective/efficacy.html>

Larwin, K.H. (2010). Reading is Fundamental in Predicting Math Achievement in 10th Graders. *International Electronic Journal of Mathematics Education* [online]. vol. 5(3) [Accessed 24 March 2011]. Available at: <http://www.iejme.com/032010/ab2.htm>

Logan, S. & Medford, E. (2011). Gender differences in the strength off association between motivation, competency beliefs and reading skill. *Educational Research* 53(1), March, pp.85-99, (online Eric)

Maalouf, J. (n.d). *Problem Solving Strategies Listed by Type* [online]. [Accessed 23 November, 2011] Available at:
<http://www.une.edu.au/bcss/psychology/john-malouff/problem-solving.php#clarify>

Ministry of education(MOE).(2012).[online].Dubai; MOE.[Accessed 25 April 2012].Available at: <http://www.moe.gov.ae/English/Pages/UaeEdu.aspx>

Sir Robinson, K. (2006). *RSA Animate - Changing Education Paradigms* [online]. [Accessed 5 June 2012] Available at: <http://www.youtube.com/watch?v=zDZFcDGpL4U>

Orlich, Donald, C., Harder, R. J, Callahan, R. C.(end). (2009). *Teaching strategies: A guide to a better Instruction*. Boston: Wadsworth Cengage Learning.

Paul, R. (1995). Critical Thinking: How to Prepare Students for a Rapidly Changing World. Dillon Beach: Foundation for Critical Thinking.

Reardon, T. (2001). Teaching problem solving strategies in the 5-12 curriculum: thank you George Polya [online]. [Accessed 6 November 2011] Available at: http://www.austintown.k12.oh.us/~aust_tr/PSS%20Teaching%20Problem%20Solving%20Strategies.pdf

Trochim, W. (2006). The Research Methods Knowledge Base. Cincinnati: Atomic Dog Publishing.

Zhang, Li-Fang, & Sternberg R. (2001). *Perspectives on Thinking, Learning and Cognitive Styles* . London: Erlbaum.

Appendices:

Appendix -A-

Table 1-
Nationalities of students in school X

Nationality	Female	Male	total	%
Algeria	4	0	4	0.161031
Bahrain	2	3	5	0.201288
Bosnia	0	1	1	0.040258
Bulgaria	1	0	1	0.040258
Canada	17	29	46	1.851852
Egypt	35	31	66	2.657005
France	0	1	1	0.040258
Germany	1	2	3	0.120773
Hungary	0	1	1	0.040258
India	3	1	4	0.161031
Iran	12	14	26	1.046699
Iraq	28	34	62	2.495974
Jordan	197	185	382	15.37842
Lebanon	111	137	248	9.983897
Libya	0	4	4	0.161031
Morocco	1	5	6	0.241546
New Zealand	3	1	4	0.161031
Pakistan	1	0	1	0.040258
Palestine	61	80	141	5.676329
Philippine	1	0	1	0.040258
Romania	2	0	2	0.080515

Russia	2	3	5	0.201288
Saudi Arabia	1	2	3	0.120773
Sudan	4	14	18	0.724638
Sweden	1	1	2	0.080515
Syria	94	115	209	8.413849
Tunisia	4	2	6	0.241546
UAE	591	572	1163	46.81965
USA	27	32	59	2.375201
Uzbekistan	0	1	1	0.040258
Yemen	2	7	9	0.362319
Total	1206	1278	2484	100

Appendix B:

Table 1- “Comparing countries performance in PISA 2009, mathematics.” The mean scores are in descending order. It shows that Dubai had the highest mean scores between the participant of the Arab countries. Source: OECD, 2009.

Pisa Results of some countries	Mathematics Mean Scores
Shanghai China	600
Dubai	453
Turkey	445
Jordan	387
Qatar	368
Kyrgyzstan	331
Pakistan	N.A

Appendix C-

Table -1-Characteristics of critical thinking :

"The chart below is an overview of the concept of critical thinking supported by thirteen years of research from the center of critical thinking and moral critique, Sonoma state university, California."

A unique kind of purposeful thinking	In any subject area or topic, whether academic or practical, requiring intellectual fitness training for the mind.
In which the thinker systematically and habitually	Actively develops Traits such as intellectual integrity, intellectual humility, Fairmindness, intellectual empathy, and intellectual courage.
Imposes criteria and Intellectual standards Upon thinking	Identifies the criteria of solid reasoning, such as precision, relevance, depth, accuracy and establishes a clear standard by which the effectiveness of the thinking will be finally assessed.
Taking charge of the construction of thinking	Awareness of the elements of thought such as assumptions and point of the view, that are present in all well-reasoned thinking, a conscious, active and disciplined effort to address each element displayed.
Guiding the construction of the Thinking according to the standards	Continually assessing the cause of construction during the process, adjusting, adapting, improving, using the candles of criteria and standards to light the way.
Assessing the effectiveness of the thinking according to the purpose, the criteria and the standards	Deliberately assessing the thinking to determine its strengths and limitations, according to the defining purpose, criteria and standards, studying the implications for further thinking and improvement

Appendix D

Table 1-Critique checklist for article 1(The effect of Problem solving strategies on students' achievement, attitude and motivation, 2010) and article 2 (Effect of using problem solving method in teaching mathematics on the achievement of mathematics students, 2010) -Source: ASRT quantitative research manuscript checklist.

	Article 1			Article 2		
Skills	Yes	No	N/A	Yes	No	N/A
Topic						
Validates or adds on the body of knowledge	✓			✓		
Title						
Clearly states the theme or purpose of the article	✓			✓		
Concisely states theme or purpose of the article	✓			✓		
Abstract concisely summarizes the following						
Introduction	✓			✓		
Methods	✓			✓		
Results	✓			✓		
Conclusion	✓			✓		
Introduction						
States the problem or need	✓				✓	
Describes relevance to practice	✓				✓	
Presents relevant background material	✓			✓		
Clearly states the purpose of the research	✓			✓		
Literature Review						
Describe the literature search	✓				✓	
Presents a thorough review of the literature	✓				✓	
Provides a critical assessment of the literature	✓			✓		
Defines a problem	✓			✓		
states research question or hypothesis	✓			✓		
Provides definitions	✓			✓		

Provides assumptions	✓		✓
Methods or Procedure			
A-Research design			
Identifies a research design	✓		✓
Uses appropriate research design	✓		✓
B-Sample			
Defines a population, if appropriate		✓	✓
Describes sampling selection process	✓		✓
Uses an appropriate size sampling		✓	✓
Minimizes sampling error	✓		✓
C-Includes a description of the data gathering procedure	✓		✓
D-Instrumentation			
Describes instrument	✓		✓
Describes validity	✓		✓
Describes reliability	✓		✓
Reports reliability	✓		✓
E-Describes statistical tests relevant to the research question or hypothesis			
F-Uses appropriate statistical evaluation tools	✓		✓
Results			
Describes demographic of sample		✓	✓
Reports results of statistical analysis related to each research question or hypothesis	✓		✓
Demonstrates objectivity in reporting results	✓		✓
Discussion			
Draws conclusion supported by the findings of the study	✓		✓
Integrates findings with related literature	✓		✓
Discusses implications of results for practice		✓	✓
Identifies limitations of the study		✓	✓
Suggests directions for future research		✓	✓

Summarizes conclusions	✓		✓	
Figures and Tables				
Provides figures and tables of sufficient quality	✓		✓	
Provides a sufficient number of figures and illustrations	✓		✓	
figures and tables do not require revision	✓		✓	
Style				
Is organized and has logical flow	✓		✓	
Use appropriate and current terminology	✓		✓	
References				
Use timely or historically significant references	✓		✓	
Contains appropriate references to support material presented	✓		✓	
Includes sufficient references	✓		✓	

Appendix E:

The letter that students signed and approved in participating in the investigation. In addition, the questionnaire students answered concerning the data of their socio economical background.

Date Jan 16,2012

Dear Student,

As a postgraduate in educational research in British University in Dubai, I am preparing for an action research in this school as a data collection for my dissertation : MEd. (Master of education)-International management and policy studies in education, during the term II 2012. This research focuses on the effect of problem solving on students' achievement in mathematics so your participation and your attendance will be my case study.

Moreover, Ethical consideration will take part of the research, that is :

- No names or papers of the participants and the school will be mentioned.
- Participants will be acknowledged about the progress of this action research.
- The data collected from the participants, volunteers, will be preserved confidentially.
- The permission of the students and their written consent will be secured before the research commences.
- As a further notice this research will not affect your report card; however it will be a good experience.

Your participation is important in attaining a better research and conducting my action research successfully.

Thank you for your cooperation; it is highly appreciated.

Sincerely yours,

Dana Dannawi

Student's Signature:.....

Please find the following questions to be answered

Purpose : The following of this questionnaire is a tool that to have a better understanding of the social background of the class that will be under study. The questionnaire contains general questions respecting the privacy of each individual.

Name (optional)	Gender:	Age:	Nationality

-Number of years you are in UAE:

-Number of years you are in this school :

-Please circle the number of brothers and the number of sisters and fill down the age of each in the table below:

Number of brothers: **1-2-3-4-5, other:** _____

Number of sisters: **1-2-3-4-5, other:** _____

Age of each brother in decreasing order (yrs)									
Age of each sister in decreasing order (yrs)									

Father's highest degree in education	Mother's highest degree in education
(Please tick one box only) <input type="checkbox"/> Never went to school <input type="checkbox"/> Completed some primary school <input type="checkbox"/> Completed all of primary school <input type="checkbox"/> Completed some secondary school <input type="checkbox"/> Completed all of secondary school <input type="checkbox"/> Completed college/university <input type="checkbox"/> Completed post-graduation (masters) <input type="checkbox"/> Don't know	(Please tick one box only) <input type="checkbox"/> Never went to school <input type="checkbox"/> Completed some primary school <input type="checkbox"/> Completed all of primary school <input type="checkbox"/> Completed some secondary school <input type="checkbox"/> Completed all of secondary school <input type="checkbox"/> Completed college/university <input type="checkbox"/> Completed post-graduation (masters) <input type="checkbox"/> Don't know
-Occupation of your father can be defined (Please tick only one box)	-Occupation of your mother can be defined (Please tick only one box)

<input type="checkbox"/> professional and managerial	<input type="checkbox"/> professional and managerial
--	--

- clerical and sales
- skilled blue-collar
- semi-skilled and unskilled

Father's work position:

- clerical and sales
- skilled blue-collar
- semi-skilled and unskilled

Mother's work position:

-**Do you have your private room?** Yes No

-**Do you have a mobile?** Yes No

-**Your pocket money per week ranges between**

- Below 50 Dhms
- within 50 Dhms & 100 Dhms
- Above 100 Dhms

Other: _____

-About how many books are there in your home? (Do not count newspaper or magazines. Please tick one box only)

- None
- 1-10
- 11-50
- 51-100
- 101-200

<input type="checkbox"/> More than 200
--

-Which of the following are at your home?(Please put tick beside each)

<input type="checkbox"/> Television set	<input type="checkbox"/> Car
<input type="checkbox"/> Video games	<input type="checkbox"/> Radio
<input type="checkbox"/> Computer	<input type="checkbox"/> telephone
	Other : _____

Math Student Background Information:

1-Does your family get any magazines regularly? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know.	2-Is there an encyclopedia in your home? It could be a set of books, or it could be on the computer. <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know.
3-About how many pages a day do you have to read in school and for homework? <input type="checkbox"/> 5 or fewer <input type="checkbox"/> 6–10 <input type="checkbox"/> 11–15 <input type="checkbox"/> 16–20 <input type="checkbox"/> More than 20	4-How often do you talk about things you have studied in school with someone in your family? <input type="checkbox"/> Never or hardly ever <input type="checkbox"/> Once every few weeks <input type="checkbox"/> About once a week <input type="checkbox"/> Two or three times a week Every day
5-How often do people in your home talk	6-How often do you use a computer for

to each other in an English language? <input type="checkbox"/> Never <input type="checkbox"/> Once in a while <input type="checkbox"/> About half of the time <input type="checkbox"/> All or most of the time	math at school? <input type="checkbox"/> Never or hardly ever <input type="checkbox"/> Once every few weeks <input type="checkbox"/> About once a week <input type="checkbox"/> Two or three times a week <input type="checkbox"/> Every day or almost every day
7-Do you use a computer for math homework at home? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	8-Do you use the Internet at home? <input type="checkbox"/> Yes <input type="checkbox"/> No
9-Do you use a computer to practice or drill on math? <input type="checkbox"/> Yes <input type="checkbox"/> No	10-Do you use a computer to make charts or graphs for math? <input type="checkbox"/> Yes <input type="checkbox"/> No
11-Do you use the Internet to learn things about math? <input type="checkbox"/> Yes <input type="checkbox"/> No	12-Do you use a computer to play math games? <input type="checkbox"/> Yes <input type="checkbox"/> No
13-How often do you use e-mail, instant messages, blogs, or text messages to get help with math from someone other than your teacher, family, classmates, or friends? <input type="checkbox"/> Never or hardly ever <input type="checkbox"/> Once or twice a month <input type="checkbox"/> Once or twice a week <input type="checkbox"/> Every day or almost every day	14-How often do you feel your math class work is too hard? <input type="checkbox"/> Never or hardly ever <input type="checkbox"/> Sometimes <input type="checkbox"/> Often <input type="checkbox"/> Always or almost always
15-Do you study or do work for math at an after-school or tutoring program?	16-How often do you feel your math class work is too easy?

<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Never or hardly ever <input type="checkbox"/> Sometimes <input type="checkbox"/> Often <input type="checkbox"/> Always or almost always
17-How often do you feel you can do a good job on your math assignments? <input type="checkbox"/> Never or hardly ever <input type="checkbox"/> Sometimes <input type="checkbox"/> Often <input type="checkbox"/> Always or almost always	18-How often do you like what you do in class for math? <input type="checkbox"/> Never or hardly ever <input type="checkbox"/> Sometimes <input type="checkbox"/> Often <input type="checkbox"/> Always or almost always
19-How often do you feel you like math? <input type="checkbox"/> Never or hardly ever <input type="checkbox"/> Sometimes <input type="checkbox"/> Often <input type="checkbox"/> Always or almost always	20-How often do you feel math is one of your favorite subjects? <input type="checkbox"/> Never or hardly ever <input type="checkbox"/> Sometimes <input type="checkbox"/> Often <input type="checkbox"/> Always or almost always
21-How important is it to you to do well on a math test? <input type="checkbox"/> Not very important <input type="checkbox"/> Somewhat important <input type="checkbox"/> Important <input type="checkbox"/> Very important	

Appendix F

Name : _____ Word Problems Test (1) _____ Date: _____
Grade 10 _____

Solve each problem from 1 to 6. Please Justify your answer in the box obtained (Explain).

Question 1: Exchange Rate

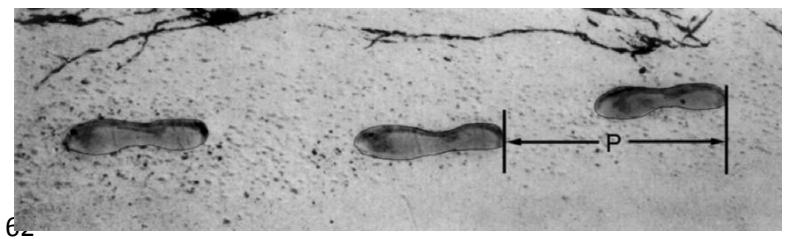
Dima found out that the exchange rate between U.S. dollars (\$) and U.A.E dirham (Dhm) was: 1 \$ = 3.8 Dhm.

Dima changed 3000 U.S. dollars into dirham at this exchange rate.

How much money in dirham did Dima get?

Question 2: Walking

The picture shows the footprints of a man walking. The pace length P is the distance between the rear of two consecutive footprints. For men, the formula, $\frac{n}{P} = 140$



gives an approximate relationship between n and P where,
 n = number of steps per minute, and
 P = pace length in meters.

If the formula applies to Fadi's walking and Fadi takes 70 steps per minute, what is Fadi's pace length?.

Question 3: Apples

A farmer plants apple trees in a square pattern. In order to protect the apple trees against the wind he plants conifer trees all around the orchard. Here you see a diagram of this situation where you can see the pattern of apple trees and conifer trees for any number (n) of rows of apple trees:

$n = 1$	$n = 2$	$n = 3$	$n = 4$
X X X	X X X X X	X X X X X X X X	X X X X X X X X X X
X • X	X • • X	X • • • X	X • • • • X
X X X	X X	X X	X X
	X • • X	X • • • X	X • • • • X
	X X X X X	X X	X X
		X • • • X	X • • • • X
		X X X X X X X	X X X X X X X X
			X • • • • X
			X X X X X X X X X

X = conifer tree
• = apple tree

There are two formulae you can use to calculate the number of apple trees and the number of conifer trees for the pattern described above:

$$\text{Number of apple trees} = n^2$$

$$\text{Number of conifer trees} = 8n$$

where n is the number of rows of apple trees.

There is a value of n for which the number of apple trees equals the number of conifer trees. **Find the value of n and show your method.**

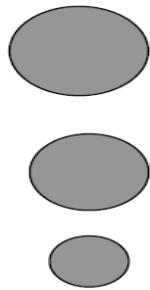
Question 4: Coins

You are asked to design a new set of coins. All coins will be circular and colored silver, but of different diameters.

Researchers have found out that an ideal coin system meets the following

requirements:

- diameters of coins should not be smaller than 15 mm and not be larger than 45 mm.
- given a coin, the diameter of the next coin must be at least 30% larger.
- the minting machinery can only produce coins with diameters of a whole number of millimeters (e.g. 17 mm is allowed, 17.3 mm is not).



You are asked to design a set of coins that satisfy the above requirements.

You should start with a 15 mm coin and your set should contain as many coins as possible. **What would be the diameters of the coins in your set?**

Question 5: The Best Car.

A car magazine uses a rating system to evaluate new cars, and gives the award of “The Car of the Year” to the car with the highest total score. Five new cars are being evaluated, and their ratings are shown in the table.

Car	Safety Features (S)	Fuel Efficiency (F)	External Appearance (E)	Internal Fittings (T)
Ca	3	1	2	3
M2	2	2	2	2
Sp	3	1	3	2
N1	1	3	3	3
KK	3	2	3	2

The ratings are interpreted as follows: 3 points = Excellent, 2 points = Good, 1 point = Fair

To calculate the total score for a car, the car magazine uses the following rule, which is a weighted sum of the individual score points:

$$\text{Total Score} = (3 \times S) + F + E + T$$

The manufacturer of car “Ca” thought the rule for the total score was unfair.

Write down a rule for calculating the total score so that Car “Ca” will be the winner.

Your rule should include all four of the variables, and you should write down your rule by filling in positive numbers in the four spaces in the equation below.

$$\text{Total score} = \dots \times S + \dots \times F + \dots \times E + \dots \times T$$

Question 5 : Number Cubes

On the right, there is a picture of two dice.

Dice are special number cubes for which the following rule applies:

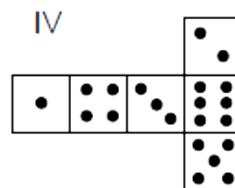
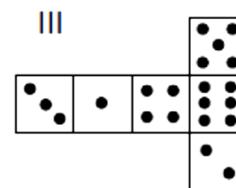
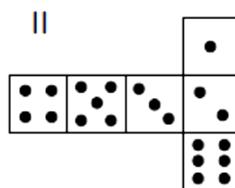
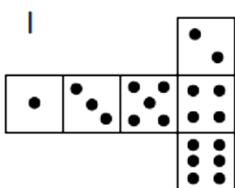
The total number of dots on two opposite faces is always seven.

You can make a simple number cube by cutting, folding and gluing cardboard. This can be done in many ways. In the figure below you can see four cuttings that can be used to make cubes, with dots on the sides.



Which of the following shapes can be folded together to form a cube that obeys the rule that the sum of opposite faces is 7?

For each shape, circle either “Yes” or “No” in the table below.



Shape	Obeys the rule that the sum of opposite faces is 7?
I	Yes / No
II	Yes / No
III	Yes / No
IV	Yes / No

Appendix G

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Posta	32.17	6	20.547	8.388
	Prea	21.8333	6	15.76600	6.43644
Pair 2	Preb	10.8333	6	10.60974	4.33141
	Postb	6.5000	6	7.94355	3.24294
Pair 3	Prec	15.0000	6	12.32883	5.03322
	Postc	13.1667	6	14.98555	6.11782
Pair 4	Pred	6.1667	6	7.25029	2.95992
	Postd	4.5000	6	6.25300	2.55278

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1 "a"	Posta & Prea	6	.902	.014
Pair 2	Preb & Postb	6	.818	.047
Pair 3	Prec & Postc	6	.949	.004
Pair 4	Pred & Postd	6	.946	.004

Paired Sample T-Test	Paired Differences					t	df	Sig. (2-tailed)			
	95% Confidence Interval of the Difference										
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper						
Pair "a" Pre-test - Post-test	10.33333	9.30949	3.80058	.56362	20.10305	2.719	5	.042			
Pair "b" Pre-test - Post-test	4.33333	6.15359	2.51219	-2.12446	10.79113	1.725	5	.145			
Pair "c" Pre-test - Post-test	1.83333	5.07609	2.07230	-3.49369	7.16036	.885	5	.417			
Pair "d" Pretest - Postest	1.66667	2.42212	.98883	-.87519	4.20853	1.685	5	.153			