International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

EXPERIMENTAL STUDY OF THE EFFECTS OF GEORGE POLYA'S PROBLEM-SOLVING MODEL ON STUDENTS' PROBLEM-SOLVING ABILITY AND MATHEMATICAL PERFORMANCE

BEHNOUSH TAHERI[1*], SEPIDEH MORADPOUR[1], ALI RAHMATI[1], AMIR HOSSEIN PASHA[2]

[1]Department of Mathematics Science and Research Branch, Islamic Azad University, Tehran, Iran;

behnoush_taheri@yahoo.com

[2]Department of GIS & RS Science and Research Branch, Islamic Azad University, Tehran, Iran

ABSTRACT

In solving every problem, the problem-solver discovers something, and depending on the size of this discovery, a glorious happiness and joy fills his or her heart. Regarding the importance of problem-solving, not only in mathematics, but in a person's whole life, it's appropriate to think about this important issue and effecting factors on it. This analysis has been done with the aim of investing the effect of George Polya's problem-solving model on problem-solving performance and ability of students. Statistical sample of this research is the third year female students of high schools in district 3, Kermanshah, Iran; and the statistics population is 120 people. This study has been done on the two groups of experimental and control, and also on examination of pre and post conducting of the model. In collecting data for this study, the standard Heppner and Peterson questionnaire for measuring the problem-solving ability of students and a math test for getting information on math function of the students. The research results showed that with contacting the George Polya's problem-solving model, their three ability of confidence in solving the problem, approach-avoidance style and self-control, all improves. It also led to this conclusion that conducting the George Polya's problem-solving model has a positive effect on math problem-solving of the students.

Key words: problem-solving, mathematics, ability, performance

INTRODUCTION

Learning to solve problems is an important goal in learning mathematics. Because problems are inevitable in a person's life (Patton, Cronin, Bassett, & Koppel, 1997). One of the main goals in teaching mathematics is developing the problem-solving abilities of the student in this field. For solving a problem, the student has to think about it and decide how to use the apt ways. The success of the students in getting to their goals leads to positive view of mathematics and cultivating the problem-solving activities in them (Zakaria & Yusoff, 2009). Now this question comes to mind: What is exactly a problem? A problem is a situation that one should find a solution for, a solution not previously known to him or her. There are three conditions for a situation to be a problem: first, one should be able to find a clear goal as the solution of the problem; second, there should be an obstacle in the way to the solution; and third that the first two urges the person to find some ways for removing the obstacles (Krulik & Rudnick, 1996). Problems occur when the problem solver in a particular situation has some difficulty in switching the problem in a desirable goal and this is named the problem solution discovery process (Mayer & Wittrock, 1996). The problem is essentially a mental matter, meaning the thing that is a problem to somebody might be a trivial exercise to somebody else (Dollah, 2006).

Problem-solving is four parts: cognitive, process based, purposive and personal. Problem-solving is cognitive because it perceives by behavior. It is process based because it needs the transferring of knowledge. It is purposive because it is about to gain a goal and it is not possible to gain that goal directly. And in the end, because of the knowledge and the abilities of every single person, it is personal (Baker & Mayer, 1999).

These following four are necessary for an effective problem-solving: It should have information about content knowledge; it should have a specific mental state for advancing the problem-solving ways; it should have self-awareness and evaluate its advancement; and finally, it should be excited up by effort and self-efficiency (O'Neil, 1999).

One of the problem-solving models is George Polya's problem-solving model. This model involves four stages:

1. Understanding the problem: What's the X? What is the data? What is the condition? Is problem's condition enough for defining the X?

2. Charting the Plan: Find the connection between data and X. you might have to find an auxiliary problem if a direct connection between data and X was not found. You have to design a plan for solving the problem in the end.

3. Executing the Plan: Examine every step during executing the plan. Is the Step taken correct? Can you prove its correctness?

4. Take a Look Back: Examine the answer you've found. Can you gain the same result from another rout? (Polya, 2009)

Educational development in mathematics involves defining the problems that are in the way of students learning in this field. Problems imposed to the student in learning mathematics have either a source in mathematics or outside of it. And Problems outside mathematics are either inside-personality or outside-personality. Inside personality problems rise from student's personal characteristics in mental process, learning, motivations and mentalities, while outside personality problems rise from cultural, social and educational factors and the condition of teaching, teachers' behavior… (Alam ol hodaee, 2002). One of the effective inside personality factors in educational development in mathematics is motivational and cognitive factors. In a lot of early studies about students learning and success, motivational and cognitive factors are studied separately. At least since 1980, studies are focused on how motivational and cognitive factors mutually influence on students' learning and success (Linnenbrink & Pintrich, 2002). In recent years, problem-solving has been studied with different variables and in various fields, including mathematics. This has some reasons. One is that mathematics has a special place in curriculums. Moreover, mathematics has a significant and important role in evaluating development, and plays the role of an important sift for students who are about scientific and technical jobs in universities (Pajares & Graham, 1999).

Today the importance of problem-solving abilities is clear to everyone. Its importance has specially increased in the ever changing world of today. The higher students go in the educational system, especially in the college, the more they should find their own learning and problem-solving abilities, so they depend less on their teachers and professors (Boekaerts, 1997). The problem-solving ability of people is linked to their focus on problem and self-evaluation (Heppner, Baumgardner, & Jakson, 1985). If the

problem-solving ability is a cognitive activity, then improvement of the problem-solving ability by education should be a valuable goal (Seminara, 1996). Michael Marland (1991) in his definition of a powerful person says:

1. A Powerful Person is someone who can recognize and define the questions at the heart of the problem.

2. Be continually after theoretic sources, debate and gaining information.

3. Be able to collect the most important sources and information.

4. Organize the results effectively.

5. And eventually, be able to deliver an appropriate report (Lawrence, 2005).

These informational abilities never appear on their own, but they should be teached and introduced by educational and learning processes. In the course of controlling the information, students not only learn things about results of the research, but by learning the very process of learning, understand what is needed in a study-based attitude to problem-solving. Controlling the information is a mutual process that enables students to develop and cultivate their learning independence, not as information consumptive humans and observers, but as creative individuals (Lawrence, 2005).

Though mathematics has always been emphasized, students' abilities in it was also always in question (Zakaria & Yusoff, 2009). The results of Schoenfeld study (1985) shows that students are not really weak in solving the problems, but lack the necessary abilities for solving special problems (Schoenfeld, 1985). The most important problem of students in the middle school about mathematics is their inability in understanding the problem. About 98% of the students confirmed that they have some problem in understanding what the question wants from them. Students pay little attention to the guidelines that are needed for answering the problem (Zakaria & Yusoff, 2009). Manouchehri & Goodman (1988) say that learners weakness in all educational stages of mathematics, from elementary school to the college are connected to their weakness in problem-solving (Manouchehri & Goodman, 1988).

Roni (2010) in his research says that students in high school usually can't use their knowledge for defining and predicting concepts, and are disable to solve the new problems. This issue is caused by this fact that teachings in classes lacked the appropriate and suitable qualitative strategies for reasoning (Roni, 2010).

The questions of this study can be described as:

1. Does conducting the George Polya's problem-solving model have any effect on problem-solving abilities of the students?
2. Does conducting the George Polya's problem-solving model have any effect on mathematics performance of the students?

Research Tools

Three structures in problem-solving process described by Heppner are: Feeling adequate in solving the problem, personal control on excitements and behaviors, and approach-avoidance styles. Also in this filed various research and theoretic proofs about metacognition parameters, specially an evaluation as an affecting parameter in solving the problem was proposed. The questionnaire about problem-solving by Heppner and Peterson (1982) has 35 entries for examining the person's understanding of his or her problem-solving behaviors, which is designed to evaluate the person's reactions to their daily problems (PSI).

The problem-solving questionnaire based on factor analysis rotation has 3 separate subscales:

PSC problem-solving confidence with 11 phrases, AA approach-avoidance style with 16 phrases, PC personal control with 5 phrases.

Problem-solving questionnaire has been designed and tested with several triables. It has relatively high internal similarity with alpha rates between 0.72 to 0.85 in subscales and 0.72 PC, 0.84 AA, 0.85 PSC and 0.90 in the whole scale. The validity of the test showed that these tools evaluate the structures that are related to personality variables and significantly control centered. Test-retest reliability of the total score of the questionnaire in two-week was reported in the range of 0.83 to 0.89, which indicates that the problem-solving questionnaire is a reliable tool for measuring the problem-solving ability. (Heppner & Anderson, 1985).

Participants:

The statistics population of this study is all the third year female students of high schools in district 3, Kermanshah, Iran, for the 2014-15 school year. In this study sampling method was cluster-like, meaning 2 high schools among female high schools of district 3, Kermanshah were selected and some of the third year students of these high schools were analyzed. The sample size was selected from the statistics population by Cochran formula; 120 third grade students who this study has be conducted on them.

Research conduction method:

For gathering data, schools were approached and classes where selected. Two classes where experimental group and two classes where control group. Problem-solving ability evaluation questionnaires were used to obtain required. After entering the classes, first the students' list was prepared and then the purpose of the research, the number and duration of response to their questionnaire explained to the students and then they were given the questionnaires and were asked to carefully respond to the questions. After about 40 minutes, the questionnaires were collected from all at once. After collecting the questionnaires, final math test results of students in last semester were taken from teacher. After that George Polya's problem-solving model was implemented on the experimental group; two classes of students in the second semester of the academic year. After the second semester, schools were approached again and after that experimental group and the control group answered to the problem-solving abilities questionnaire, their math results of the second semester was taken from the teacher.

Findings:

In Table 1, it is investigated that how normal is the results obtained in all three components of Heppner questionnaire, before and after the George Polya's model was executed in both experimental and control groups. It's obvious that all the data are normally distributed. Thus parametric tests were used.

In Table 2, confidence in problem-solving component in two groups of experimental and control is analyzed by T-test. In both groups, before and after using the George Polya's model, P/obtained values that are more than 0.50, will be accepted based on equal variances.

Table 1: Evaluating the Normality of the Data in the Experimental and Control Groups

		Confidence in Problem-solving	Approach-Avoidance style	Personal Control
The Normality of the Data of the Pre-Test	Average	28.2000	44.1500	13.7250
	SD (standard deviation)	8.69188	8.70764	5.01274
P – Pre-Test Value		.611	.604	.789
The Normality of the Data of the Post -test	Average	31.8750	47.9250	17.4250
	SD (standard deviation)	8.05808	7.95303	4.74956
P – Post-Test Value		.519	.791	.771

Table 2: T-test Results for Evaluating Differences in Confidence in Problem-Solving, in Experimental and Control Groups

		Levene's Test for Equality of Variances		T-Test for Equality in Averages				
		F Statistics	P Value	T Statistics	Degrees of Freedom	P Value	Average Difference	Standard Error

Confidence in Problem-Solving Ability – Before the Test	**If the Variance is Equal**	**2.059**	**.160**	**-3.569**	**38**	**.001**	**-8.60000**	**2.40985**
	If the Variance is not Equal			**-3.569**	**37.135**	**.001**	**-8.60000**	**2.40985**
Confidence in Problem-Solving Ability – After the Test	**If the Variance is Equal**	**1.514**	**.226**	**-2.437**	**38**	**.020**	**-5.85000**	**2.40074**
	If the Variance is not Equal			**-2.437**	**37.473**	**.020**	**-5.85000**	**2.40074**

As you can see, because P - obtained value in testing equality in averages - is less than 0.50, two groups' averages should be examined in Table 3.

Table 3: Evaluating the Average of Confidence in Problem-Solving Results in the Experimental and Control Groups

	Code	**Average**	**SD of the Average**
Confidence in Problem-Solving Abilities – Before the Test	**Experimental Group**	**23.9000**	**1.82944**
	Control Group	**32.5000**	**1.56861**
Confidence in Problem-Solving Abilities – After the Test	**Experimental Group**	**28.9500**	**1.79543**
	Control Group	**34.8000**	**1.59374**

Studying table 3, we can see that the average results of confidence in problem-solving abilities in control group class, before and after the execution of George Polya's model is better than the results of the test group. The study of before and after implementing the model in each group shows that results have improved after running the model, and improvement of the results in the experimental group was significantly higher than the increase in its control group. So implementing George Polya's model had positive effect on increasing confidence in problem-solving ability in the experimental group.

Table 4: T-test Results for Evaluating the Differences of Approach-Avoidance Style in Experimental and Control Groups

		Levene's Test for Equality of Variances		**T-Test for Equality in Averages**				
		F Statistics	**P Value**	**T Statistics**	**Degrees of Freedom**	**P Value**	**Average Difference**	**Standard Error**
Approach-Avoidance Style- Before the Test	**If the Variance is Equal**	**.007**	**.932**	**-4.880**	**38**	**.000**	**-10.65000**	**2.18219**

	If the Variance is not Equal			-4.880	37.843	.000	-10.65000	2.18219
Approach-Avoidance Style –After the Test	**If the Variance is Equal**	.098	.757	-3.472	38	.001	-7.70000	2.21757
	If the Variance is not Equal			-3.472	37.523	.001	-7.70000	2.21757

In Table 4, approach style component in both experimental and control groups were analyzed using T-test. In both groups, before and after the execution of George Polya's model, P, the value calculated by Levene's test is more than 0.50. This leads to accept the assumption of equality of variances. By studying the table for equality of the averages, we observe that P Values in this test are less than 0.50, so the two groups are evaluated in Table 5.

Table 5: Evaluating Average Results of Approach-Avoidance Style in Both Experimental and Control Groups

	Code	Average	SD of the Average
Approach-Avoidance Style – Before the Test	**Experimental Group**	38.8500	1.49257
	Control Group	49.5000	1.59192
Approach-Avoidance Style – After the Test	**Experimental Group**	44.0500	1.47697
	Control Group	51.7500	1.65414

As shown in Table 5, average approach style results of the control group class, before and after implementing George Polya's model, was better than results of the experimental group. Examining before and after implementing the model in each group showed that the results have improved. The improvement rate of the results in the experimental group was about 6 points and in the control group was about 2. In general, applying George Polya's model has been effective in increasing approaching style of the students and had more effect in improving the approaching style of the experimental group.

In Table 6 , personal control components in both experimental and control groups were analyzed using T-test. In both groups, before and after the implementation of George Polya's model, P/obtained values more than 0.50, was be accepted based on equal variances. It can be seen, because P/obtained value in the test is less than 0.50, the average of two groups should be examined in Table 7, but after the test, it is observed that P/obtained value provided more than 0.50. So the equality of the two group's average will be accepted in this area.

Table 6: T-test Results for Evaluating the Differences of the Personal Control Components in Both Experimental and Control Groups

		Levene's Test for Equality of Variances		T-Test for Equality in Averages				
		F Statistics	P Value	T Statistics	Degrees of Freedom	P Value	Average Difference	Standard Error
Personal Control – Before the Test	If the Variance is Equal	.254	.618	-2.930	38	.006	-4.25000	1.45036
	If the Variance is not Equal			-2.930	37.741	.006	-4.25000	1.45036
Personal Control – After the Test	If the Variance is Equal	1.005	.323	-.897	38	.376	-1.35000	1.50573
	If the Variance is not Equal			-.897	37.254	.376	-1.35000	1.50573

By examining Table 7 in the pre-test, we see that the average results of personal control in the control group is higher than experimental group's results; also in the post-test average results are almost equal. Comparison of two groups before and after implementing the model shows that the average results of the control group after implementation of George Polya's model not much has changed; while the results in the experimental group increased significantly. So we can conclude that George Polya's model had a significant impact on students' personal control.

Table 7: Evaluating the Average of Personal Control in Both Experimental and Control Groups

	Code	Average	SD of the Average
Personal Control – Before the Test	Experimental Group	11.6000	1.06721
	Control Group	15.8500	.98214
Personal Control – After the Test	Experimental Group	16.7500	1.13758
	Control Group	18.1000	.98649

In Table 8, the math performance level in both experimental and control groups were analyzed using T test. P/obtained value by Levene's test is accepted with the assumption of equality of variances. As you can see, P/obtained value is more than 0.50 in T-test and this indicates the equality of the averages. So the Math performance average of two groups, before implementing the model was equal, meaning two groups were almost at the same educational level.

Table 8: T-Test Results for Evaluating Differences of Math Performance in Both Experimental and Control Groups

		Levene's Test for Equality of Variances		T-Test for Equality in Averages				
		F Statistics	P Value	T Statistics	Degrees of Freedom	P Value	Average Difference	Standard Error
Math performance – Before the Test	**If the Variance is Equal**	.390	.536	-.356	38	.724	-.20000	.56195
	If the Variance is not Equal			-.356	37.717	.724	-.20000	.56195

To investigating the mathematical performance of the experimental and control groups, before and after implementation of George Polya's model, a paired test was used, which its results can be seen in Table 9. According to the P/obtained value of the experimental group, the equality of the averages is accepted and as you see, math performance difference of the students in this group is very low, about 0.65.

Because P/obtained value in the control group is less than 0.50, the equality of the average assumption in this group is rejected. The more detailed evaluating the mathematical performance averages of the two groups are presented in Table 10.

Table 9: Pair Test Results for Evaluating Mathematical Performance of Both Experimental and Control Groups, Before and After Implementation of the Model

	Average Difference	T Statistics	Degrees of Freedom	P Value
Math Performance – Experimental Group	.65000	1.332	19	.199
Math Performance – Control Group	2.45000	3.741	19	.001

As you can see in Table 10, despite to increased volume and difficulty of the course material in the second semester, math scores in the experimental group had not such significant reduction after implementating the model. So it follows that implementating George Polya's model was effective and has prevented students from backsliding; while mathematics performance average of the control group in the second semester, after the model run had significantly declined, which suggests to increased volume and difficulty of the course material had a negative effect on the scores of the control group.

Table10: Evaluating Average of Mathematical Performance in both Experimental and Control Groups, Before and After Implementing the Model

	Code	Average	SD of the Average
math performance – Experimental Group	**Before Test**	18.2000	.41422
	After Test	17.5500	028539
math performance – Control Group	**Before Test**	18.4000	.37975
	After Test	15.9500	.52050

DISCUSSION AND CONCLUSION

The main responsibility of professionals and researchers in the mathematics education, is to study about how the learners achieve mathematics knowledge, and an educator's goal is to improve the mental perspective and learning experience of the students or be about to find the source of students failure in learning. One of the objectives of mathematics education is to fertilize mathematical thinking is, and problem-solving ability is one way to do so. According to Polya, one's beliefs shape him or her a mathematics global perspective and she will be able to take math and math activities based on that perspective (Polya, 2009). If this method can change one's belief in the parameters studied, a helpful step was taken toward changing the students' mathematical point of view and therefore improvement of their mathematical activities. In general, there are two perspectives on problem-solving in mathematics education. Sometimes math lessons that use problem-solving are seen as an approach, in which students must increase their skills and problem-solving strategies, and teachers don't pay particular attention to developing concepts and mathematical skills. In this interpretation of problem-solving lessons, the class usually ends when each student gets to the solution and the teacher's role in the solution is to help students find solutions through using effective strategies, because the main goal of the lesson is to solve problems by students.

On the other hand, problem-solving can be seen as a powerful approach to developing mathematical skills and concepts; so in this approach, teachers in addition to the developing the problem-solving strategies, teach the mathematical skills, concepts and methods. As a result, in this approach the lesson's plan, in addition to teaching problem-solving strategies, also pursues content goals. The second approach is usually called learning through problem-solving. In structured problem-solving approach, it is emphasized that the most important role of teachers in the course of the education is in facilitating the mathematics after the solution was found by each of the students. It means that at the beginning of the students, individually and using their own math knowledge work on the problem and then offer various solutions and approaches to it. It is natural to find different solutions, because the teacher presented a problem to the class, without suggesting a method. So what's in the textbooks are the common approach and ideas of the students. As the target of structured problem-solving

approach is developing students' understanding of mathematical concepts and skills, the teacher is expected to compare solutions for the class through some discussions, and guide students. For this, and as part of their lesson plan, teachers need to have a clear plan for these discussions that anticipate the variety of solutions of the students. This anticipation of the solutions, not only is the most effective method, but also involves the solutions gained as the result of students' misunderstanding (Takahashi, 2007).

Memorization in a meaningless way, and cannot lead to any results in the development of thinking and problem-solving skills. Schools' curriculums should focus their programs on methods in which students learn how to learn through intellectual discipline, rather than just learning. Educational environments have a critical role in realization of these goals and should be organized so that instead of storing scientific facts, students get involved in problem-solving - problems that has a connection with their real lives - because innovative methods adapted to life, make educational situations more attractive, increases students' interest and effort in learning, and lead to educating competent people in schools (Fathi azar & Heydari far far, 2011). To care about the

students' studies and providing enough opportunity to research, collecting data, analysis and discussion with peers leads to training higher levels of thinking in students (Yang & Cheng, 2009).

The results of this study, related to the impact of the implementation Polya's problem-solving model on problem-solving ability suggests that compared to the students of control group, this model had a positive and additive effect on this ability of students in the experimental group. Running this model improves their abilities in all three fields of confidence in the problem-solving, approach-avoidance style and personal control. In fact, it makes the problem-solving ability of students grow better. This also results to this conclusion that implementing George Polya's problem-solving model has a positive effect on math performance of the experimental group students and because of it, the group results in the second semester of school year, given the increased volume and difficulty of the content, had no significant decline and the average of the results were almost identical in both semesters, while in the control group, not been through this model, students results dropped a lot. So applying this model causes to improve and prevent a decrease in mathematics performance of the students.

REFERENCES

Alam ol hodaee, H. (2002). *New strategies in mathematics education. Tehran.* Tehran: Shiveh Publisher.

Baker, E. L., & Mayer, R. E. (1999). Computer-based Assessment of Problem Solving. *Computers in Human Behavior, 15*(3-4), 269-282.

Boekaerts, M. (1997). Self-regulated learning: A new concept embraced by researchers, policy makers, educators, teachers, and students. *Learning and Instruction*, 161-186.

Dollah, M. U. (2006). *Mathematics Teaching and Learning through Problem Solving.* Kuala Lumpur: Dewan Bahasa & Pustaka.

Fathi azar, E., & Heydari far far, A. (2011). Evaluating the effect of Problem-solving Method on students' creativit. *Article offered in 3ed Conference of educational methods.* Tehran: Shahid Rajaee.

Heppner, P. P., & Anderson, W. P. (1985). The relationship between problem solving self- appraisal and psychological adjustment. *Cognitive Therapy & research, 9*(4), 415-427.

Heppner, P. P., Baumgardner, A. H., & Jakson, J. (1985). Depression and Attributional Style: Are They Related? *Cognitive Therapy and Research, 9*, 105-113.

Krulik, S., & Rudnick, J. A. (1996). Teaching Reasoning and Problem Solving in Junior and Senior High School. Boston: Allyn and Bacon.

Lawrence, A. (2005). *Role of ICT in the Classroom.* (M. Fazli Khani, & F. Fathi nejad, Trans.) Tehran: Varaye Danesh.

Linnenbrink, E. A., & Pintrich, P. R. (2002). Motivation as an enabler for academic success. *School Psychology Rewiew, 31*, 313-328.

Manouchehri, A., & Goodman, T. (1988). Mathematical Curriculum Reform and Teachers: Understanding the Connections. *Journal of Educational Research, 92*(1), 27-41.

Mayer, R. E., & Wittrock, M. C. (1996). *Problem-solving Transfer.* New York: Macmillian Library USA, Simon &Schuster Macmillan.

O'Neil, H. F. (1999). Perspectives on Computer-based Performance Assessment of Problem Solving. *Computers in Human Behavior, 15*, 225-268.

Pajares, F., & Graham, L. (1999). Self-efficacy, Motivation Constructs, and Mathematics Performance of Entering

Middle School Students. *Contemporary Educational Psychology, 24*, 124-139.

Patton, J. R., Cronin, M. E., Bassett, D. S., & Koppel, A. E. (1997). A Life Skills Approach to Mathematics Nstruction: Preparing Students with Learning Disabilities for the Real-life Math Demands of Adulthood. *Journal of Learning Disabilities, 30*(2), 178-187.

Polya, G. (2009). *How to resolve the problem* (Vol. 9). (A. Aram, Trans.) Tehran: Keyhan.

Roni, M. (2010). Successful problem solving. *Journal of Research in Science Teaching, 47*(9), 1094-1115.

Schoenfeld, A. (1985). *Mathematical Problem Solving.* University of California Press.

Seminara, L. (1996). An Exploration of the Relationship Between Conceptual Knowledge, Sex, Attitude And Problem Solving In Chemistry. Unpublished doctoral dissertation. *Columbia University*.

Takahashi, T. (2007). Beyond show and tell: Neriage for teaching through problem- solving. *Research and development in problem solving in mathematics education*.

Yang, H. L., & Cheng, H. H. (2009). Creative self- efficacy and its factors:An empirical study of information system analysts and programmers. *Computers in Human Behavior, 25*(2), 429-438.

Zakaria, E., & Yusoff, N. (2009). Attitudes and Problem-Solving Skills in Algebra Among Malaysian Matriculation College Students. *European Journal of Social Sciences, 8*, 232-245.