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Pre-Service Elementary School Teachers' learning styles and their Ability to Solve Mathematical Problems according to Polya's Strategy

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Abstract
The purpose of this study is to determine the learning styles of pre-service elementary school teachers at the University of Petra, and to assess their ability to solve mathematical problems according to Polya's strategy. This research was administered to 85 students who had completed a course on basic concepts in mathematics during the second semester of 2013-2014 academic years. To collect the data, the researcher employed two types of instruments: the Learning Style Inventory (LSQ), which was prepared by Honey & Mumford (1992), and the Mathematical Problems Solving Test (MPST) according to Polya's strategy, which was prepared by the researcher. The study concluded that students lack the ability to solve mathematical problems and that the level of students' ability to solve mathematical problems varies depending on the school year. In addition, the study concluded that students' ability to solve mathematical problems varies depending on their learning style. The most frequently preferred learning style was Activist-Reflector style, which showed better performance in solving math problems than other styles.

Keywords: Learning styles, math problem solving, G. Polya

1. Introduction

1.1 problem solving

Problem solving is considered one of the essential cognitive activities used in daily life contexts; and mathematical problem solving is seen as the most important part in the field of mathematics. Mathematical problem-solving as been the focus of mathematics teachers and workers, even in specialized centres such as the National Council of Teachers of Mathematics and a number of educational researchers, considering its great effect in raising thinking levels in learners and developing their abilities to solve problem (NCTM-1989).
Mathematical problem-solving also holds great importance in being the final objective and outcome of the teaching and learning process; it is seen as the correct approach to thinking in general; for there is no mathematics without thinking, and no thinking without problems.
The problem meant that the gap between the individual and accomplishing his or her goals and resolving the existing problem; this is observable in a number of different ways, starting from games to various problems of daily life. Notably, students who have a great desire to understand problems and to solve the most difficult of these problems are usually those who provide accurate and unique answers (Coutinho, 2006). In fact, teaching problem solving is seldom found in formal teaching environments, because teachers understanding of problem solving strategies are quite limited. Additionally, studies focused on teaching development give only little attention to the process of problem-solving (Jonassen, 2000).

Problem solving requires a large amount of training, and learners encounter a lot of difficulties in solving mathematical problem. The weakness in understand of the problem by the students is due to lacking mathematical strategies that assists in problem solving, as well as the necessary mathematical skills, and low motivation. Many students and teachers see the problem solving process as a headache (Soancatl et al., 2010).
There are various strategies that teach us how to solve problems, and the most successful way to learn the skills of problem solving is gained through a meaningful context. In this situation, the learner needs a piece of evidence to explain success or failure through the process of problem solving (Mayer, 1998).
Understanding what the individual does in the process of problem solving is one of the most critical aspects of learning how to solve problems. Thus, students who possess learning, thinking, and problem solving strategies are more capable of using and integrating the previously mentioned skills in various situations than people who do not possess that knowledge (Cai, 2003). Ghafour (2012) asserts that students face difficulties in the teacher preparation phase when it comes to mathematical problem solving due to students' lack of knowledge of proper teaching styles and methods, in addition to a general weakness in the field of mathematics.
Problem solving depends on three basic components: mathematical and arithmetic skills, metacognitive skills, and determination combined with aspiration. These components are influenced by the steps and instructions that work to enhance non-routine problem solving, or those problems which appeared in non-mathematical context (Mayer, 1998).
Problem solving is not an easy task, as there are various types of problems. Different levels of effort, styles and proper teaching methods are necessary for solving these problems and arriving at the appropriate approach for

problem solving training (Soancatl, et al., 2010). The lake of problem-solving skills in any academic subject is one of the most important factors that lead many students to failure and frustration (Carmo et al., 2006). Students need to learn how to think through problem solving and how to properly analyze their steps while resolving a problem.

Problem solving has a long history in the field of mathematics; numerous studies have focused on this issue with intensified attention. Problem solving in the field of mathematics has been the focus of many studies. The year 1945 was a turning point in the history of teaching mathematical problems; it was the year in which George Polya set the steps of mathematical problem solving and encouraged people to initiate the problem-solving process; In his book “How to Solve It” (Louange, 2007). Polya argues that the problems individuals face, and which could be quite simple problems, challenge the learner’s curiosity and generate a feeling of enjoyment in discovery. This in turn leaves a positive impact on the learner’s self in different life stages. Additionally, Polya argues that the skill of problem solving, like the process of learning how to swim, requires a large amount of training and experimenting. Polya's strategy has received wide acceptance, and has become the basis of other strategies. The researcher has chosen this strategy since all recommendations and strategies in studies deal with mathematical problem solving are editable and can be accommodated one way or another to fit the Polya’s strategy. Listed below are Polya's stages of problem solving:

1- Understanding the problem: In this stage, one must identify available information, data and its sufficiency, assumptions, and the desired outcome.
2- Devising a plan: in this stage, the learner should attempt to link information and data with the desired outcome – in case this link is not clear enough, the learner must devise a plan that illustrates how to join the available information with the desired outcome.
3- Carry out the plan: this is the step where the learner is required to carry out the solution and validate the sequence of problem solving steps.
4- Examine the solution: examining the solution is to validate the answer and results.
Figure (1) shows the relationship between problem solving and the required processes during these stages.

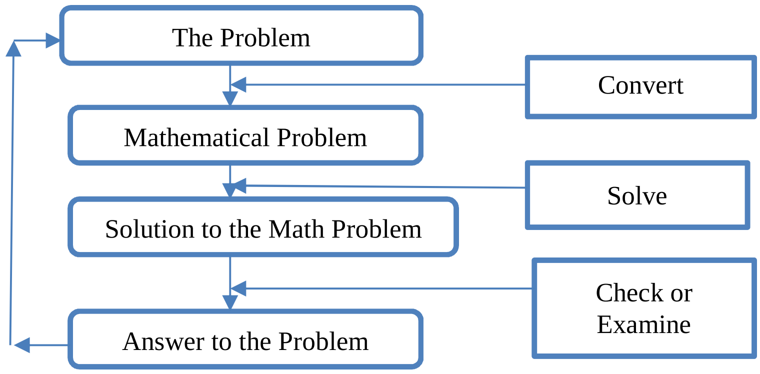

Figure 1 . G. Polya's problem solving steps

Polya argues that problem solving is to find a way to resolve a difficult situation, overcome an obstacle, and achieve a desired goal in a time when there are no known ways of problem solving. Polya also believes that the problem solving strategy is independent of the nature of the question/problem. In other words, these steps can be applied in different contexts and situations (Polya, 1945).

1.2 Learning style

Learning style is one of the key processes that affect our lives. It also directs and changes our behavior and the way we deal with daily issues. During the learning process, individuals are more inclined to prefer different methods of dealing with, processing, and interacting with information. These methods or preferences are called Learning Styles (Şİrİn & GÜzel, 2006).Thus; understanding learning styles is essential and necessary for identifying the individual’s personal learning style and discovering the best way to present knowledge to the learner (Montgomery & Groat, 1998). A number of psychologists have pinpointed different learning styles based on specific standards of classification. Identifying the preferred learning style of a learner is important in that it guides the learner toward success and helps him or her avoid failure. It also helps in improving the learning process and in designing educational programs (Swailes & Senior, 1999).

Students have different information processing systems or learning styles. Identifying students’ with his particular learning styles and his information processing systems could be helpful to him and to educational designer and faculties. Learning styles can be the core of most teacher-training programs. Notifying students about their learning styles will support their learning and enhance student performance. Although notifying instructors about their students' learning styles can contribute to for the use of various methods of teaching.

Honey and Mumford (1992) stress that the literature related to teaching methods and learning styles point toward the benefits of knowing and identifying a preferred learning style of the learner; turning this knowledge into action motivates the learner conscious and deepens his or her understanding of their perspective and way of learning. Additionally, Louange (2007) asserts that identifying a learner's preferred learning style, in respect to his or her learning characteristics, helps the learner to develop and achieve learning goals, enhance teaching strategies and increase the efficiency of the learning outcome. Ozgan & Alkan (2012) consider the learning style as a factor that affects how an individual learns mathematics. It is necessary to integrate the teaching method with the learning styles of students to improve learning. Beside mathematical content, learning and teaching methods affect the teaching process of mathematics. Furthermore, problem solving is considered to be the basis of learning and teaching mathematics, which requires us to establish harmony, consistency, and accommodation of teaching methods with the learning methods and characteristics of the learner. Therefore, identifying the learning style has become obligatory for better teaching methods in mathematics in order to equip the learner with problem solving skills (Louange, 2007). Figure (2) illustrates the relationship between the learning style, teaching style, and problem solving.

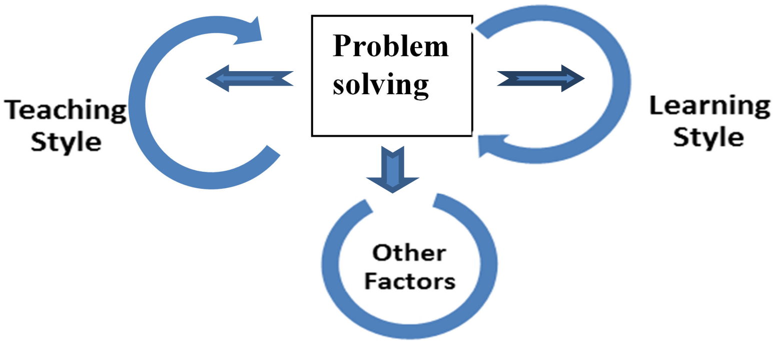

Figure 2.The relationship between the learning style, teaching style, and problem solving.

Carmo and his colleagues (2006) confirmed that people learn in different ways and conduct different preferences when learning new subject, so learning styles are a helpful tool to help both students and teachers knowing how to optimize manner in which learning and teaching (Carmo et al., 2006). Kolb pointed to the process of selecting and socialization that lead to homogeneity disciplinary culture so that it is not affected by other variables. He emphasized that with time sciences students become more analytical and less creative. On the other hand Art student become creative and less analytical, this means that the educational process has the ability to accentuate the gap in abilities between these sets of learners (Montgomery & Groat, 1998). Many researchers examine the relationship between student's learning style and their performance and achievement, but there is another important manifestation is to determine how students -according to their learning styles-deal with the problem and embark on solving, and what are the ways and styles of representation they prefer when tackling problems. It is very important to understand and analyze pre-service teachers learning styles, because if they were understanding, grasp these styles, and become familiar with the methods of their own learning, they will determine their student's individual differences in the future and this will enable them to adopt appropriate decisions in the teaching methods (Cavas, 2010).

A number of studies have tackled learning styles and their relation to academic success; these studies have also pointed out a relationship between different learning styles and academic achievement in various subjects based on numerous scales of learning styles (Awad, 1999; Rawashdeh et al., 2010; Garcia & Hughes, 2000). Some studies that focused on the effect of learning styles on academic achievement found that it positively correlates with achieving high scores in mathematics and physics (Şİrİn & GÜzel, 2006; Adeyemo et al., 2013). Other studies on learning styles and problem solving in various fields found several correlations between some learning styles measured using different scales and problems in certain areas and different ages, cultures and environments (Asha & Al-Absi, 2013;Şİrİn & GÜzel, 2006) .

Awad (1999) argues that training students to solve problems based on George Polya's strategy is important and a cornerstone; and showed that abstract learning style more correlated to this strategy compared to concrete learning style (Awad, 1999).

With regard to the relationship between specialization and the learning style, the fact is that students of a particular area are likely to have the common characteristics of a particular learning style, which is common to the faculty, students, teachers, and practitioners in this area (Montgomery & Groat, 1998).

Honey & Mumford (1992) have modified Kolb's (1984) scale of learning styles in respect to the learning cycle he illustrated; as the Honey & Mumford (1992) recognize that learning style is used to describe attitude and behavior, which in turn defines the individual's learning preferences. The modified scale shows high reliability as it engages in measuring behavior, attitude, and achievement; additionally, most of its items were of a behavioral context. This scale is characterized by flexibility in describing learning styles as it can provide us with sub-categories due to the fact that there is more than one style present in the same scale (Klein et al., 2007). The scale can be used to determine the learning styles in graduate and post-graduate teaching, and it reaffirms that no learning style is superior to another, but certain styles could be more effective in certain situations (Gantasala & Gantasala, 2009). Based on Honey & Mumford's argument, an individual learns in two ways: first, through the process of learning and secondly, through his experience.
Honey and Mumford describe the four stages of learning as follows:
Stage one: Having an experience. Stage Two: Reviewing the experience. Stage Three: Concluding from the experience. Stage Four: Planning the next steps (Beard & Wilson, 2006).

Figure (3) illustrates the learning cycle based on Honey and Mumford.

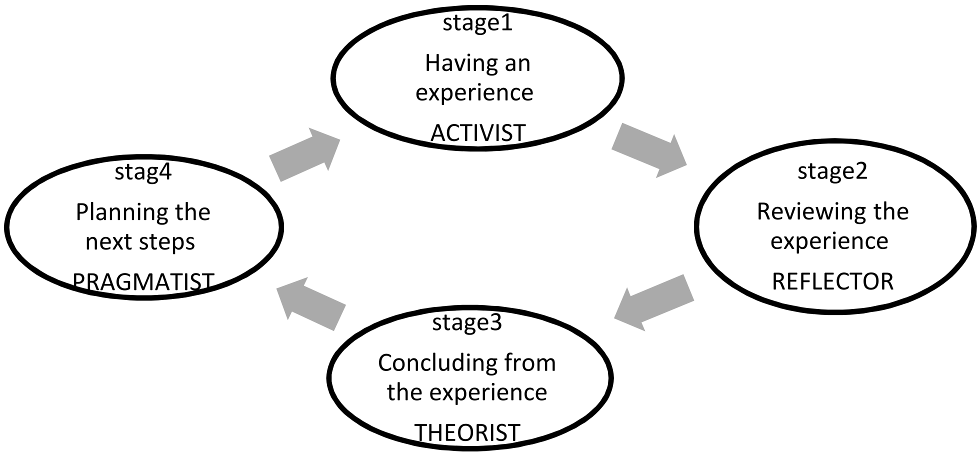

Figure 3. Honey & Mumford learning cycle

Honey and Mumford assert that individuals can be classified based on their level of achievement in each stage of the learning cycle using the four classifications. They also state that an individual changes his or her learning style with respect to the given task. Therefore, we conclude that learning styles are static but individuals tend to prefer one style over the others (Beard & Wilson, 2006).

The four learning styles are:
First, Activist
Individuals of this style are known to blend into new experiences and find happiness through being guided by experience. They prefer to process problems through brainstorming. They are also inclined to engage in challenges using new experiences, and they encounter boredom when it comes to procedures. Their motto is, "I will attempt to try".
Second, Reflectors
These individuals prefer to stand behind experiences, collect information, and pay great attention to the details of information prior to issuing generalizations and conclusions. They tend not to jump to conclusions or make decisions until they have the necessary evidence and proof. Their motto is, "You should be careful". They tend to observe others and keep in the background to notice, observe, and consider other people's input.
Third, Theorists
The individuals of this style tend to modify and organize notes in theories that may be complex, yet logical. They think about problems in a logical and sequential way; in addition, they favor to analyze, synthesis, and focus on the given subject and follow hypotheses, principles, and theories. Their philosophy implies "sanctification of logic and mind". From their point of view what is logical is good, and their approach toward problem solving is

logical and sequential. They also refuse anything that is not consistent with logic. They prefer to analyze information and form comprehensive theories.

Fourth, Pragmatist

Pragmatists are individuals who are characterized by their attempt to generate ideas, theories, and applications to test them in reality in a positive and practical way. They take advantage of all opportunities to try things out in practical and applicable situations, and tend to lack patience in long discussions. Their philosophy mottos are "There is always a better way" and "If it works, it is good" (Honey & Mumford, 1992; Cassidy, 2004; Gantasala, 2009; Sayer & Studd, 2006).

It is essential that teacher-training programs comprise different educational environment that allow pre-service teachers to acquire the necessary skills. This is because studies confirmed that the teachers learning styles, personality styles and teaching methods, influence students' performance and attitudes toward any issues or topics (Cavas, 2010).

2. Study Problem

2.1 *Study importance:*

There is a shortage of research that focuses on math problems and solving them, which is the main constituent in the process of learning math. The literature search carried out by the researcher did not yield any studies determining relationships between learning styles as measured by the learning style inventory (LSQ) and math problem solving according to Polya's strategy. This study examines the process of solving math problem and the characteristics of the students' learning styles measured by the learning style inventory (LSQ).The findings of the present study are believed to fill this important gap. The researcher could not help noticing, through her work as an instructor of the "Basic Principles of Mathematics", that students face many difficulties in this subject. Furthermore students exhibited a clear deficiency in mathematical problem-solving abilities. This drove her to investigate students' ability to solve mathematical problems as well as identify their personal learning styles in order to setup successful targeted training programs and to develop suitable teaching strategies.

Specifically, this study aims to identify the learning styles of pre-service elementary school teachers at Petra University, as well as their level of ability in solving mathematical problems based on Polya's strategy. In addition to determining to what extent, the students' learning style is related to his or her ability to solve mathematical problems, and the correlation between learning styles in every step of mathematical problem solving according to George Polya. Also, this study aims to investigate the effect of Tawjihi high school and university academic year level on the student's ability to solve mathematical problems.

2.2 Study Questions

1. What are the learning styles of students taking a course in basic concepts of mathematics?
2. What are the different learning styles of students according to their academic level /year and stream of specialization inTawjihi high school?
3. What is the level of students' ability to solve mathematical problem in general, and in the step sequence of Polya's strategies, according to their academic year level / and stream of specialization in Tawjihi high school in particular?
4. Does math problem- solving ability in general and following Polya's stages differ according to students' learning styles?

2.3 *Operational Definitions*

2.3.1 Learning styles

Keefe (1979) defined a learning style as "characteristics cognitive, affective and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment". Learning styles are determined in the light of students' answers on the scale used in this study.

2.3.2 Problem solving

The level of ability needed to find a solution to a certain mathematical problem. It measured by the ability of students to resolve the problems in a test specially prepared for this study and which consists of problems similar to the ones students take in " Basic Concepts of Mathematics"..

3. Methodology

3.1 participants

(85) Pre-service students from the department of Educational Sciences at University of Petra enrolled in the first and second semesters of academic year (2013/2014) participated in this study. The number of students in the first year is (35) students and the percentage is (41.2%). The number of students in the second year is (23) students and the percentage is (27.1%).The number of students in the third year is (18) students and the percentage is (21.2%) In the fourth year there are 9 students at a percentage of (10.6%). The distribution of students in streams

of specialization in Tawjihi high school: the number of students in the Scientific stream is (9) students at a percentage of (10.6%). The number of students in the Art stream is (42) students at a percentage of (49.4%). In the Information Technology (IT) stream, the number is (31) students at a percentage of (36.5%), and from other streams we have (3) students at a percentage of (3.5%).

3.2 Instruments (Data Collection Tools)

To collect data, the researcher used two instruments: Learning Style Questionnaire (LSQ) and Math Problem Solving Test (MPST).

3.2.1 Learning Style Questionnaire *(LSQ)*

To determine students ' learning styles, the researcher used the (Honey & Mumford's, 1992) learning style (LSQ). It consists of four styles assessed by (80) items, (20) for each style. Each item requires the student to answer by agree or disagree. A student is considered to be strong in a style if he/she gets (14-15) or more on the total items. As for the Activist style, a student will be strong in this style if he/she gets total of (10) or more. In addition, that the student may reflects strong in a particular style or more, so it treats each individual according to the situation fully accomplished rather than a single score Profile. The researcher translated the tool (LSQ) into Arabic. Then the translation was reviewed by a group of specialists (in the field) to ensure it is suitable for the Jordanian culture context. Although the tool already possesses great validity and reliability in its original format, the reliability coefficient (Cronbach Alpha) was calculated using a sample group of 30 students. The reliability value for (LSQ) scale as a whole was (0.787).In addition, the reliability for each learning style was as follows: (0.423) for the Activist style, (0.623) for the Reflector style, (0.606) for the Theorist style, and finally (0.423) for the Pragmatist style. The reliability coefficient is acceptable for the purposes of scientific research.

3.2.2 Math Problem Solving Test (MPST)

The researcher prepared a math problem- solving test (MPST) which consists of (8) multiple-choice questions. It included questions on a variety of topics in mathematics such as numbers and operations, algebra, patterns, data processing, geometry and measurement. Each questions included sub-questions to measure students' ability to solve the problem according to the steps of George Polya. These questions measure a student's ability in determine data, select the desired data, determine the assumptions, determine the solution strategy, implementation the strategy and then carrying the answer. The student gets a score of (1) when an answer is correct and a (0) when an answer is wrong for each sub-question and all questions. The Test has also been reviewed by a number of specialists in mathematics, and has been modified according to their suggestions and feedback. Their over-all approval of the scale is proof of its consistency. The test has been applied (administered/given) to a sample of (30) students (Pilot group).The coefficient of internal consistency (Cronbach Alpha) was calculated and it reached (0.70) which is acceptable for scientific research. To determine the level of students' ability in solving math problems, the researcher used the following classification: when the grade of a student in the test is between (70% -100%), the student is given a rating of "Very good". The rating "Good" is given when the grade is between (55% -69%), the rating is "Acceptable" if the grades between (40% -55%), and "Weak" if the grade is less than (40%).

3.3 Limitations of the study

The results of this study are limited in the light of the following factors:

1. The study was limited to students at the University of Petra.
2. The results were determined by characteristics of the scales used, and their ability to detect differences between students in the learning style inventory (LSQ) which prepared by (Honey & Mumford, 1992), and it classified student learning styles from their own view and different from other scales. The second test was the problem solving test which prepared by the researcher to examine student ability in solving mathematical problems based on Polya’s strategy. All study subjects are females
3. All study subjects are females.

4. Results

This study aims to determine the learning styles of pre-service teachers at the University of Petra, and their ability to solve the mathematical problem according to the Polya's strategy, and also aims to determine the relationship between student's relevant learning style and their ability to solve the mathematical problem. Additionally, it aims to as well as a the relevance of their learning styles with each step of solving mathematical problems according to Polya's strategy

Question one: What are the learning styles of students taking a course in basic concepts of mathematics?

To answer the first question that the researcher calculated the frequency and percentage of the students on each learning style classification. The results are shown in Table 1.

Table 1. Frequency and percentage of the students on each learning style

	STYLE								
	ACTIVIST	REFLECTOR	THEORIST	PRAGMATIST	ACTIVIST+ REFLECTOR	ACTIVIST + THEORIST	ACTIVIST + PRAGMATIST	REFLECTOR+ THEORIST	3 or more
Frequency	10	4	4	3	14	12	8	7	23
Percentage	11.8%	4.7%	4.7%	3.5%	16.5%	14.1%	9.4%	8.2%	27.1%

Table 1 shows that some students showed one type of learning styles and others showed high ability in two types of learning styles, and some showed high ability in three styles and more, and these constitute (27%), and they are the highest among all the styles, and the students. Activist-Reflector learning style came in second order (16.5%), followed by Activist Theorist style (14.1%), then Activist style rate (11.8%). The rest of the styles were ratios less than 10%.

Question two: What are the different learning styles of students according to their academic year level and stream of specialization in Tawjihi high school?

To find out the distribution of students among different learning styles by academic year of study and stream of specialization in Tawjihi high school, the researcher calculated the number of students and their percentage in different years, as well as their specialization in Tawjihi high school depending on their learning style. Table 2 shows the student numbers and percentages according to the different styles as well as specialization in Tawjihi high school and the level of the academic year school.

Table 2. The student percentages according to the different styles as well as specialization in high school and the level of the year school

Specialization inTawjihi high school and Year Level		STYLE									Total and percentage
		Activist	Reflector	Theorist	Pragmatist	Activist+ Reflector	Activist + Theorist	Activist + Pragmatist	Reflector + Theorist	3 or more	
Specialization inTawjihi high school	Science	4.7%	0	0	0	1.2%	2.6%	0	2.6%	0	9 (10.6%)
	Arts	5.9%	3.5%	0	3.5%	11.8%	2.6%	2.6%	3.5%	16.5%	42 (49.4%)
	IT	0	1.2%	4.7%	0	3.5%	9.4%	7%	2.6%	8.2%	31 (36.5%)
	Others	1.2%	0	0	0	0	0	0	0	2.6%	3 (3.5%)
Academic year Level	First-Year	2.6%	2.6%	4.7%	0	11.8	2.6%	4.7%	1.2%	11.8	35 (41.2%)
	Second-Year	3.5%	1.2%	0	2.6%	4.7%	8.2%	2.6%	3.5%	1.2%	23 (27%)
	Third-Year	4.7%	1.2%	0	1.2%	0	2.6%	0	2.6%	9.4%	18 (21.2%)
	Fourth-Year	1.2%	0	0	0	0	1.2%1	2.6%	1.2%	4.7%	9 (10.6%)

Table 2 shows that the Activist style is the most frequent style for the science stream. "3 or more" styles is the most frequent style for Arts stream, Activist and "3 or more" styles are the most frequent for IT stream and the "3 or more style" are the most frequent for other streams.

Distribution according to academic year level; for first- year students, the Activist- Reflector style and "3 or more styles" are the most frequent styles. For second-year students; the Activist-Theorist is the most frequent styles. For third-year and fourth-year students, the "3 or more style" is the most frequent.

Question Three: What is the level of students' ability to solve mathematical problems in general, and in the step sequence of Polya's strategies according to their academic year level and stream of specialization in Tawjihi high school?

The researcher first calculated the mean and standard deviation values of student scores in the different stages of problem solving (understanding the problem, devising a plan, carrying out the plan & examining the solution), and on the overall test. The researcher calculated the t-values, which are shown in Table 3.

Table 3. The mean and standard deviation values of student's scores in different stages of problem solving and on the overall test.

	Minimum	Maximum	Mean	S.D	t	sig
Understanding the problem	0	6	3.21	1.254	23.605	.000
Devising a plan	0	8	2.34	1.630	13.244	.000
Carry out the Plan	1	8	3.74	1.691	13.244	.000
Examine the solution	0	7	2.66	1.630	15.041	.000
Problem solving	5	23	11.99	4.210		

Table 3 indicates that the mean students' scores values in the carrying out the plan stage is the highest (3.74), followed by the understanding the problem (3.21),examine the solution (2.66),devising a plan (2.34).While the average score for students in the ability to solve the math problems on overall test is (11.99).It can be noted from Table 3 that the values of (t) calculated were statistically significant, which means that students differ in their abilities through the four stages of the solution.

In order to determine whether the students' ability of solving math problems vary according to the academic year-level and specialization in high school, the researcher first calculated the mean and standard deviation values of students' scores in the different stages of problem solving, and on the overall test. ANOVA test was used to find out if there were significant statistical differences between the means of student's score attributed to specialization in high school and academic year-level. Table 4 demonstrates these findings.

Table 4. Means and standard deviations for scores of problem solving based on student's specialization in high school and year-level

		N	Mean	S.D	F	Sig
Understanding the problem	First-year	35	3.17	1.445	1.039	.380
	Second-year	23	3.57	1.037		
	Third-year	18	2.89	1.323		
	Fourth-year	9	3.11	.601		
	Science	9	3.33	1.581	.246	.864
	Arts	42	3.24	1.265		
	IT	31	3.10	1.221		
	Others	3	3.67	.577		
Devising a Plan	First-year	35	2.43	1.754	.249	.862
	Second-year	23	2.09	1.756		
	Third-year	18	2.44	1.149		
	Fourth-year	9	2.44	1.810		
	Science	9	2.22	2.33	.888	.451
	Arts	42	2.62	1.55		
	IT	31	2.06	1.55		
	Others	3	1.67	1.53		
Carrying out the plan	First-year	35	4.34	1.66	7.011	.000
	Second-year	23	4.13	1.77		
	Third-year	18	2.61	.95		
	Fourth-year	9	2.67	1.32		
	Science	9	4.00	1.66	.104	.957
	Arts	42	3.76	1.85		
	IT	31	3.65	1.60		
	Others	3	3.67	0.58		
Examining the solution	First-year	35	2.89	1.91		
	Second-year	23	3.00	1.41	1.771	.159
	Third-year	18	2.06	1.21		
	Fourth-year	9	2.11	1.453		
	Science	35	2.78	1.92	1.065	.369
	Arts	23	2.40	1.61		
	IT	18	3.03	1.60		
	Others	9	2.00	1.00		
Problem solving	First-year	35	12.91	4.979	2.809	.045
	Second-year	23	12.78	3.516		
	Third-year	18	10.00	2.787		
	Fourth-year	9	10.33	3.571		
	Sciences	35	12.33	5.70	.086	.968
	ART	23	12.07	4.44		
	IT	18	11.87	3.68		
	Others	9	11.00	2.00		

It can be noted from Table 4 that the differences between means values of student's score are significant according to academic year-level in the overall math problem test, and in the carrying out the plan stage. To identify the sources of these differences, Tukey post Hoc test has been applied, the results of these comparisons indicate that there is a statistically significant difference between the means of first year students' scores and those of the third year students in the overall test in favor of first year students. Also there is a statistically significant differences between the means second year students' scores and the scores of third year students in the overall test in favor of the second year. Furthermore, there is a statistically significant differences in favor of first year students compared with those of third year students in the carrying out the plan stage; there is a statistically significant differences in favor of the first year compared with the fourth year in the carrying out the plan stage. In addition, there is a statistically significant difference in favor of the second year compared with the first year in the carry out the plan stage.

To investigate the impact of specialization in high school on the students' ability to solve mathematical problem, the researcher first calculated the means and standard deviation values of students' scores in problem solving according to their specialization in high school, Table 4 demonstrates these findings.

Table 4 indicates that the mean students' scores values of IT specialization is the highest (3.03), followed by the Science specialization (2.78), Arts (2.40) and others (2.00). It can be noted from Table 4 that there is no statistically significant difference between the means of students' score according to specialization in high school.

In regard to determining the students levels of ability to solve math problems according to the categories set by the researcher (V. Good, Good, Acceptable and Weak), the frequencies and percentages of student scores were calculated. Table 5 shows these results.

Table 5. Frequencies and percentages of students' scores according to category define.

Category	V. good	Good	Acceptable	Weak	Total
Frequency	4	20	34	27	85
Percent	4.7%	23.5%	40.0%	31.8%	100.0%

Table 5 shows that there is a clear weakness in students' ability to solve mathematical problems. Where the percentage of students who have low abilities in solving math problem was (31.8%), they recorded less than 40% on a mathematical problem solving scale. The students whom their appreciation "Acceptable" their proportion (40%), those students whom scores were between 40% and 55% on a scale to solve math problems, and this performance is not a high performance. The percentage of the students whom their appreciation was "good" or "v. good" was (28.2%), the students' scores ranged between 56% and 100% on a math problem scale.

Question Four: Does math-problem solving ability in general and following Polya's stages differ according to students' learning styles?

To answer this question, the researcher calculated the means, standard deviation and (F) values of the sample. ANOVA test was used to find if there were statistically significant differences between the students' means in math problem solving according to their learning styles. The findings are shown in Table 6.

Table 6. The mean and standard deviation values for scores of problem solving based on students' learning style and the (F) values.

	Understanding the problem		Devising a Plan		Cary out the plan		Examine the solution		Problem solving	
	M	SD	M	SD	M	SD	M	SD	M	SD
Activist	2.80	1.751	1.70	0.949	2.70	0.823	2.30	1.636	9.50	3.567
Reflector	4.00	0.00	3.50	1.00	5.75	1.50	2.75	0.50	16.50	1.732
Theorist	3.00	0.00	2.00	0.00	3.00	0.00	5.00	0.00	13.00	0.00
Pragmatist	4.67	.577	5.00	0.00	2.33	1.155	2.33	1.155	14.33	2.887
AR	3.79	1.369	3.00	1.922	5.14	1.916	3.43	1.555	15.43	4.972
AT	2.75	1.815	2.08	1.832	3.83	1.801	3.00	1.706	11.67	4.924
AP	3.25	0.886	2.00	1.309	2.75	1.581	2.50	2.204	10.50	5.043
RT	3.43	0.535	2.00	1.00	4.14	1.345	2.57	2.070	12.14	3.185
3 or more	2.91	0.848	2.09	1.756	3.48	1.344	1.87	1.058	10.35	2.248
Total	3.21	1.254	2.34	1.63	3.74	1.691	2.30	1.636	11.99	4.210
F	1.721		2.156		4.171		2.593		3.618	
Sig	0.107		0.040		0.000		0.015		0.001	

It can be shown from Table 6 that the values of (F) were statistically significant at the devising a plan stage, carrying out the plan stage, as well as at the examining the solution and at problem solving in general. This

means that the students' abilities to solve the mathematical problem vary according to their learning styles. This difference is evident in all stages of solving math problems according to Polya' strategy except in understanding the problem stage, where there were no statistically significant differences between students' abilities to solve a problem according to learning style in this stage.
To identify the sources of these differences, Tukey post Hoc test applied. The results of these comparisons indicate the following: At the level of problem solving in general, there is a difference between the students' performances in Activist style and student performance in Activist-Reflector style in favor of Activist-Reflector style. At the level of problem solving in general, there is a difference between the student's performance in Activist-Reflector style and student's performance in "3 or more" styles in favor of Activist-Reflector style. At the devising a plan stage, there is a difference between the student's performance in Activist style and student performance in pragmatist style in favor of pragmatist style. At the carrying out of the plan, there are five differences as following: 1) Differences between Activist style and Activist-Reflector style in favor of Activist-Reflector style.2) The Differences between Activist style and Reflector style in favor of Reflector style. 3) The Differences between Activist-Pragmatist style and Reflector style in favor of Reflector style. 4) The Differences between Activist-reflector style and Activist-Pragmatist style in favor of Activist-reflector style. 5) The Differences between Activist-reflector style and "3 or more" styles in favor of Activist-reflector style.

5. Discussion and Conclusions

The study clearly shows students lack the ability to solve the mathematical problem as the percentage of students whose performance was "Good" or "v. Good" is 28.2%. those students whose grades lay between (56% -100%), and the percentage of students with weak abilities to solve the problem (31.8%), those got less than 40% on mathematical problem solving scale. The students who got "Acceptable" appreciation reached the percentage (40%). They are the students whom got grades ranging from 40% -55% on to math problem solving scale. The results of this study are consistent with the (Şİrİn & GÜzel, 2006) study, which also showed a weakness in the ability to solve mathematical problem among the university students. Therefore, teacher preparation programs need to focus on problem-solving skills and consider these skills during preparing school and university programs and through the development process.
The results show a difference in the students' ability to solve math problems and in the four-stage according to Polya strategy where the best performance of the students showed in the carry out the plan stage. This means that students have the ability to (perform calculations), followed by (understanding the problem) and then (examine the solution) and finally (devising a plan).
This shows that the weakness of the students in (solving the problem) appears in the (devising a plan) stage and in (examine the solutions) stage and both processes require careful thinking and meditation for completing design and planning both processes successfully. Gholami & Bagheri (2013) emphasized that difficulties faced by individuals in solving problems due to the impaired ability of individuals to choose the correct behavior when facing a problem. This behavior is important in the process of developing a plan solution. This may be due to the weakness in the stages of primary education, and tertiary stage. Awad (1999) confirmed the need to teach solving mathematical problem skills according to poly's stages from the early levels of school.

The results show that students' performance in solving mathematical problems in general varies according to the level of the academic school year. The performance of students in the first year is better than third-year students. Also, the performance of students in the second year is better than the performance of third-year students. The performance of students in the first year is better than performance of students in the third and fourth year in the (carrying out the plan) stage. There is also a difference in students' performance between second year and third year in favor of the second year in the (carrying out the plan) stage. These results are not consistent with results of a study by Ozgan, & Alkan, (2012). Their study shows that the performance of fourth and fifth year students was better than the performance of students in the first and second years. The first and second year student performance of this study in math problem solving confirms that there is a weakness in the preparing teachers program in mathematics, where only one math course was taught to students within the teacher-preparing program. In addition, the first and second year student's skills return to what they have learned in the previous years of their secondary school. This underlines the need to reconsider the issue of teacher preparation programs to include more than one course in math problem solving and teaching mathematical problems solving strategies in particular.

The specialization in high school was not a statistically significant effect, because the mathematical problem solving test used in this study dealt with problems related to the basic concepts in mathematics which was not an in-depth or specialized, This result contrasts with what is mentioned in the (Şİrİn & GÜzel, 2006) study. The study results showed that the students' ability to solve mathematical problems varies depending on their learning style. This result was consistent with what is stated in the (Gholami & Bagheri, 2012) study.

The results of this study show that this difference apparent in all stages of the math problem solving according to Polya’s strategy except at the stage of understanding the problem, where there were no statistically significant differences between students' abilities to solve a math problem and their learning styles. Specifically, there was a difference in students' performance between the Activist learning style and Activist-Reflector learning style in favor of Activist-Reflector learning style. There was a difference between the students' performance in Activist-Reflector style and student performance in "3 or more" styles in favor of Activist-Reflector style. This means that individuals of Activist-Reflector style are the best in the ability to solve mathematical problem compared to other styles even better than students who prefer three styles and more (multi-style). This result contradicts with what is mentioned by Kolb (1984) who stressed that student would learn better by using all four styles, rather than using his preferred learning style. That is, student should incorporate all styles so that he/she can use the Learning Cycle. This leads us to the relation between the characteristics of this style and the ability to solve mathematical problem. Honey & Mumford (1992) stated that people are classified into four classes in terms of their achievement in every stage of the Learning Cycle and this pattern is not fixed. An individual can change the Learning Cycle according to the job or task performed.

According to the results of this study, the Reflector-Activist style is better to solve math problem where it combines the properties of the Reflector and Activist styles together, which may help students to raise their ability to understand and solve the mathematical problem according to Kolb's Learning Styles. This result is largely consistent with (Şİrİn & GÜzel, 2006), where found a positive correlation between the skill of mathematical problem solving and Reflective-Observation learning style in spite of differences in learning style scale used in the studies. Regarding the (devising a plan) stage, statistically significant difference was found between the performance of students from Activist style and students from Pragmatist style in favor of Pragmatist style. Students who prefer Reflector-Activist style are characterized as being practical problem solvers who prefer to think, do and focus on abstract ideas and experiment actively in order to find practical application.

Regarding (carrying out the plan) stage, the performance of students from the Activist-Reflector style was better than the performance of students from the Activist style, and those of the Reflector style. In addition, this confirms that the common characteristics of the two learning styles Reflector style and Activist style had an impact positive effective in carry out the plan stage. Also, the performances of the students from the Reflector style are better than the performance of students from the Activist-Pragmatist style. As was the performance of students from Activist-Reflector style are better than the performance of students from Activist-Pragmatist style, as well as the performance from the students from (multi-style).

In addition, the performance of students from the Reflector style was better than the performance of students from Activist-Reflector style, as well as the performance from the students from (multi-style) in the same stage. Muro & Terry(2007) expounding that individuals prefer Assimilation (Theorist) style and Diverge (Reflector) style when solving scientific and mathematical problems, this is consistent with what is stated in this study, which addressed the math problems and concluded that the effectiveness of Reflector style and its interaction with the Activist style in the ability to solve math problems.

The difference in the results of studies addressed the learning styles and its relationship with other variables due to different learning environments, different age groups, and the level of achievement, the different communities in their cultural characteristics, demographics and the nature of the curriculum applied (Mountfordeta al., 2006).

6. Recommendations

In light of the result of this study, it is suggested that the following recommendations be taken into consideration:

1- Infusing educational courses with problem solving activates.

2- Enriching teacher –training programs with math problem-solving activates and skills

3- Further studies should be conducted in the areas of Learning styles, and math problem solving and the relationship between the two.

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