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THE EFFECT OF A FIVE-STEP FRACTION PROBLEM-SOLVING INSTRUCTION METHOD ON THE PERFORMANCE OF THE SIXTH GRADE PRIMARY SCHOOL STUDENTS

Vahid ALAMIAN[1]*, Khadijeh SORANI[2], Molouk HABIBI[2]

[1] Faculty member Department of mathmatics Farhangian University, Tehran, Iran.
[2] MA, Department of mathmatics Farhangian University, Tehran, Iran.

***Corresponding Author:**
Email: Vahid_alamian@yahoo.com

ABSTRACT

The primary goal of the present study is the recognition of the effect of a five-step fraction problem-solving instruction method on the performance of the sixth-grade primary school students from Semirom County. The study is an applied research in terms of its goal. It is an experimental research in terms of implementation and it is a quantitative study in terms of the measurement. Moreover, the study has been conducted based on a semi-experimental plan of the pretest-posttest type. The study population included the sixth-grade primary school students of Semirom County reaching in number to 873 persons during the 2016-2017 academic years. The study sample was selected based on an experimental method through congruent sampling and assigned to two groups, namely experimental and evidence, each containing 25 individuals identically. The data collection instrument was a 10-question test administered in the pretest-posttest form as well as the qualitative interview. The validity of the questions was confirmed by 20 experts and math teachers based on content validity ratio (CVR). The test's reliability was obtained equal to 0.88 and 0.94 respectively through retest and Cronbach's alpha methods. The analysis of the study data was carried out in SPSS22 in two descriptive and inferential levels. The study findings indicated that the students who had been subjected to five-step problem-solving instruction, including comprehension, classification, proposing a plan, implementing the plan and retrogression significantly differ from the students who had been instructed traditionally in terms of the problem-solving performance.

Keywords: *problem-solving, fraction, five-step, sixth-grade primary school students.*

INTRODUCTION

Mathematics is amongst the human knowledge essentially applicable to the solving of the daily problems and issues in such a way that the entire human progresses in the other scientific fields somehow depend on math. Nowadays, the importance of this knowledge is clearly vivid to everyone but the issue that still persists is that how such knowledge can be taught to the learners (Hesam, 2005).

One of the goals of teaching math should be assisting the students in forming their conceptual perception of the mathematical concepts in all scholastic levels, especially primary school. The mission of teaching math and researchers in this area of the human knowledge is setting the proper grounds for development of the mathematical thoughts and skills in the learners so that the teachers and learners can take steps in the complex yet beautiful world of math and enjoy it through reaching a mutual perception (Alam Al-Hoda'ei, 2009). The thing that is posited as the learning problem in math and problem-solving begins from primary school and lasts to the higher schooling courses. The individuals unable in learning math are those that, despite

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enjoying natural intelligence, physical health, and psychological soundness as well as being in a good social and economic environment, have serious problems in math lessons and make lesser progresses in contrast to their peers (Abbas Hussein Abadi, 2008). Problem-solving is one of the most important approaches to learning in mathematics in such a way that the lessons are thought in some of the countries based on the problem-solving approach. Rayhani (2010), citing Stacy (2005), expresses that problem-solving strategies are amongst the procedural goals of math instruction in Australia. He asserts that problem-solving is the primary goal of teaching math as pointed out in the document of Singapore's curricula. Problem-solving is also amongst the procedural standards offered in the document of the principles and standards for teaching math in schools by the National Council of Teachers of Mathematics (NCTM, 2000).

One of the primary problems of the students is that they do not know where to begin and how to solve when they encounter a problem. Generally, if the math teachers are asked about the main problem of the students in a math lesson, they would surely answer that they are weak in problem-solving. Based on the results obtained from TIMSS test in a study, the students perform weakly in most of the problems of this written test.

Polia (1962) believes that the solution method is good provided that it can be predicted from the beginning and it is in this case that the goal can be accomplished. In line with this, Polia offered a four-step model that, as stated by Schoenfeld (1985), while being appropriate for professional mathematicians, does not offer sufficient details for the students who are not adequately familiar with strategies of mathematical problem-solving so the offering of a proper method for problem-solving and supplementing Polia's model seems to be important and necessary.

There are various strategies and methods for problem-solving in the classroom and this instruction is not limited to a given format. One of the methods is five-step problem-solving that can be applied for teaching problem-solving in primary school. Amongst the issues taken into account in teaching math in primary school and having a special significance in problem-solving, fraction and problem-solving in fractions can be pointed out. In terms of the importance of fraction as well as problem-solving, teaching based on the traditional method cannot guide the students towards a complex and advanced evolution; thus, part of the traditional method is required for enhancing the math of the students so that the students can be induced with a subtle perception of math.

THEORETICAL FOUNDATION:

Problem-Solving:

Jones (2001) realizes problem-solving as a situation with which the individual is faced while having no algorithm to solve it. Furthermore, Trisman (1988) defines problem-solving in the statement that "you do it but you do not know what you are doing" (Mortazi Mehrabani, 2003). According to the definition, when a learner faces a situation to which s/he cannot rapidly respond based on the information and skills s/he has at that moment or when a learner has a goal and has not yet learned the way to achieve it, one can say that s/he is faced with a problem. Considering the definition of problem, problem-solving can be defined in the form of the recognition and application of knowledge and skills that lead to a correct answer by a learner to the situation or his or her accomplishment of the intended goal (Sayf, 2001).

Problem-solving entails purposive strategies by which an individual defines a problem, decides to adopt a solution, runs the problem-solving strategies and supervises it (Adabjou, 2016). Sayf (2008) expresses that problem-solving includes the recognition and application of knowledge and skills that lead to a proper answer by the learner to a situation or his or her achievement of the intended goal.

The essential element in problem-solving is the application of the previously learned knowledge and skills to the new situations. Problem-solving includes a cognitive-behavioral process guided by the individual who tries to effectively or consistently solve the problems of his or her daily life using the effective solutions. This way, problem-solving is a conscious, logical and purposive process (Dzorilla and Nezu, 2001).

Lesh (1981) realizes problem-solving as going beyond the obtained answers and, in fact, he introduces it as an instrument, a thinking method, philosophy, and preparedness for learning through accessible chances (Mortazi Mehrabani, 2003). Schoenfeld (1985) goes even more forward and realizes the entire math as problem-solving. Alam Al-Hoda'ei (2009), as well, expresses that if not a sort of problem-solving, math is comprised for a vast part of the knowledge and experience of every student in the arena of mathematical work. As an excellent mental activity, problem-solving is a sort of learning. Learning how to solve problems leads to the acquisition of new knowledge and skill (Adabjou, 2016).

Problem-Solving as a Sort of Learning:

Ganier realizes problem-solving as a sort of learning the principles based on rules and regulations because he is of the belief that problem-solving is the product of several previously learned principles and the creation of a new principle at a higher level (Adabjou, 2016).

Transferring of learning is usually carried out in two ways of positive and negative transferring. In the former, the prior knowledge facilitates the learning of the later materials like the knowledge of bicycling that eases the learning of motorcycling; but, in the latter, the prior knowledge disrupts the subsequent learning such as the drivers who are used to driving on the left side of the street as in England and facing problems when driving on the right side of the street as in Iran (Shahmoradi, 1995). In learning math, subtle study and avoidance of mistakes are amongst the necessities. On the other hand, the repetition and review of the lesson subjects are still needed by the students who are relatively weak.

Marton and Saljo (1976) believe that there is a tension and difference between subtle learning and learning based on exercise with preliminary learning being more subtle and more conceptual. These two researchers confirmed that learning is often based on repetition and exercise in western culture and not learning through deep perception. In the mathematical studies, the students should have perceived the subjects and the sole remembering of them and falling short of perceiving the meanings and concepts of them is not sufficient (Junaedi et al, 2015). According to Lie (2006), western teachers should emphasize on the perception of the concepts before teaching the symbols and rules, Watkins and Biggs (2001), as well, disagree to the learning of math under the influence of the memorized activities and exercises. They have found out that learning based on exercise and repetition leads to weak educational results (Junaedi et al, 2015).

When the teachers encourage the students to share their thoughts with the rest of the students and offer their answers in loud voice or in written form, they make a greater help to the instructors because they perform mathematical operations and the more the students move towards the standard answers, the better their results will get (Berman, 2003).

In the education journal of the US and as cited by Slocum & Marchand-Martella & Martella (2004), it is stated that if many of the students, especially the less active and less experienced students express a clear-cut and brief explanation about what they are doing, they learn better and faster. Upon ending the preliminary part of the mathematical problems, the students enter the primary section of the instruction program. In fact, teaching and education begin from this section from which the students advance from the modeled instruction (copying the teacher) to the guided instruction (along with teacher's guidance) hence to independent instruction (made by the students themselves). Such gradual progress from the teacher to the student is very useful, particularly for the less active and less experienced students. In fact, before being spectators, they are allowed to be participants (Bruner, 1983). As was mentioned, one of the types of learning is instruction based on problem-solving which is carried out in three ways: the first is that the student copies and uses the method offered by the teacher. The second is that the student begins solving the problem with the help of the teacher and not necessarily through his or her offered way. The third is that the student independently performs problem-solving. The following section is a brief review of each of the foresaid learning ways.

Problem-Solving Models:

The four stages of problem-solving identified by Wallace are preparation and introduction, latency period, induction and research (confirmation).

The general framework of Polia (1945) includes an understanding of the question, proposing the plan, implementation of the plan and review or retrogression.

The four main sections introduced by Schoenfeld (1985) are resources, approaches, control, and system of beliefs.

One of the models offered for problem-solving is the one offered by Glover and Browning. The stages of this model are problem recognition, definition and perception of the possible solutions, discovery of the possible solutions, working on the discovered solutions and a glance behind and evaluation of the activities' results.

One of the other models offered for problem-solving is the one offered by Maidio et al. The stages of this model are sophistication, postponing the judgment, proper atmosphere, analysis, and feedback.

In the instruction journal of the US's Massachusetts University and in an article called "an introduction to the perception and solving of the discourse issues", a six-stage process has been offered for perceiving and solving the math problems. This process includes pre-representation, reading, offering a plan, implementing the plan, checking and reviewing.

Dr. Williams and Dr. Carey (2003) offered a six-step model for problem solving in an article named "solving the difficult problems". These steps are identification of the problem (problem understanding), finding the problem's determined information and goals (data and wants of the problem), a spark of thought (mental production of the solution), selection of the solution (proposing the plan), description of the solution (implementation of the plan) and review and investigation (retrogression).

Also, in the journal of instruction issued by the US's University of Massachusetts, the experts of the Federal Finance Supply Organization (1998) have recommended a five-step model for aiding

the general instruction of the students for perceiving the mathematical problems. These stages are investigate the question (perception), find the required information (problem classification), select a plan for solving the problem (problem's plan), solve the problem (implementation of the plan) and investigate and review the answer (retrogression).
Robert E. Reyes, Marilyn N. Suydam and Mary Montgomery (1998) have offered a five-step model in a book titled "helping the children learn math" for problem-solving with their posited steps being: perception, classification of data, proposition of the plan, implementation of the plan and retrogression.

Operation with Fractions:
The algorithms of operation with fractions should not be instructed. They should be constructed by students. The instruction that only underlines the procedures increases the misunderstanding of these procedures and improper application of them in the students (Dusti, 2013). Therefore, instruction should provide the students with an opportunity to make the procedures of operation with fractions themselves.
The problems of the students and teachers in working with fractions stem from the improper recalling of the procedures as well as inappropriate transferring of the integers' ideas into the concepts of operation with fractions. One of the misunderstandings of the students and teachers in working with fractions is that the multiplication always gives larger values and division always makes numbers smaller (Fischbein & Deri & Nello & Marino, 1985). The answer to a problem may become smaller or larger than or equal to the two numbers in a problem or equal to unity through multiplication and division.
Language is another barrier that has to be overcome for the perception of the operations with fractions (Dusti, 2013). The students' perception of the four operation symbols is very limited. To the students, addition means increase, subtraction means decrease, multiplication means being increased several times as much and division means being divided several times as much. According to Tobias (2009), the operation becomes a different concept in many of the cases in fractions. For example, three minus two can be interpreted initially by assuming three things and subtracting two of them; minus can be interpreted as subtraction. When the problem is subtracting one second from three, it is wrong to begin with three and subtract one second from it. The situation of apportionment in division is another example of this type. In integers, division can be interpreted as a separation into several parts. For instance, five divided by four can be perceived as apportioning of four things between five individuals. If the problem is changed instead to$\mathbf{2\frac{3}{5}} \div \frac{1}{2}$, it is wrong to say that one wants to be divided $\mathbf{2\frac{3}{5}}$ of something between half a person. It can be understood based on this example that the method of expressing the problem can disrupt the students' ability to perceive the fraction-incorporating situations (Dusti, 2013).

Study Method:
The present study is an applied research in terms of goal; it is an experimental study in terms of implementation and it is a quantitative research in terms of measurement style. In addition, the study is an experimental (empirical) research in terms of the data collection method. The study population of the present study included all the students from the sixth-grade primary school in Semirom County that reached in number to 873 individuals studying in the primary schools of the aforesaid county during 2016-2017 academic years.

Since the study sample volume was assigned to experimental and evidence groups in the present research and because use has been made of an experimental research method, two classrooms were randomly selected with the number of students being equal in both of them; 25 students were considered for the experimental group and 25 students were considered for the evidence group.

In the present study, after studying and investigating the similar studies' background and theoretical foundation, two 10-question tests, including pretest and posttest, were designed based on the relevant questions and researchers. These two tests were arranged through considering the scales related to the development and measurement of the concepts applied in the model proposed by M. Behr et al (1983). The test was utilized as the means of measurement for collecting the required information. After coordinating with and acquiring permits from the respected education management and the studied schools' principals, the pretest was implemented in the first week of March in the two schools; then, 20 instructional sessions were held for the experimental group during March, April, and May and the posttest was also held for both of the classrooms during the second half of May. After each of the tests, the students were interviewed for getting informed of the quality of their answers to the questions, especially in the retrogression step. Before the students could answer the questions and take part in the instructional course, the required explanations were provided by the researcher to them about the value of this study and the method of their answering. The time required for answering the pretest and posttest questions had been set at 45 minutes.

In this study, use was made of content validity and face validity tests. The reliability of the questionnaires was estimated equal to 0.88 and 0.94 through retest and Cronbach's alpha methods. The analysis of the study data was conducted in descriptive and inferential levels by taking advantage of SPSS Software, version 22.

Study Questions:

1) Does the instruction based on five-step problem-solving method have any effect on the students' perception of the fraction problems?
2) Does the instruction based on five-step problem-solving method have any effect on the students' performance of data classification in the fraction problems?
3) Does the instruction based on five-step problem-solving method have any effect on the students' performance of plan proposition in the fraction problems?
4) Does the instruction based on five-step problem-solving method have any effect on the students' performance of plan implementation in the fraction problems?
5) Does the instruction based on five-step problem-solving method have any effect on the students' performance of retrogression in the fraction problems?
6) Does the instruction based on five-step problem-solving method have any effect on the students' performance in solving the fraction problems?

STUDY FINDINGS:

This section deals with the analysis of the data obtained from the questionnaires through the use of descriptive and inferential statistics. In order to investigate and describe the information related to the general properties of the respondents, use was made of such indices as frequency, percentage, mean and related diagrams; in order to investigate the study questions and their answers, the following hypotheses were codified and the existence of relationship between the study variables was verified through pairwise t-test and independent t-test.

Hypothesis One: instruction based on the five-step problem-solving method influences the students' perception of fraction problems.

Table 1: descriptive analysis of the students' performance in the perception stage

Variable		Number	Mean	Standard deviation	Standard mean error
Problem-solving's perception	Pretest	25	3.75	0.94	0.19
	Posttest	25	4.17	1.11	0.22

Descriptive analysis of Table (1) showed that the pretest mean of the fraction problems' perception stage is 3.78 with a standard deviation of 0.94 and that the posttest means of the fraction problems' perception stage is 4.17 with a standard deviation of 1.11.

Table 2: pairwise t-test for comparison of the students' performance in the perception stage

Variable		Degree of freedom	t	Significance level
Perception	Pretest	24	-2.3	0.031
	Posttest			

Based on Table (2), the pairwise t-test indicated that there is a significant difference between the pretest and posttest mean values of the students' performance in the fraction problems' perception stage so the researcher's assumption that the instruction of problem-solving influences the students' perception of the fraction problems is confirmed at a 0.05 error level.

Hypothesis Two: instruction based on the five-step problem-solving method influences the students' data classification performance in solving the fraction problems.

Table 3: Descriptive analysis of the students' performance in data classification stage

Variable		Number	Mean	Standard deviation	Standard mean error
Data classification	Pretest	25	1.78	0.64	0.13
	Posttest	25	3.70	1.19	0.24

Descriptive analysis of Table (3) showed that the mean pretest value of the data classification stage is 1.78 with a standard deviation of 0.64 and that the mean posttest value of the data classification stage is 3.70 with a standard deviation of 1.19.

Table 4: pairwise t-test for comparison of the students' performance in the data classification stage

Variable		Degree of freedom	t	Significance level
Data classification	Pretest	24	10.6	0.000
	Posttest			

Based on Table (4), the pairwise t-test indicated that there is a significant difference between the pretest and posttest mean values of the students' performance in the fraction problems' data classification stage so the researcher's assumption that the instruction of problem-solving influences the students' data classification performance in the fraction problems is confirmed at a 0.05 error level.

Hypothesis Three: instruction based on the five-step problem-solving method influences the students' plan proposition performance in solving the fraction problems.

Table 5: Descriptive analysis of the students' performance in plan proposition stage

Variable		Number	Mean	Standard deviation	Standard mean error
Plan proposition	Pretest	25	3.18	0.6	0.12
	Posttest	25	4.02	0.75	0.15

Descriptive analysis of Table (5) showed that the mean pretest value of the plan proposition stage is 3.18 with a standard deviation of 0.6 and that the mean posttest value of the plan proposition stage is 4.02 with a standard deviation of 0.75.

Table 6: pairwise t-test for comparison of the students' performance in the plan proposition stage

Variable		Degree of freedom	t	Significance level
Plan proposition	Pretest	24	-5.5	0.000
	Posttest			

Based on Table (6), the pairwise t-test indicated that there is a significant difference between the pretest and posttest mean values of the students' performance in the fraction problems' plan proposition stage so the researcher's assumption that the instruction of problem-solving influences the students' plan proposition performance in the fraction problems is confirmed at a 0.05 error level.

Hypothesis Four: instruction based on the five-step problem-solving method influences the students' answer-finding performance (plan implementation) in solving the fraction problems.

Table 7: Descriptive analysis of the students' performance in the plan implementation stage

Variable		Number	Mean	Standard deviation	Standard mean error
plan implementation	Pretest	25	3.40	1.13	0.23
	Posttest	25	3.70	1.02	0.2

Descriptive analysis of Table (7) showed that the mean pretest value of the plan implementation stage is 3.4 with a standard deviation of 1.13 and that the mean posttest value of the plan implementation stage is 3.70 with a standard deviation of 1.02.

Table 8: Pairwise t-test for comparison of the students' performance in the plan implementation stage

Variable		Degree of freedom	t	Significance level
plan implementation	Pretest	24	-2.7	0.013
	Posttest			

Based on Table (8), the pairwise t-test indicated that there is a significant difference between the pretest and posttest mean values of the students' performance in the fraction problems' plan implementation stage so the researcher's assumption that the instruction of problem-solving influences the students' plan implementation performance in the fraction problems is confirmed at a 0.05 error level.

Hypothesis Five: instruction based on the five-step problem-solving method influences the students' retrogression performance in solving the fraction problems.

Table 9: Descriptive analysis of the students' performance in retrogression stage

Variable		Number	Mean	Standard deviation	Standard mean error
Retrogression	Pretest	25	1.30	1.00	0.20
	Posttest	25	3.70	1.11	0.22

Descriptive analysis of Table (9) showed that the mean pretest value of the retrogression stage is 1.3 with a standard deviation of 1.00 and that the mean posttest value of the retrogression stage is 3.7 with a standard deviation of 1.11.

Table 10: Pairwise t-test for comparison of the students' performance in the retrogression stage

Variable		Degree of freedom	t	Significance level
Retrogression	Pretest	24	-10.08	0.000
	Posttest			

Based on Table (10), the pairwise t-test indicated that there is a significant difference between the pretest and posttest mean values of the students' performance in the fraction problems' retrogression stage so the researcher's assumption that the instruction of problem-solving influences the students' retrogression performance in the fraction problems is confirmed at a 0.05 error level.

Hypothesis Six: there is a significant difference between the students subjected to the five-step problem-solving instruction method and the students subjected to the traditional instruction method in terms of their performance in solving the fraction problems.

Table 11: Descriptive analysis of the performance of the students taught based on the traditional method and problem-solving method

Variable		Number	Mean	Standard deviation	Mean standard error
Performance	Experimental (problem-solving)	25	15.06	4.4	0.89
	Evidence (traditional)	25	12.02	2.8	0.57

Descriptive analysis of Table (11) indicated that the students who have been subjected to five-step problem-solving instruction (experimental group) outperform the students taught based on the traditional method (evidence group).

Table 12: comparison of the performance of the students taught based on traditional and problem-solving methods

Variable		Degree of freedom	t	Significance level
Performance	Experimental (problem-solving)	48	2.55	0.02
	Evidence (traditional)			

Based on Table (12), the independent t-test indicated that there is a significant difference between the students subjected to the five-step problem-solving instruction method (experimental group) and the students subjected to traditional instruction method (evidence group) in terms of their performance in solving the fraction problems so the researcher's claimed assumption is confirmed at a 0.05 error level.

CONCLUSION:

Based on the findings of Table (2), there is a significant difference between the mean pretest and posttest values of the students' performance in the fraction problems' perception stage so the researcher's claimed assumption indicating the effectiveness of the problem-solving instruction in students' perception of the fraction problems is confirmed in a 0.05 error level. The significance of the differences in the pretest and posttest mean values of the students' perception of the fraction problems means that the students' abilities have been developed in perceiving the fraction problems in the posttest as compared to the pretest and that this progress is reflective of the effectiveness of the five-step problem-solving method in the students' perception of fraction problems.

According to the findings of Table (4), there is a significant difference between the pretest and posttest mean values of the students' performance in the data classification stage of solving the fraction problems so the researcher's claimed assumption that the instruction of the five-step problem-solving influences the data classification performance of the students in solving the fraction problems is confirmed at a 0.05 error level. The confirmation of the effectiveness of five-step problem-solving instruction in the data classification performance of the students when solving the fraction problems is suggestive of the idea that such a type of instruction can influence the students' recognition of the required data and elimination of the redundant data of the problem, specification of and organizing and rendering coherent the data and wants of the problem and assisting the selection of the proper strategy for proposing the plan hence solving the problem successfully.

Corresponding to the findings of Table (6), there is a significant difference between the pretest and posttest mean values of the students' performance in the plan proposition stage of solving the fraction problems so the researchers' claimed presumption that the instruction of the five-step problem-solving influences the plan proposition performance of the students in solving the fraction problems is confirmed at a 0.05 error level. The significance of the difference between the pretest and posttest mean values of the students' performance in the plan proposition stage when solving the fraction problems means that the students' abilities of plan proposition for solving the problems have been advanced in the posttest as compared to the pretest and such a progress is indicative of the idea that the five-step problem-solving instruction method has been able to positively influence the plan proposition skill and proper problem-solving strategy selection.

According to the findings of Table (8), there is a significant difference between the pretest and posttest mean values of the students' performance in the plan implementation stage of solving the fraction problems so the researchers' claimed presumption that the instruction of the five-step problem-solving influences the plan implementation performance of the students in solving the fraction problems is confirmed at a 0.05 error level. The significance of the difference between the pretest and posttest mean values of the students' performance in the plan implementation stage when solving the fraction problems means that the students' abilities of plan implementation for solving the problems have been increased in the posttest in comparison to the pretest and such a progress is indicative of the idea that the five-step problem-solving instruction method has been able to considerably elevate the students' plan implementation skill and running of the selected strategy and the process of reaching an answer and the subsequent mathematical processing thereof.

Based on the findings of Table (10), there is a significant difference between the pretest and posttest mean values of the students' performance in the retrogression stage of solving the fraction problems so the researchers' claimed presumption that the instruction of the five-step problem-solving influences the retrogression performance of the students in solving the fraction problems is confirmed at a 0.05 error level. The significance of the difference between the pretest and posttest mean values of the students' performance in the retrogression stage when solving the fraction problems means that the students' abilities of retrogression for solving the problems have been enhanced in the posttest in contrast to the pretest. The retrogression step was one of the most important parts focused herein. The confirmation of the effectiveness of five-step problem-solving instruction in the retrogression performance of the students when solving the fraction problems is suggestive of the idea that such a kind of instruction can also influence the review and evaluation as well as generalization and expansion and eventually the enhancement of the mathematical level of the students hence the successful solving of the fraction problems by them.

Descriptive analysis of Table (11) indicated that the performance of the students subjected to the five-step problem-solving instruction method (experimental group) is better than the performance of the students subjected to the traditional method (evidence group). According to Table (12), there is a significant difference between the students subjected to the five-step problem-solving instruction method (experimental group) is better than the performance of the students subjected to the traditional method (evidence group) in terms of their problem-solving performance so the researcher's claimed presumption is confirmed at a 0.05 error level.

Summary:

In our country, there are not performed many studies regarding the problem-solving methods and the researcher's efforts to finding similar studies were in vain. Amongst the foreign studies carried out in this regard is the one by Sukoriyanto et al (2016) that was undertaken in Indonesia under the title of "students' mistakes in solving the problems related to combinations and permutations based on Polia's problem-solving stages. This study's model is very close to the present research's though it lacks the data collection stage which is one of the most important parts of the current article. The results obtained by Sukoriyanto et al (2016) in a study of 25 students through the use of a 4-question test indicated that the students' abilities have been low in approaching the problem's data and that they underestimate the data classification. Due to the same reason, they make mistakes in perceiving the problems and cannot propose the proper plan and formula; the participants of the foresaid study were also found having a low capability in plan implementation.

Based on this study, the five steps, namely perception, data classification, plan proposition, plan implementation and retrogression, are very useful in problem-solving. Therefore, if these steps are taught to the students for problem-solving not as separate subjects but as general and integrated subjects, the students' problem-solving performance can be notably elevated.

The students were found mostly making mistakes in understanding the questions, especially in perceiving the key terms and concepts of the questions. In other words, most of the students could not figure out what the questions want. Therefore, it is better for the teachers of the education ministry to emphasize more on the understanding of the subjects by the students than the performing of the mathematical calculations.

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