

Comparing the Effect of 5 E and Problem Solving Teaching Methods on the Students' Educational Progress in the Experimental Sciences Course

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ABSTRACT

This study reviews the effect of two teaching methods including the problem solving and E 5 on the fifth grade elementary school students' educational progress in the experimental sciences course in Dezful city during the years 89-90. This is an applied research and its method is quasi-experimental. The research has pretest - posttest plan with the experimental group 1 and 2. The Statistic Population of this study consists of all fifth-grade elementary school girls who were studying during the years 89-90 at elementary schools of Dezful city. From the primary schools, first a school was randomly selected in the two-stage cluster random method of sampling. The independent T-test was used in order to analyze data and determine the differences in educational progress of two groups significantly. Results indicated that there were significant differences between the average of educational progress in students who were educating by the E 5 and problem solving methods. In the other words, the students who were trained by the E 5 method had higher educational progress compared to whom were trained by the problem solving method. In addition, there had been significant differences between the average of educational progress in strong and weak students' who were trained by the E 5 method and strong and weak students' who were trained by the problem-solving method. But there had not been any significant differences between the average of educational progress in intermediate students who were trained by the E 5 method and intermediate students who were trained by the problem-solving method.

KEY WORDS: Method; education; E 5 teaching method; problem solving teaching method; educational progress.

INTRODUCTION

Nowadays, having activity at schools and learning the sciences, skills and attitudes have been a huge part of individuals' life. We cannot assume the student and his education by the past attitude. Identifying and benefiting from the new methods of teaching is a very important issue which needs to be addressed. Students should personally have a major role in learning and collaborate with teachers in adopting methods, selecting goals, and using the tools.

Teachers as people who have always been trying to train best students, have been exposed to varied expectations and demands by society, families, and students throughout the history, and all these have been in line with improving the quality and enhancing the students' learning. In response to these demands, students have also tried to create a continuous learning in the classroom and outside of it. If teachers enter the classroom with scientific knowledge about their profession and with practical skills in performing the role of teaching, they would certainly consider what are effective in teaching and learning, and perform the necessary actions for the students' comprehensive development by an overall but delicate and precise view.

The elementary period is the basis of children's preparation for entry into other courses. Teachers' knowledge, skill, and effort in this educational level are very important and effective; and teachers need to teach and communicate with students professionally and learn the teaching skills for training (Bahmai, 1389).

In recent years, fundamental changes are occurred in the structure, content and education methods in the world. Some of these changes influenced our educational system and remaining to some extent affects the different aspects of our educational system. Nowadays the teaching objects are different from that of two decades ago. Similarly, the current teaching methods are different from traditional teaching methods.

One of the main learning factors is teaching method that has crucial effect on enhancing the students' capabilities and correct understanding of new teaching methods can help us in preparing future labor force and equip the students with knowledge and skills to be successful in new unknown world challenges. The teachers should find some ways to change the monotonous atmosphere of the class of an exciting environment.

According to what was mentioned and the need for using the active teaching methods, the researcher intends to measure the efficiency and effectiveness of 5 E and solving problem teaching methods in the students' educational progress in sciences course and find that which of these two methods have greater effect on the

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student's educational progress in the sciences course; therefore, the obtained results make a belief and interest about changing the educational methods in the curriculum particularly in teachers.

Subject Expression

Nowadays, we live in the information and communication era and in the other words in the knowledge era. New technologies, especially the information and communication technologies have provided the field for rapid and irreversible changes in the world; these changes in developments and interactions have made challenges in the current society. One of these challenges happens in the field of education which has provide a new look to the system, and this is an education which is going to prepare humans for future (Omidi, 1390). Every human has merit, intelligence and talent in different way. But our problem (as the educational teacher) is that we do not identify and put the learners' capability and talent under review. Selecting and applying the appropriate methods for teaching different subjects and courses can attract the students' mind and help them to understand, develop, and expand the talents (Abdullahi, 1387).

Active learning is the result of teaching method in which students are involved actively. Active teaching methods involve the students in the groups with defined roles for each student and the task is done in the group. Active teaching method increases class learning knowledge and memorization (Keyser, 2000).

Learning based on problem solving began by encountering the student with a problem, team or individual work based on the teaching objective. The teachers here are facilitator not the primary database (Kar and Hamkar, Translated by Fardanesh, 2008).

And the students test their solutions and conclude based on the test (Rahalzadeh, 2008).

There are different methods for problem solving method that most important models are stated by John Dewy and George Polya and this research is designed based on Polya four -step model.

5E method is a method which can be used for preparing teachers in the teacher training courses and during the service; this method is so popular in America. The reason why it is named 5 E is that it contains five steps and the name of these five steps begins with E in English.

Numerous studies in abroad have confirmed the efficiency of active methods (Jaklin 2007; Dinsio et al, 2010), and researches which have been conducted domestically suggest the effectiveness of active teaching methods (Heidari, 1384; Kanaani, 1378; Abiri, 1389; Dehghanpour, 1389). Researchers' exploratory studies have shown that there has not been any research in Iran which directly compares the effect of E5 and problem solving teaching methods in students' educational progress in the sciences course; therefore, it seems necessary to conduct research in this field.

Elaboration of E5 method

Teacher has a key role in the education process. The teacher is one who can fulfill the educational goals or makes them ineffective. Hence, making change in the teachers' attitude towards the teaching and training is essential, and this attitude changing should to be started from the teacher training and in-service training courses. 5E method is one of the ways which can be used for preparing teachers in teacher training and in-service courses.

The steps of 5E method

1 – Engagement with subject: In this step, teacher engages students with the subject of course by showing a picture, telling a story, asking a question, running a show, taking students out of class and showing them the phenomena in order to make the students' previous learning clear. For example: In teaching the insect topic, the teacher asks students to collect a number of insects from the environment and bring them to class.

2 - Searching and Exploration: In this step, by teacher's guidance the students research and explore the subject through the observation, measurement, testing and comparison, and..., and try to find the points of course they lost. This step gives the students courage to ask questions. Thus, the students do mental ad handy activities in order to explore the subject. In the case of insects, students observed the insect body parts with a microscope, distinguished different parts from each other, and painted them in their own notebook.

3 – Subject Explanation: In this step, the students explain about their findings and express what they think is right without fear or anxiety and defend them. Students' right or wrong opinions is not important in this step but what matters is that students are able to defend their findings and explain them well logically and reasonably. Here, teacher corrects the students' ideas, and teaches the new words, concepts, and scientific information. In the case of insects, teacher will teach the name of insect's various organs and their role in the body.

4 - Subject Elaboration: In this step, teacher guides students through referring to various sources including books, Encyclopedia, magazines, knowledgeable and experienced people, the Internet and ... in order to expand their knowledge about the subject. In the case of insects, teacher asks students to study about the name of insect, its living environment, and benefits and possible harms and report them to class.

5 – Evaluation: In this step, teacher finds by the evaluation that whether students have achieved their desired goals or not; and what is the cause if they have not got them? And what other actions should be taken in order to

achieve the objectives of course. In case of insects, the teacher asks about the role of various organs of insect body.

Benefits

- 1 – The students' previous learning will be revealed.
- 2 – In this method, teacher has the guiding role, and students search on their own, so they will learn better.
- 3 - Students will find the courage to ask the questions.
- 4 - Students do mental ad handy activities in order to explore the subject.
- 5 - Students explain about their findings and express what they think without fear and defend it.
- 6 - Students are continually evaluated.

Constraints

- 1 - In this method, teacher will face with a difficult task.
- 2 - The class time is limited in order to complete the students' presentations (Adibnia, 1389 b).

Problems solving method

The condition in which the learner by information and the skills on that time cannot react immediately to it and he has not find his way to achieve the goal, this is a problem (Seif, 2001)

Morgan et al (Cited in Adibnia, 2010 a) knows problem as "a conflict or the difference between the current condition and another condition we want to create". Recognition and application of knowledge, previous skill and experience of a person leading into the correct answer of the learner to the condition and finding sequence and order of the ways to achieve the goal is called problem solving (Seif, 2001).

Problem solving steps:

- 1- Understand the problem: The first expectation we have of the learners is the recognition of the problem. This is called recognition and requirements of the problem.
- 2- Make a plan: in this method planning the problem solving is the most important action. Creating a series of the required skills for thinking and searching different ways is occurred in this stage.
- 3- Carry out the plan: After the selection of different solutions an reaching the agreement, the learners should carry out the achievements as individuals and give their activity report to the group and groups members after discussing give the results to other students.
- 4- Look back at the solution: In this stage the students evaluate all the 3 steps again with the help of their children. All the applied methods are compared, if possible and the probable limitations are discussed.

Advantages

- 1- It connects school activities with the real life of the students.
- 2- It is one of the best methods for creating inductive thinking and scientific reason in students.
- 3- It gives motivation to the students.
- 4- It increases understanding of science, creating thinking and information analysis.
- 5- By this method, research method can be taught to children.

Limitations

- 1- Needing experienced and research knowledgeable teachers.
- 2- It is time-consuming (Shabani, 2000, p. 349).

REVIEW OF LITERATURE

Various studies are carried out regarding the effectiveness and efficiency of some of educational methods by education researchers. The results of these studies have mostly taken the attention of education system authorizes to improve and modify educational methods. These results depending on the type of research show the desirability of some of the methods in comparison with the other methods. Some examples of the researches carried out in Iran and the world are reviewed in the followings.

Research background of active teaching methods in abroad

Kele & chane, 1988 (Cited in Heidari, 2005) in a research study compared the effectiveness of mastery learning method on academic achievement of reading in weak and strong students. In that study, 180 students of 3rd grade with a wide range of reading capabilities were in 4 conditions randomly, they were considered in one of 4 groups in which a different level of mastering was taught. In each group the students with high and low cognitive entry behavior (CEB) were present. The first group was exposed to mastery learning for each unit, the student performed pre-test post-test and were taught in group after this step, they underwent again pre-test post-test and corrective learning was applied on them to obtained unit mastery on the required criterion. The first

group was expected that before entering one stage achieve 90% mastery in the previous unit. While in the second group it was required that to go into the next stage, 70% mastery is obtained. The third groups used the teaching of 3 units- one by one and by traditional method without considering the function level of post-test. The fourth group (control group) were ignored in learning three units. At the end of the program, 4 groups performed comprehension test to evaluate their summative achievement. The results of comprehension summative test showed that mastery-learning program was mostly in favor of weak students than strong students. It means that strong students in control group and incorrect mastery group like their equivalents were in mastery group of 70% and 90% but regarding the weak students, only the students in group of 90% mastery revealed good achievement.

Williams (1992) in a study reviewed the effect of collaborative and individual learning in students' academic achievement. The results of this general study showed that: There is significant difference in terms of academic achievement between the subjects being taught using collaborative learning in comparison with the subjects being taught individually. It means that the subjects being taught as actively had high academic achievement level.

Thompson (1997) in a study reviewed the effect of active learning on academic achievement. The research divided the subjects- in elementary school- as randomly into two groups. One group learning collaboratively and another group were exposed to traditional teaching. The results showed that there is not significant difference in terms of academic achievement between two groups.

Jecklin (2007) in a research called as the effect of active-collaboration learning in the priority of learning strategies in nurse students as a semi- empirical research to identify the effect of the combination of active and collaboration method in classrooms and the priority of students activities based on active teaching method divided nurse students in Virginia university as randomly. In one section receiving was in the first priority of active learning while in another section, receive was in the second priority and it was taught by traditional method based on lecture. The results of this research showed that the students being taught by active method after one semester give more importance to active learning method and the students being exposed to traditional education, gave less importance to traditional methods. In addition, the students of active learning classes were increased.

Dinescu et al (2010) in a research called " Necessities of active teaching in teaching science in highschool asked for the opinion of teachers about selecting criterions for teaching method as these methods are important in teaching process. The results of this study showed that for math and science teachers, doing active teaching method was not in the priority. Also in another study he studied the effect of some of collaborative active strategies in students' academic achievement in physic and found that by active methods considerable academic achievement in physic will be achieved.

Review of literature of active teaching methods in Iran

In our country regarding the there is not research about the comparison of the effect of modular teaching method and problem solving method on academic achievement of the students in science text book of elementary grade. Here, we only mention some examples of the research in which active teaching methods are compared with traditional teaching methods.

Kanani (1999) in a research called "The comparison of the effect of collaborative teaching method with traditional method (lecture) on academic achievement of girl and boy students of first of high school in Rasht "compared strong, moderate and weak students academic achievement in collaborative and traditional methods and compared the effect of collaborative teaching method on academic achievement of girls and boys. To do this, he divided 100 people (50 girls and 50 boys) randomly into 4 classes of 25 and in two classes, collaborative method and in the other 2calsses, traditional method was used. The studied topic was geometry (1).The results showed that collaborative learning in comparison with traditional learning increased academic achievement of the students. Also, collaborative learning had equal effect on academic achievement of girls and boys. In additional strong, moderate and weak students benefit collaborative learning equally.

Ansari (2000) in a research titled "The effective of metacognitive strategies on academic achievement and self-control of girl students in first of high school of region 19 in biology textbook". He evaluated the effectiveness of metacognitive strategies as group work by traditional method (lecture) in academic achievement of strong, moderate and weak students. To do this, he selected a school randomly among the schools and among first of high school classrooms randomly selected two classes and grouped them randomly in experimental and control group. Both groups performed research-based pre-test and then in experimental group, metacognitive strategies learning method and in control group traditional method (lecture) were preformed for 6 weeks and then a researcher-based post-test was done in both classes. The results showed that in terms of academic achievement there is no significant difference between using metacognitive strategies method in group work and lecture method in all the students and subgroups of strong, moderate and weak.

Heidari (2005) in a research titled "The comparison of the effect of two teaching methods 5E and traditional in academic achievement of fifth grade of elementary students in natural science in Ghaemshahr in

academic year 2004-2005 found that there was significant difference between average of academic achievement of the students exposed to 5E method and the students exposed to traditional teaching. Also the academic achievement of moderate students exposed to 5 E teaching methods is more than that of moderate students being taught by traditional method. But there was not significant different between average of academic achievement of strong and weak students exposed to 5E teaching method and strong and weak students exposed to traditional methods. This research was practical and semi-experimental. This design of this research is pre-test – post test with experimental group 1, 2. Sampling method in this research is two-stage cluster random method.

Abiri (2010) carried out research titled “The comparison of the effect of collaborative, explorative and lecture teaching method on academic achievement and attitude toward physic in girl students of first of high school in Sangar region in Gilan. Statistical population of this research was all the girl students of first of high school in Sangar region. The findings of this research showed that there was significant difference between collaborative and explorative teaching method in academic achievement of physic and the average of added scores of collaborative groups was more than explorative group but there was no significant different between two other groups two-by –two.

Dehqanpour (2010) did a research titled “teaching geometry by educational hand-made tools and its comparison with traditional teaching method in girls’ guidance schools of Kerman in academic year 2009-2010. In this research, two experimental and control group were selected by cluster sampling method including 40 girl students. In one group by educational hand-made tools and in another group it was being taught by traditional method. Then, to review research hypotheses, Thales' theorem and similar figures were selected for doing the tests. Different questionnaires and tests are provided for students. Attitude of teachers about the effect of learning hand-made tools on students was measured by researcher-built questionnaire. In this research in addition to descriptive statistics such as mean and variance, T-test of independent groups was used. After data analysis, these results were achieved: Applying hand-made tools in math teaching in comparison with traditional teaching method are effective on increasing learning level, improving positive attitude in students about the required textbook, enjoying more of math, less fear and anxiety of this book, increasing motivation, increasing importance of math, increasing the capability of math problem solving and increasing the amount of metacognition in students and teachers have positive view about educational hand-made tools.

Research design

Research design of this research is of quasi-experimental designs with equal pretest-posttest that is performed by two-group method. Its model is as the followings:

Table 1- Two-group research design

| pre-test | Independent variable | Post-test |
|----------|----------------------|-----------|
| O1 | X1 | O2 |
| O1 | X2 | O2 |

Statistical population

Statistical population in this study is including all girl students of fifth grade of elementary school studying in academic year 2010-2011 in elementary schools of Dezful city.

Statistical sample, sampling method and sample volume

In this aspect of research related to empirical design, sampling unit is class (group). For sampling of target population, two-stage cluster random sampling method was used. As in urban schools for sampling clusters, two girls’ schools and from the mentioned schools two classes (group) of fifth grade of elementary school were selected and were tested. The tested classes were including 36 students. Experimental groups in this research are including students of 2 selected classes.

Research instruments

In this research natural science text book of fifth grade of elementary school published in 2008 was used and during research work sessions, learners were exposed to teaching. The exact properties of textbooks used in this research are presented in table (2).

Table 2- The properties of teaching texts

| subject | Text |
|-----------------|--|
| Natural science | Materials structure, materials changes, machines, light and color of section 1, earth history of section 2 |

To study the academic achievement to evaluate research variable, research-built tests (multiple- choice) in pre-test and post-test were used. The questions of this test (pre-test and post-test) were similar and they were designed based on Bloom's Taxonomy for Cognitive Learning. Thus, the required data was obtained of reviewing academic achievement tests.

Reliability and validity of data collection

In this research to be sure of content validity of the test, two dimensional table (properties table) and opinion of some of teachers and natural science experts and education science teachers are asked. The results indicate high validity of the questions.

Consistency of a test in measuring the required subject during different periods is called reliability. Among different methods used for determining reliability of a test, cronbach's alpha method is used to determine internal consistency of a test (Moemeni, 2008). In this study cronbach's alpha is used for reliability of test that indicates good reliability of the test (Table 3).

Table 3- Reliability of test questions

| Number of items | Cronbach's Alpha |
|-----------------|------------------|
| 43 | 0.713 |

RESEARCH METHOD

In this study, subjects participated in two experimental groups in order to learn the sciences course in the fifth year of primary school. About the method of research implementation, the program was conducted in the following steps according to a regular and pre-designed program and by considering all factors and variables which could make problems in implementing the program.

After determining the desired size, text and subject of sample and by considering the conditions, the groups were pretested in order to have the criterion for comparing with the posttest. Then the current study was conducted during 40 sessions of 50 minutes at the test classes. The experimental group 1 was trained with the 5E teaching method and 20 sessions, and the experimental group 2 with the problem solving teaching method and 20 sessions. After the completion of training course, the learners' learning level in the experimental groups was measured by the posttest.

Analysis of research findings

Main Hypothesis: There are differences among the educational progress scores gained by students who are trained with the problem-solving teaching method and whom are trained with 5E teaching method.

Table 4- The frequency distribution of educational progress in groups 1 and 2

| Educational Progress | frequency | | Percentage of frequency | |
|----------------------|----------------------|----------------------|-------------------------|----------------------|
| | Experimental group 1 | Experimental group 2 | Experimental group 1 | Experimental group 2 |
| 2-3 | 3 | 14 | 16.66 | 77.77 |
| 4-5 | 7 | 4 | 38.88 | 22.22 |
| 6-7 | 5 | 0 | 27.77 | 0 |
| 8-9 | 1 | 0 | 5.55 | 0 |
| 10-11 | 1 | 0 | 5.55 | 0 |
| 12-13 | 1 | 0 | 5.55 | 0 |
| Sum | 18 | 18 | 100 | 100 |

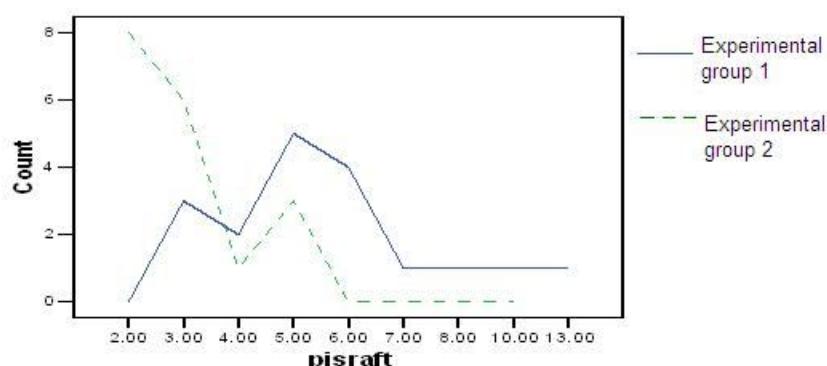


Chart 1: Polygonal diagram of educational progress in the experimental groups 1 and 2

Table 5- Independent T test results of main hypotheses

| Experimental groups | Teaching Method | Total Subjects | Mean | Standard Deviation | Standard error | Degree of Freedom | Confidence Level | Observed T | T-Table |
|----------------------|-----------------|----------------|------|--------------------|----------------|-------------------|------------------|------------|---------|
| Experimental group 1 | 5E | 18 | 6.77 | 3.53 | 0.69 | 34 | 0.05 | 4.34 | 2.04 |
| Experimental 2 | Problem solving | 18 | 3.94 | 1.9 | 0.36 | | | | |

Considering that the value of observed T (4.34) in the confidence level 0.05 and degree of freedom 34, is higher than the T Table (2.04), the hypothesis zero is rejected and it is concluded that the difference between two means is significant, in the other words, sufficient evidence show that there are differences between the effect of two methods on the progress and the effect of 5E teaching method on the educational progress is higher than the problem solving teaching method.

Sub-hypothesis 1: There is a difference between the educational progress in active students who are training with 5E teaching method and the active students training with problem solving teaching method.

Table 6- Frequency distribution of active students' educational progress in the groups 1 and 2

| Educational Progress | Frequency | | Percentage of Frequency | |
|----------------------|----------------------|----------------------|-------------------------|----------------------|
| | Experimental group 1 | Experimental group 2 | Experimental group 1 | Experimental group 2 |
| 2-4 | 0 | 3 | 0 | 100 |
| 5-7 | 3 | 0 | 100 | 0 |
| Sum | 3 | 3 | 100 | 100 |

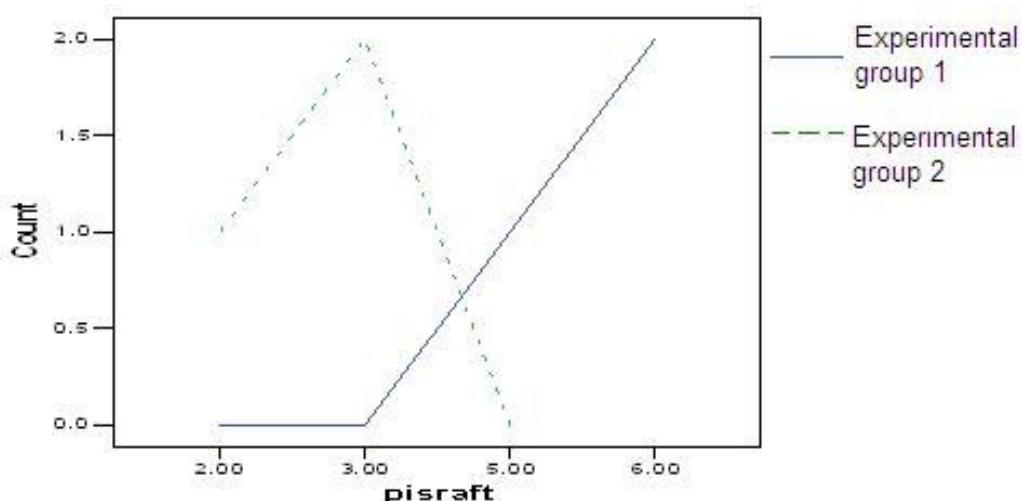


Chart 2: Polygonal diagram of educational progress in active students in the experimental groups 1 and 2

Table 7- Independent T test results of sub-hypotheses 1

| Experimental groups | Teaching method | Total Subjects | Mean | Standard Deviation | Standard error | Degree of Freedom | Confidence Level | Observed T | T-Table |
|----------------------|-----------------|----------------|------|--------------------|----------------|-------------------|------------------|------------|---------|
| Experimental group 1 | 5E | 3 | 4.54 | 0.47 | 0.33 | 4 | 0.05 | 6.36 | 2.77 |
| Experimental group 2 | Problem solving | 3 | 2.46 | 0.38 | 0.25 | | | | |

Considering that the value of observed T (6.36) in the confidence level 0.05 and degree of freedom 4, is higher than the T Table (2.77), the hypothesis zero is rejected and it is concluded that the difference between two means is significant, in the other words, there are differences between the educational progress in active students who are trained by the 5E teaching method and the ones trained by the problem solving method; it means that the active students who are trained by the 5E teaching method have higher educational progress than the ones trained by the problem solving teaching method.

Sub-hypothesis 2: There is a difference between the educational progress in intermediate students who are training with 5E teaching method and the intermediate students training with problem solving teaching method.

Table 8- Frequency distribution of intermediate students' educational progress in groups 1 and 2

| Educational Progress | Frequency | | Percentage of Frequency | |
|----------------------|----------------------|----------------------|-------------------------|----------------------|
| | Experimental group 1 | Experimental group 2 | Experimental group 1 | Experimental group 2 |
| 2-4 | 4 | 10 | 33.33 | 83.33 |
| 5-7 | 7 | 2 | 58.33 | 16.66 |
| 8-10 | 1 | 0 | 8.33 | 0 |
| 11-13 | 0 | 0 | 0 | 0 |
| Sum | 12 | 12 | 100 | 100 |

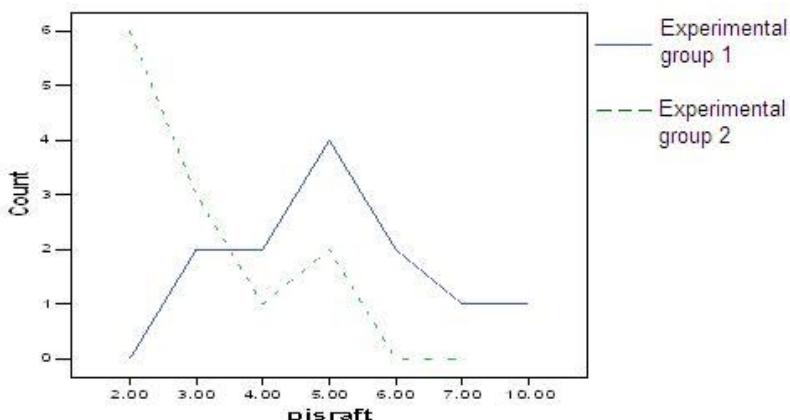


Chart 3: Polygonal diagram of educational progress in intermediate students in the experimental groups 1 and 2

Table 9- Independent T test results of sub-hypotheses 2

| Experimental groups | Teaching method | Total Subjects | Mean | Standard Deviation | Standard error | Degree of Freedom | Confidence Level | Observed T | T-Table |
|----------------------|-----------------|----------------|------|--------------------|----------------|-------------------|------------------|------------|---------|
| Experimental group 1 | 5E | 12 | 5 | 3 | 1.89 | | | | |
| Experimental group 2 | Problem solving | 12 | 3.23 | 0.52 | 0.88 | 4 | 0.05 | 1.54 | 2.77 |

Considering that the value of observed T (1.54) in the confidence level 0.05 and degree of freedom 4, is lower than the T Table (2.77), the hypothesis zero is confirmed and it is concluded that the difference between two means is not significant, in the other words, there are not any differences between the educational progress in intermediate students who are trained by the 5E teaching method and the ones trained by the problem solving method; it means that both methods do not affect the intermediate students.

Sub-hypothesis 3: There is a difference between the educational progress in inactive students who are training with 5E teaching method and the inactive students training with problem solving teaching method.

Table 10- Frequency distribution of inactive students' educational progress in the groups 1 and 2

| Educational Progress | Frequency | | Percentage of Frequency | |
|----------------------|----------------------|----------------------|-------------------------|----------------------|
| | Experimental group 1 | Experimental group 2 | Experimental group 1 | Experimental group 2 |
| 2-7 | 1 | 3 | 33.33 | 100 |
| 8-13 | 2 | 0 | 66.66 | 0 |
| Sum | 3 | 3 | 100 | 100 |

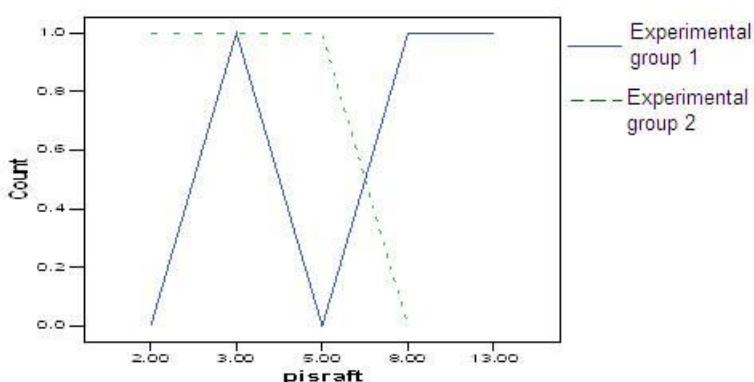


Chart 4: Polygonal diagram of educational progress in inactive students in the experimental groups 1 and 2

Table 11- Independent T test results of sub-hypotheses 3

| Experimental groups | Teaching method | Total Subjects | Mean | Standard Deviation | Standard error | Degree of Freedom | Confidence Level | Observed T | T-Table |
|----------------------|-----------------|----------------|------|--------------------|----------------|-------------------|------------------|------------|---------|
| Experimental group 1 | 5E | 3 | 5.25 | 1.81 | 0.55 | | | | |
| Experimental group 2 | Problem solving | 3 | 2.91 | 1.15 | 0.33 | 22 | 0.05 | 3.60 | 2.07 |

Considering that the value of observed T (3.60) in the confidence level 0.05 and degree of freedom 22, is higher than the T Table (2.07), the hypothesis zero is rejected and it is concluded that the difference between two means is significant, in the other words, there are differences between the educational progress in inactive students who are trained by the 5E teaching method and the ones trained by the problem solving method; it means that the educational progress in inactive students who are trained by the 5 E teaching method is higher than the ones trained by the problem solving teaching method .

DISCUSSION AND CONCLUSION

Conclusion about the main hypothesis: This hypothesis suggests that there is a difference between the means of educational progress in students who are trained with 5E teaching method and the ones trained by the problem solving method. This hypothesis is confirmed. In the other words, the data analysis has indicated that there is a difference between the effect of 5E and problem solving teaching methods on the students' educational achievement; and according to the means, the effect of 5E method on the educational progress is higher than the problem solving method.

The results of this study are in line with the findings obtained by Heidari (1384), Abiri (1389), Dehghanpour (1389), Williams (1992), Jaklin (2007), and Dinsio (2010), because all these researches have shown that the active teaching methods affect the educational achievement, and the education-centered teaching method is more effective than the teacher- centered method.

Moreover, the results of this study are not in line with the findings obtained by Ansari (1379) and Thompson (1997), because there are not any significant differences between the students' educational progress by the active teaching methods and other methods.

Conclusion about the sub-hypothesis 1: This hypothesis suggests that there is a difference between the level of educational progress in active students who are trained with 5E teaching method and the active students trained by the problem solving method. This hypothesis is confirmed. In the other words, the obtained analysis has indicated that the effect of 5E method on the active students' educational progress is higher than the problem solving method.

The results of this study are in line with the findings obtained by Kanaani (1378), because this researcher has concluded that the active teaching methods affect the active students' educational achievement. Moreover, the results of this study are not in line with the findings obtained by Ansari (1379) and Heidari (1384), and Kale and Chan (1998) because these researchers have not found any significant differences among the educational progress in active students who are trained by different teaching methods.

Conclusion about the sub-hypothesis 2: This hypothesis suggests that there is a difference between the level of educational progress in intermediate students who are trained with 5E teaching method and the intermediate students trained by the problem solving method. This hypothesis is not confirmed. In the other words, obtained data analysis has indicated that the effect of both methods on the intermediate students' educational progress is the same. In addition, there are not any significant differences between the educational progress in intermediate students who are trained by the 5E teaching method and the intermediate students trained by the problem solving method.

The results of this study are in line with the findings obtained by Ansari (1379), because this researcher has not found any significant differences between two methods of using the meta-cognitive strategies in groups and the presentation method in intermediate students. Moreover, the results of this study are not in line with the findings obtained by Kanaani (1377) and Heidari (1384), because these studies have indicated that the active cooperative teaching method has a positive effect on the level of learning and educational progress in intermediate students.

Conclusion about the sub-hypothesis 3: This hypothesis suggests that there is a difference between the level of educational progress in inactive students who are trained with 5E teaching method and the inactive students trained by the problem solving method. This hypothesis is confirmed. In the other words, obtained data analysis has indicated that the effect of 5E method on the inactive students' educational progress is higher than the problem solving method. In addition, there are significant differences between the educational progress in inactive students who are trained by the 5E teaching method and the inactive students trained by the problem solving method.

The results of this study are in line with the findings obtained by Kale and Chan (1998), because these researchers have concluded that the effectiveness of teaching methods for students who are scientifically weaker has been more beneficial. The results of this study are not in line with the findings obtained by Ansari (1379) and Heidari (1384), because these researchers have not found any significant differences between two methods of using the active teaching methods and the presentation method in the inactive students

REFERENCES

- Adib Nia, Asad, (1389 a), Advanced teaching methods, Isfahan: Kankash Publications;
- Adib Nia, Asad, (1389 b), Methods and techniques of teaching Experimental Sciences, Isfahan: Kankash Publications; Ansari, Maryam, (1379); The effect of meta-cognitive strategies on the female students' educational progress and self-controlling in biology course in the first year of high school. Unpublished MA thesis, Allameh Tabatabai University;
- Omidi, Fereydoun; and Ebrahimi, Somayeh (1390), Modern teaching-learning methods, Isfahan: Kankash Publications;
- Heidari, Reza, (1385); Comparing the effect of 5E and presentation teaching methods on the male students' educational progress in the biology course in the fifth class of elementary school in Ghaem Shahr during the school year 1383-84, unpublished MA Thesis, Allameh Tabatabai University;
- Dehghanpour, Maryam, (1389); Teaching the geometry using the educational handmade tools and comparing it with the traditional teaching method at secondary female schools in the district 1 of Kerman city during the school year 88-89, M.A. Thesis, Shahid Bahonar University of Kerman;
- Rahal Zadeh, Reza, (1386); The best teaching methods with emphasis on the types of instructional design, Tehran: Jahad Daneshgahi University, Teacher Training unit;
- Seif, Ali Akbar, (1380), Developmental psychology, Tehran: Agah;
- Shabani, Hassan, (1379), Skills of education, Tehran: Samt;
- Abdollahi, Hossein, (1387), Introduction of teaching methods, techniques and skills, Tehran: Allameh Tabatabai University Press;
- Abiri, Marjan, (1389), Comparing the effect of cooperative (partnership), exploratory, and presentation teaching methods on the educational progress and attitude towards the physics course in female students at secondary school in the Sangar region of Gilan and the first grade of high school, not published M.A Thesis, Gilan University;
- Kanaani, Shahnaz, (1378), Comparing the effect of collaborative teaching method with the traditional teaching method (Presentation) on the first grade male or female students' educational progress at high school in Rasht city, not published Thesis, Allameh Tabatabai University;
- Carr, David; Makher, Fanster, Son, Richard, et al., (1387), Advanced teaching methods (translated by Hashem Far-Danesh), Tehran: Kavir, (It does not have a publication date in the original language).
- Dinescu ,L.,et al.(2010).Active strategies- option and necessity for teaching science in secondary and high school education. Procedia Social and Behavioral Sciences 2, 3724 .
- Jecklin,K.S.(2007).The impact of active/cooperative instruction on beginning nursing student learning strategy preference. Nurse Education Today, 27, 474
- Keyser , M.(2000). Active Learning and cooperative learning : understanding the difference and using both styles effectively . Research Strategies,17 ,39-44 .
- Thompson , C.(1997). Differences in classroom teaching preferences between traditional and adult BSN students. Journal of Nursing Education 36, 165.
- Williams ,K.A.(1992). Active learning in action. RQ 31 (Spring), 328.