An Investigation on the impact of using problem-based trainings in the in-service courses on the teachers' performance and capabilities, by relying on the elementary sixth grade mathematics book (case study: the city of Ahvaz)

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Abstract
Changes in the administrative structure of the education system and the need to coordinate with the world of science and technology and hence, the need to update the general and technical information and knowledge, have doubled the importance and necessity of holding the new and efficient in-service trainings for the teachers. In this study, the attempt was taken to examine and analyze "the impact of using problem-based trainings during the in-service courses on the teachers' performance and capabilities, by relying on the mathematics book of the sixth grade elementary level (case study: the city of Ahvaz)". To do so, using a quasi-experimental study, 37 teachers of the sixth grade were selected from the elementary schools of Ahvaz city. For the in-service training courses on the teaching of mathematics, the problem-based learning method was used. After conducting the problem-based teaching method and the traditional method of teaching, through using the test and the standard questionnaire, the data about the teaching practice and the capabilities of the teachers were collected. Using t-test for the paired and independent samples, it was demonstrated that the problem-based in-service trainings, enhance the teachers' capabilities and performance regarding the problem-solving skills.

Keywords: In-service training, Problem-based teaching, Teachers, Math, Problem solving, Problem solving skill, Educational capacities.

1 Introduction

To prepare the new generation for living in the future, the education system must be responsive to the demands based on the new circumstances and it must adapt itself to them, by recognizing the spirit of the time and the needs emanating from it. (Fallahi, 1388) [3]. Addressing how to train pre- and in-service teachers is very important. Moreover, preparing the present teachers of the education system for using the
active teaching methods in the process of teaching and learning in the form of long-term and short-term courses are also necessary. Teaching as a very important factor and as a key element for achieving the goals and implementing the programs of the education system, intend to achieve the goals such as: Raising the level of knowledge and job skill, creating the necessary expertise that fit the job, improving the methods to increase the level of professionalism, creating the spirit of study, research and innovation, updating the knowledge and information, and creating the context for the appropriate adaptability of the individuals to the changes, to be able to access the benefits of job trainings.

Orangi et al. (1390) [1] examined the effect of in-service training courses held in the field of teaching methods and techniques, class management, assessment and measurement on the performance of teachers in four education zones of Shiraz city. The results of this study showed that the in-service training courses of the teaching methods and techniques, classroom management, assessment and measurement, have no effect on the professional performance of the teachers in their class practice, class management, and their classroom assessment of their students' academic achievements.

Rezaei Kalantary et al. (1391) [2] examined the factors contributing to the establishment of virtual in-service training courses from the viewpoints of teachers in the city of Sari. The results of their study showed that all the three factors of: hardware, software and human are affective in the establishment of the virtual in-service courses. Moreover, considering the statistical samples, despite the fact that software factors have more shares in the establishment of in-service training courses, there was a difference between the opinions of teachers and in-service teachers.

Mahmoudi et al. (1392) [4] examined the role of in-service training courses on the individual professional, and organizational performance of the employers and the teachers working for the education organization of Marivan city. The research findings showed that the training courses have improved the individual, professional, and organizational performance of the staffs and the teachers working for the education organization. Moreover, the ability of working with Word and Excel software were selected as the most practical skills, from the viewpoints of the staffs and the teachers. On the other hand, It was found that enhancing the computer knowledge and improving the professional performance were the main goals of the teachers and staffs for taking the ICT training course.

The Parado's research (2002) has proved that the trained teachers have a significant influence on the creative performance, academic achievement and cognitive development of the students; and this influence involves both gifted students and untalented ones. Considering the research results, Parado suggests that some regular and continuous trainings be held for the teachers, especially in developing countries.

Kabryta et al (2015) investigated the teachers' in-service trainings and the educational restoration at high school. They searched for the necessary features for training the math teachers. They emphasized on the resources and the international scopes in the field of mathematics teaching. The teachers' training courses were conducted on the basis of the educational changes. They showed that the teachers' in-service training is effective in the way of ensuring the appropriate implementation to rebuild the education of high school.

Tarhan (2015) in a study, investigated on the status of the teachers' in-service training and the teachers' training in the National Council of Education. He showed that in the National Council of Teachers, all the components of the teachers' educational system are under the permanent review process, and the teachers' training constantly changes according to the global changes. He reviewed the change process of the Teacher Education from the seventh to the eighteenth period of the National Council's activity. In the eighteenth period, the decisions were made on the efficient training of the teachers.

Niculescu & Percec (2015) in a study, investigated on the intercultural education and the development of the pre-service and in-service teachers. Their study aimed to change the good educational experiences about methodology and understanding of the cultural and intercultural diversity of the teachers. Through interviews with teachers, they showed that the teachers were trained with opener views toward their own
culture. Relying on the culture of each group of teachers, the educational process made them to improve their hearing and decision making abilities.

Problem solving is a form of a very complex learning and problem and the attempt to solve that problem is the part of any individual's life. It can be said that the process of dealing with the living conditions is the problem itself. In teaching mathematics through problem-solving, the real-world is the starting point; that is to say, the problem is selected from the real world and then it is translated into mathematical language. This translation is in fact a kind of mathematical modeling. Sometimes, for the better understanding or for more accurate translation, we may take several round-trips between the real world and the mathematics world, to finally solve it mathematically in the mathematics world. However, this is not the ending point; the problem must be interpreted and translated in the real world. The interaction between the two worlds will continue dynamically and every time a new problem will promote the mathematics and add new sections to it. On the other hand, the expansion and promotion of mathematics will open the door to solving the more complex problems than the problems in the real world.

If we ask the math teachers what is the main problem of their students in mathematics, they will certainly say: "They are incapable of solving the problems". One of the reasons for this inability is the lack of design for teaching the problem solving skills to the students; or in the other words, that the teachers have not taught them how to solve the problems. Whenever the students faced a problem and were unable to solve that, the teachers relied only on expressing the solution or the answers to the problem; and the questioning, curious, and puzzled looks of the students remained with these questions: how could our teacher solve the problem? How the answer to the question came to his mind? Why could not we find the solution? In most cases, those teachers who have tried to teach the solution to their students in a way; did it in a wrong way, through providing incorrect teachings.

For example, they have told the students: "The numbers in the problems are very important. Underline them. Do not forget that you should use them". This false teaching has led students not to recognize information of the problem. Therefore, according to the fundamental changes of the school textbooks based on the modern methods of teaching and learning (problem-based), the training courses related to these changes are held for the teachers and educators, using the traditional way of teaching (teacher-centered), in which only the teachers' knowledge, that is his subject knowledge will be enhanced. The researcher in this study tried to investigate the effect of the problem-based in-service courses in the sixth grade elementary school on the teachers' educational performance and capabilities.

2 Methodology

In this study, the quasi-experimental method is used, based on dividing the participants into the two groups of control and experiment. According to the quasi-experimental method, the researcher first randomly divided some of the teachers into the control group and some into the experimental group. Then in the control group, those teachers were considered that had received traditional in-service trainings, and in the experimental group, those teachers were considered that were trained with problem-based teachings. Therefore, according to this method, at the beginning, the pre-test was conducted in both groups and at the end, after the implementation of the problem-based teaching and traditional way of teaching, the post-test was administered.

3 Participants

Using multi-stage cluster sampling, from the whole teachers of the sixth grade at Ahwaz city, the sixth grade teachers of the zone 1, were selected, and further, 67 subjects were randomly selected from the sixth grade elementary school teachers. Then, 37 participants were randomly selected as the available sample for the experimental group and 30 participants were randomly selected as the available sample for the control group.
4 Instruments

Two instruments were used for this study. A questionnaire was used for assessing the extent of the teachers' training capability in problem solving skills that its problem-based training section was designed by Nantomah (2010) and its questions and items were combined and modified with the questions and items in the Heppner and Piterson's (1982) problem solving skills questionnaire and the questions related to Renee and Duncker's (2013) problem-based test design. This questionnaire consisted of 38 items which contain the following three parts:

- Part I: Problem-based teaching: 5 questions with four-point Likert scale
- Part II: problem-solving skills: 22 questions with five-point Likert scale
- Part III: problem-based test design: 11 questions with three-point Likert scale

The second instrument was test, using pre- and post-tests in mathematics which were designed and made for the sixth grade elementary school teachers and according to the education organization standards. The tests contained 6 questions with 20 points.

According to the questionnaire and test design, the experts examined their content validity and confirmed their validity. To test the reliability of the questionnaire, the Cronbach's alpha was used. The reliability of the questionnaire was proved with high reliability of 0.7 by the abroad researchers. After the data collection process, the researcher also achieved the reliability value of 0.73, using Cronbach's alpha.

5 Procedure

For the implementation of the problem-based learning method, the researcher first randomly assigned the sixth grade elementary school teachers into the two groups of control and experimental. In the control group, the participants were being trained in their in-service course, under the same traditional ways, but in the experimental group, the problem-based method of teaching was conducted for the participants by the researcher. At the beginning, a pretest on mathematics was taken from the sixth grade elementary school teachers. Then the questionnaire related to the extent of the teachers' teaching capabilities regarding the problem-solving skills was taken from the experimental group as a pre-test, before implementing the problem-based learning method. Then, the problem-based learning method was implemented for the experimental group as follows:

In this study, the "problem" is considered as a state, which defines a path for a particular purpose. The teachers solved the different problems based on the elementary sixth grade math book, through implementing the problem solving process. Teachers need to choose a method from the known methods, or they sometimes need to combine several different methods, although the highest difficulty level of a problem, is that they discover a new solution way. Its basis is to follow the model of "Polya and Shonfield" which contains the mathematical cognitive and meta-cognitive problem solving elements (Pinter, 2012). The problem-based learning stages began and conducted by designing a math problem "based on the elementary sixth grade math book problems", in the in-service training course, as it is explained below. At the time of conducting the study, the researcher tried to use the following steps in training the teachers, through designing various mathematical problems:

5.1. The steps for running the problem-based teaching

The researcher assigned the participants into the smaller groups. He then tried to lead the groups in a way that run all the following steps, one by one.

- Step 1: Understanding the problem- setting a goal
- Step 2: Proposing a plan and a strategy to solve it
- Step 3: Planning, reviewing the plan and if necessary modifying that
- Step 4: Reviewing and expanding the problem
Evaluation of the implementation way of the "problem-solving" steps

- problem-solving steps
- test, samples (examples), and counterexamples
- Drawing (drawing shapes)
- A set of problems, by asking "What if ... not be…?
- A multi-representation model

In this section we represent a "small sample" of what was implemented from the problem-based teaching section in the experimental group:

5.1.1. The Ratio and Proportion subjects of the elementary sixth grade math book

Problem: We bought a book with 10% discount and we sold it with 30% gain compared to the purchase price, for 14,040 Rls. What was the original price of the book? 
The researcher leads the teachers toward following the problem solving steps, by asking leading questions.

Step I:
The participants read the problem and recounted what they understood from it orally.
The problem's data or information: the percentage of the discount, the amount of profit compared to the purchase price, the sale price by counting the profit rate.
They defined the keywords. Such as discounts, profit, ......
The unknown information and the purpose of the problem: The percentage of the money paid for the book, the sales price percentage the book with its profit, the price paid to buy the books with its discount, the initial price of the book.

Step II:
They found the important elements of the problem, and then thought about the way to achieve them. They selected a strategy to achieve the main goal of the problem, according to the important elements.
The percentage of the money paid for the book: when he had 10% discount, then he has paid 90% of the initial price for purchasing the book.
The sales price percentage of the book, including the profit: 100% of the money paid for the book must be added to the profit. The sales price percentage the book can be found this way.
The purchase price of the book, considering the discount: The purchase price of the book considering the discount can be obtained, by counting the proportion of the percentage of buying the book with its profit and the received amount of money.
The original price of the book: by counting the proportion of the purchase price of the book with discount with the purchase percentage, the original price of the book can be obtained. (90% of what price equals with this given amount of price?).
An answer was found for each section. The answer to the last question was the very main goal of the problem.
The selected strategy was "sub-problem making", which means to divide the problem to some smaller problems, in a way that the answer to the last question be the answer to the main problem.

Step III:
At this step, the design must be implemented and controlled, and be completed if needed. At each part of the steps, it was tried that each of the participants has a look to the earlier steps, to know his status on solving the problem. "well, let us check what we have done so far", this statement was loudly recounted for several times to make the participants realize the importance of looking back and carefully paying attention to the previous steps (Polya's "look back" principle).
Sub-questions:

* How much is the payout percentage? \( 100\% - 10\% = 90\% \)

90\% of the original price equals the discounted price:

90\% \times \text{the original price} = \text{the discounted price}

*How much is the sales price percentage by counting its profit?

The percentage of the discounted price + 30\% = 100\% +30\% = 130\%

* How much is the discounted price?

\[ \ldots \ldots = 10800 \text{ Rls.} \]

\[ \frac{130}{100} = \frac{1404}{...} \]

* What was the original price of the book?

90\% \times \text{original price} = 10800 \text{ Rls.}

\[ \ldots = 12000 \text{ Rls.} \]

**Step IV:**

They first properly evaluated and reviewed the result and the answer, finding a clear method to review the answer:

They calculate 10 percent of the 12000 Rls.

\[ \frac{10}{100} = \frac{X}{12000} \]

\[ X = 1200 \text{ Rls discount} \]

They calculated the discounted price of the book.

12000-1200 = 10800 the discounted price of the book

\[ 30\% \times 10800 = \ldots \ldots \rightarrow \frac{30}{100} = \ldots \ldots \]

\[ \frac{3 \times 10800}{10} = 3240 \quad 30\% \text{ discount} \]

10800 + 3240 = 14040 \rightarrow \text{So this is the correct answer}
**The rest of the Step IV:**

Now that its answer, evaluation and validation were confirmed, by changing the information or the assumptions, new problems were made and solved, and by reviewing them, they achieved a deeper understanding of the problem and its solutions.

**6 Designing new problems**

We bought a book with 20% discount and we sold it with 30% profit over the purchase price. What was the original price of the book?

We bought a book with 10% discount and we sold it to 14040 Rls, without profit. What was the original price of the book?

We bought a book with 10% discount and we sold it to 14040 Rls, with 30% profit. What was the original price of the book?

And...

After conducting the problem-based learning method by the researcher, the questionnaire on the teachers’ teaching capabilities toward problem solving skills and the math post-test were implemented in both control and experimental groups. This method was finally used in the experimental group.

**7 Findings**

In the first section of testing the second hypothesis, we first analyze the descriptive statistical findings about the teachers’ scores in pre- and post-tests. Using the data collected by the tests, their descriptive statistics were calculated, which findings are shown in Tables 1 and 2:

<table>
<thead>
<tr>
<th>Table 1: Descriptive statistical findings-Tests</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-tests</td>
<td></td>
</tr>
<tr>
<td>Experimental group</td>
<td>Control group</td>
</tr>
<tr>
<td>37</td>
<td>30</td>
</tr>
<tr>
<td>14/83</td>
<td>14/8</td>
</tr>
<tr>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>2/82</td>
<td>2/57</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Descriptive statistical findings-Tests</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-tests</td>
<td></td>
</tr>
<tr>
<td>Experimental group</td>
<td>Control group</td>
</tr>
<tr>
<td>37</td>
<td>30</td>
</tr>
<tr>
<td>17/72</td>
<td>14/93</td>
</tr>
<tr>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>1/83</td>
<td>2/75</td>
</tr>
</tbody>
</table>

According to table 1 and 2, it is clear that no significant difference can be observed in the pre-test scores of the two groups of control and experimental. The most frequency of the scores with 15 and 13 values are in the control and experiment groups. Considering the post-tests in the two groups of control and experimental, the score mean in experimental group has a significant difference with the score mean of the control group. The most frequency of the score 16 is in the experimental group. Moreover, the lowest dispersion belongs to the post-test in the experimental group. In the second section, the descriptive statistics of the teachers' capabilities in pre- and post-tests of the questionnaire will be analyzed. Using the data, collected by questionnaire, their descriptive statistics indexes were calculated which findings are shown in Table 3:
According to table 3, it is clear that no significant difference can be observed in the data from the pre-tests of the two groups of control and experimental. Considering the post-tests of the two groups of control and experimental, the score mean of the experimental group was significantly different from the score mean of the post–test in control group. Moreover, the lowest dispersion belongs to the experimental group. Given that all obtained P- values were greater than 0.05, so the hypotheses of normality, will be confirmed. According to the normality of the scores, to test hypotheses, t-test was used for the independent samples which findings are shown in Table 4:

Table 3: Descriptive statistical findings- questionnaire

<table>
<thead>
<tr>
<th>Post-tests</th>
<th>Experimental group</th>
<th>Control group</th>
<th>indexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>number</td>
<td>37</td>
<td>30</td>
<td>number</td>
</tr>
<tr>
<td>mean</td>
<td>2/65</td>
<td>2/52</td>
<td>mean</td>
</tr>
<tr>
<td>mode</td>
<td>2/5</td>
<td>3</td>
<td>mode</td>
</tr>
<tr>
<td>standard deviation</td>
<td>0/62</td>
<td>0/57</td>
<td>standard deviation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post-tests</th>
<th>Experimental group</th>
<th>Control group</th>
<th>indexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>number</td>
<td>37</td>
<td>30</td>
<td>number</td>
</tr>
<tr>
<td>mean</td>
<td>4/01</td>
<td>2/37</td>
<td>mean</td>
</tr>
<tr>
<td>mode</td>
<td>4/03</td>
<td>2/1</td>
<td>mode</td>
</tr>
<tr>
<td>standard deviation</td>
<td>0/08</td>
<td>0/5</td>
<td>standard deviation</td>
</tr>
</tbody>
</table>

According to the results presented in Table 4, and with respect to the equality of variances, the obtained P-value is larger than 0.05 (0.95> 0.05), hence there is no significant difference between the pre-test mean of the two groups of control and experimental. Therefore, it can be claimed that the mathematical performance of the teachers who were trained based on the traditional way and problem-based teaching method, were the same in the pre-test. Following this, the compassion test as the post-test between control group and experimental group was analyzed. According to the normality of the scores, to test hypotheses, t-test was used for the independent samples which findings are shown in Table 5:

Table 4: T-test findings for the pre-test scores

<table>
<thead>
<tr>
<th>T-test for equality of means</th>
<th>Levene's test for the equality of variances</th>
</tr>
</thead>
<tbody>
<tr>
<td>The difference in the standard deviation error</td>
<td>Mean difference</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>1/28</td>
<td>-1/35</td>
</tr>
</tbody>
</table>
Table 5: The findings of t-test for the post-test scores

<table>
<thead>
<tr>
<th>%95 confidence interval difference</th>
<th>T-test for equality of means</th>
<th>Levene's test for the equality of variances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The difference in the standard deviation error</td>
<td>Mean difference</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>-1/67</td>
</tr>
<tr>
<td></td>
<td>-1/61</td>
<td>-3/97</td>
</tr>
</tbody>
</table>

According to the results presented in Table 5, due to the inequality of the variances, the obtained P-value is smaller than 0.05 (0.000 < 0.05). Thus, there is a significant difference between the post-test means in the two groups of control and experimental. It can be claimed that the performance of math teachers who were trained in the traditional way and those who were trained through the problem-based learning method were not the same in post-tests. This claim was clear, due to the high amount of score mean value for the post-test of the experimental group, compared to the post-test of control group. With the help of the Paired t-test, we compare the performance of the math teachers before and after implementing the problem-based learning method. The results of this test are described in Table 6:

Table 6: The Paired simple t-test results for the performance of Math Teacher

<table>
<thead>
<tr>
<th>P-value</th>
<th>Degree of freedom</th>
<th>t</th>
<th>%95 confidence interval difference</th>
<th>Standard deviation</th>
<th>mean</th>
<th>scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>0/000</td>
<td>36</td>
<td>-10/57</td>
<td>-2/33</td>
<td>-3/44</td>
<td>0/27</td>
<td>1/66</td>
</tr>
</tbody>
</table>

Based on the results presented in Table 6 and the P-value obtained for the mean, which is smaller than 0.05 (0.000 < 0.05), we conclude that, the math teachers' performance before and after conducting the problem-based learning method were not the same. Due to the high mean of the post-test, the performance of the teachers in experimental group has improved. In accordance with the normality of the scores, to test the hypotheses, t-test was used for the independent samples, which findings are shown in Table 7:
Table 7: T-test findings for teaching capabilities in pre-tests

<table>
<thead>
<tr>
<th>confidence %95 interval difference</th>
<th>T-test for equality of means</th>
<th>Levene's test for the equality of variances</th>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The difference in the standard deviation error</td>
<td>Mean difference</td>
<td>P-value</td>
</tr>
<tr>
<td>High</td>
<td>-0/44</td>
<td>0/15</td>
<td>0/14</td>
</tr>
<tr>
<td>Low</td>
<td>-0/44</td>
<td>0/14</td>
<td>-0/14</td>
</tr>
</tbody>
</table>

According to the results of Table 7, due to the equality of variances, the obtained P-value is larger than 0.05 (0.33 > 0.05), therefore, there is no significant difference between the pre-test means of the two groups of control and experimental. Hence, it can be argued that the teaching capabilities of the teachers, who were trained through traditional method and the problem-based learning method, were the same in pretest. In accordance with the normality of the scores, to test the hypotheses, t-test was used for the independent samples, which findings are shown in Table 8:

Table 8: T-test findings for teaching capabilities in post-tests

<table>
<thead>
<tr>
<th>confidence %95 interval difference</th>
<th>T-test for equality of means</th>
<th>Levene's test for the equality of variances</th>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The difference in the standard deviation error</td>
<td>Mean difference</td>
<td>P-value</td>
</tr>
<tr>
<td>High</td>
<td>-1/81</td>
<td>0/08</td>
<td>-1/64</td>
</tr>
<tr>
<td>Low</td>
<td>-1/83</td>
<td>0/09</td>
<td>-1/64</td>
</tr>
</tbody>
</table>

According to the results of Table 8, due to the inequality of variances, the obtained P-value is smaller than 0.05 (0.000 < 0.05), Thus, there is a significant difference between the post-test means of the two groups of control and experimental. It can be claimed that the teaching capability of the teachers who were trained through traditional way and problem-based teaching approach, were not the same in post-tests. We compare the teacher's teaching capability means, before and after implementing the problem-based learning method. The results of this test are described in Table 9:
Table 9: Paired t-test findings for teaching capacities

<table>
<thead>
<tr>
<th>data</th>
<th>mean</th>
<th>Standard deviation</th>
<th>Deviation from the mean error</th>
<th>confidence interval</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paired 1: Pre-post tests</td>
<td>-1/34</td>
<td>0.62</td>
<td>0.1</td>
<td>-1/55</td>
<td>0/000</td>
</tr>
<tr>
<td>Experimental group</td>
<td></td>
<td></td>
<td></td>
<td>-1/13</td>
<td></td>
</tr>
</tbody>
</table>

Based on the results presented in Table 9 and the P-value obtained for the mean, which is smaller than 0.05 (0.000 < 0.05), we conclude that the teachers' teaching capabilities were not similar before and after training them through problem-based learning method. Therefore, problem-based in-service trainings have enhanced the teachers' teaching capabilities regarding the problem-solving skills.

8 Conclusion

The statistical results showed that the problem-based in-service training has increased the teachers' educational capabilities and performance toward the problem-solving skills. In problem-based teaching method, the teachers selected one strategy from among the known strategies, or sometimes combined several different ways. They also discovered a new solution, at the highest level. The teachers had to represent a reformulation of the problem, or on the other words, a restatement of the problem, and through a right guidance and correct direction, they could discover new solution methods.

Teaching based on practical problems, empowered the teachers and made them to have sufficient knowledge for solving the problems, and be able to express the real life situations with the language of mathematics. The teachers implemented some strategies for the representation of the problems and for the conceptual cognition. These representations promote the cognition and discovering the underlying relationships for the successful problem solving. What were observed in the performance and the capabilities of the teachers are as follow:

- They successfully solved the math problems in different ways.
- They recorded their reasoning and their statements.
- They draw the problem information, to solve the problems.
- They monitored and evaluated their solutions and their reasoning.
- They raised new problems with certain conditions and provided some suggestions for solving these problems.

Therefore, it seems that the education organization should focus on teaching problem-designing and problem-solving skills. For having effective teaching practice, the present and future teachers need to learn problem-solving skills and experiences.

The research suggestions are as follow:
- It is suggested that the problem-based instruction be implemented for the other subjects and for the other grades of elementary school in the in-service course for the teachers, and their results be analyzed,
- It is suggested that the problem-based instruction be implemented for the subjects and grades of the other school levels (highschool, …) in the in-service course for the teachers, and their results be analyzed, and
• It is suggested that the problem-based instruction be implemented for the other subjects of elementary school in the pre-service course for the teachers and in Farhangiyan University (a university in Iran, which is specialized for training teachers), and their results be analyzed.

References:

