The Examining Two Approaches for Facilitating the Process of Word Problems Solving in Multi-Grade Classrooms

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Abstract
This study focuses on two approaches for facilitating the process of word problems solving in multi-grade classrooms. The first approach applies Mathematician’s Chair strategy and the second approach applies Jitendra’s theory (2002) of schema strategy. This study aims to compare Mathematician’s Chair strategy and schema strategy with traditional method in word problem solving in multi-grade elementary classrooms. Thus, quasi-empirical research method is used. The participants of the study, 33 boys and girls students in the third and sixth grade in multi-grade classrooms. The quantitative analysis shows that performance of mathematical word problem solving of the students who have been taught through Mathematician’s Chair and schema strategy is higher than traditional method.

Keywords: Word Problems, Multi-grade classrooms, Mathematician's Chair strategy, Schema strategy.

1 Introduction

Within Iran's education system, particular program has not implemented for mathematics education in multi-grade classes. In many countries, textbooks and assessments make to need students for word problem solving. Researchers, many similar definitions have been put forth for word problems. As such, Charles (2004) introduces word problems about real issues of the world around in which the amount of one or more quantity is active and the amount of one or some other is passive, the relationship among the quantities is explained and the problem is intended to find one or more passive quantities [1]. In fact, word problems are short designed explanations for the relationship among various objects that need to be solved by math solutions [2]. Education experts believe that those students who learn through active learning not only learn better but also enjoy learning more because they participate in learning process and they are responsible for their learning instead of just being a listener [3]. Nowadays, from among active methods that attract the attention of many education experts is learning in groups and using classmates’ help that Joyce et al (2005) believe so if this method integrates with other methods, their effects increase[4]. It is important to note that every teamwork is not necessarily participative. In group work, learners may endeavor individually or
competitively and just preserve the appearance of group work. But in group work, students work together in a non-competitive manner in order to reach their joint learning objectives [5]. Thus, the necessity of integrating active learning methods such as teaching Mathematician's Chair and schema to solve math word problems can seem necessary. An activity in which students share their word problems with their classmates and then try to solve it. They write, solve and share original mathematics word problems [6]. For a long time, psychologists have studied schema as the main core of human’s beliefs. They believe that childhood experiences and its life style caused the formation of schema in one's mind; it means that our intellectual frame work and that through which we see the world, manage the issues, make sense of others' behavior and give meaning to what is happening around us [7]. On the other hand, a class that runs with the students of two or more grades in one room with one teacher teaching them is called multi-grades class. Based on the Iran education system's statistics, about one million students educate in multi-grades classrooms. These students are trained by more than thousand and forty teachers in nearly forty-five thousand classrooms. Multi-grades classes include rural students or students from suburban towns. In the structure of the education system, a special program to focus on multi-grades classrooms has not been made. We can say that examining the structure of education system shows that the existence of multi-grades classes has been forgotten. The low number of students in rural areas and shortage of teachers are two fundamental problems that make children stay away from school. In most cases, odd results are achieved because some of these children at the age of schooling miss the school and some others don't join the classes with members younger than themselves and so stop schooling. Teaching in multi grades classes is a method that rural students can access to classrooms more [8]. Several studies in the field of examining mathematical word problems solving abilities have been done, but research has not been done yet to evaluate the performance of students in solving mathematical word problems in multi-grades classes. Therefore, in this study the aim is to compare Mathematician's Chair strategy and schema teaching with traditional methods in word problems solving in multi-grade classrooms.

2 Literature Review

So far, a study in internal research has not been done to evaluate the performance of students in word problem solving in multi-grade classes, but other areas of research have done researches about multi-grades classes. Research done by Madadi Imamzadeh (2004) on the subject of review and comparison of social skills, self-esteem and academic achievement between students of multi-grades and single grade (primary schools) classes have shown that there is a significant difference among students of multi-grades and single grade classes in terms of the amount of social skills and academic achievement. Students of multi-grades classes have higher social skills and academic achievement than the students of single grade classes. Between the two groups (multi-grades and single grade classes) there is no significant difference in terms of self-esteem and just in self-esteem subtests (education self-esteem), the average scores of students in multi-grades classes were higher than of students in single-grade classrooms [9]. Haghverdi (2014) in a study introduced the nature of word problems and the process of solving them and the by reviewing the researched literature on the problems of students in word problem solving, try to investigate the main root of these problems in understanding issues incompletely because of the difficulty of text and unfamiliar areas in middle school's word problems. Word problem solving are facilitated with the effectiveness of thematic and concept underlying wordings and their different combinations. Thus, 80 7th-grade students were randomly assigned to one of these cases and one control group. Except the control group, the students first answered the pre-test then one of the different tests of re-arrangement of word problems. The results showed that the change of wording of word problem, facilitate problem solving [10]. Jitendra (2002) on a research about the use of schemas for word problem solving showed that the use of schemas showed outstanding progress in the scores of students. They had maintained skills for more than four weeks, and students were able to employ strategies in new and complex issues. They also found that students had much better performance in learning. In this
study he showed that we can teach students to use the effective skills in solving problems [7]. O'Donnell et al (2007) found that peer education is a very useful method that students who learn with this method, understand the content of the course better, have higher motivational level and learn faster [11].

3 Method

In order to evaluate the performance of students in the implementation of teaching mathematics chair strategy and use of schema to solve word problems, quasi-experimental method with pre and post-test was used for two groups. In this project, at first a pre-test was given to control and experimental groups, then after the implementation of new educational intervention in the experimental group, post-tests were given to both control and experimental groups. At last, the analysis was conducted based on post-test.

4 Participants

Populations were four schools among all multi-grades schools in Dezful city of Khuzestan province. So, all boys and girls students studying in 2014-2015 that attended in classes of these four schools that were multi-grades, were considered as participants. In this study, like multi-stage cluster sampling was used. Thus, a multi-grades experimental and control group in third and sixth grades were randomly selected among these four multi-grades schools of Dezful. The numbers of girls and boys students in the experimental group were 33 and in the control group were 30. Math tests developed by the researchers were used as a research tool.

5 Instrumentations

These tests were conducted in two parts: pre and post test. Questions of "word problems" had been selected. Each test contains 5 items with the scoring of 10 points. These tests were designed by math teachers and experts.

6 Collecting Data Method

Before the implementation of the new educational method, a pre-test was given to both control and experimental groups based on the concepts of "addition and subtraction". Then, in the experimental group both Mathematician's Chair and schema strategies were simultaneously implemented for third and sixth-grade students. For this purpose, referring to the implementation of teaching schema-based strategy [7] the problems were taught in the form of three general categories using schema:

- In a "change" problem, students learn whether the problem ends up with more or less than the beginning amount.
- For the "group" problem, the larger group object always represents the total, because the smaller groups combine to form the larger group.
- To find the total amount in the "compare" problem, students determine whether the referent or the compared set represents the higher value. Teach students to examine the comparison, or "difference" statement, to find the set that represents the total amount in the "compare" problem.

Then, the researcher made three-member groups. In these groups, for each grade, a student who was slightly more knowledgeable than others, implements the points for other students with respect to schema's implementation. Then, the mentioned student taught schema method which he learnt from researcher based on Mathematician's Chair method. Each group member could express the real-life examples and those belonging to outdoor or indoor spaces by means of presenting "addition and subtraction problems" to his teammates. In Mathematician's Chair method, students in each group read the main parts for members and they tried to solve the problems and get the constructive feedback to presented problem. The main problem
"summation or subtraction" was presented by a student who was sitting on the chair in front of the group, and then he and other members of the three-member group, scored their answers. After the scoring and specifying the scores, the student with the highest score implements the schema-based teaching for the two other members as he is the more knowledgeable. Finally, after the implementation of two new educational methods in the experimental group and traditional teaching methods in the control group, the researcher gave post-tests to experimental group and pre-test to control group based on the implementation of schema.

7 Results

To analyze the findings in this section, we first deal with the calculation of the descriptive parameters such as mean, standard deviation and mode for scores of pre-test and post-test for the two methods of traditional teaching method and training with Mathematician’s Chair strategy and schema method of teaching in the control and experimental groups, results of which are shown in Table 1:

### Table 1: Results of descriptive statistics of the student's performance

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Control group</th>
<th>Experimental group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td>Post-test</td>
</tr>
<tr>
<td>Number</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Mode</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Mean</td>
<td>4.2</td>
<td>4.96</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1.02</td>
<td>1.11</td>
</tr>
</tbody>
</table>

As shown in Table 1, it is clear that in the post-tests of the two afore-mentioned methods for the experimental group the mean score is significantly different from that in the control group. In addition, the highest score mode belongs to the posttest of the experimental group. Also, the lowest score distribution belongs to the post-test of the control group. Using Kolmogorov-Smirnov test, we first examine the normality of the scores in both groups. Since the obtained P-values are greater than 0.05, therefore, the hypothesis of normality of the data is supported. According to the normality of the data, in order to carry out this hypothesis, the T-test for independent samples is used, which results are shown in Table 2:

### Table 2: The results of the pre-tests through t-test

<table>
<thead>
<tr>
<th>Pretests</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>T</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>1.69</td>
<td>0.19</td>
<td>-1.59</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>60.53</td>
<td>0.11</td>
<td>-0.45</td>
</tr>
</tbody>
</table>

As the Results of Table 2 shows, the obtained P-value is greater than 0.05 (0.11 > 0.05), and there is no significant difference between the pre-test scores of both control and experimental group. Therefore, it can be concluded that the performance of the students, who have been taught traditionally and with the Mathematician's Chair strategy and schema, in the pre-tests, is the same. Finally, in order to compare these
two groups’ post-tests a test was analyzed. With respect to the normality of the data, in order to do hypothesis testing, a T-test is used for independent samples of which the results are shown in table 3:

Table 3: The results of the post-tests through t-test

<table>
<thead>
<tr>
<th>Posttests</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>T</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>2.57</td>
<td>0.11</td>
<td>-8.22</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td></td>
<td></td>
<td>-8.35</td>
</tr>
</tbody>
</table>

The results in Table 3 shows the obtained P-value is smaller than 0.05 (0.000 < 0.05) and there is no significant difference between the pre-test scores in both control and experimental group. Therefore, it can be concluded that the performance of the students, who have been taught traditionally and with the Mathematician's Chair strategy and schema, in the post-tests, is not the same. Since the average performance of the students who have been taught with Mathematician’s Chair strategy and schema is better than those taught in a traditional method, it can be concluded that teaching word problem-solving via Mathematician's Chair strategy and schema is more effective compared to the traditional method.

8 Conclusion

According to the obtained results, it was shown that the performance of the students, who have been taught traditionally and with the Mathematician's Chair strategy and schema, is not the same (p<0.05). And teaching word problem solving via Mathematician's Chair strategy and schema is more effective compared to the traditional method. The reasons for this conclusion are as following: One of the major concerns of all Theorists of mathematics is the creation of the ability of problem solving in learners of mathematics. Mathematical problem solving has achieved new and substantial theories in the way of teaching and learning the ways of solving mathematical problems, through combining and modifying the theories of Piaget, Vygotsky, and so on. The main and ultimate goal of teaching any concept in mathematics, is nurturing the talent of problem solving ability in students. Lack of attention to the problem solving teaching method and understanding it, will make the students unable to use their previously learnt knowledge in solving problems when they face a new situation or practical activities. Every math teacher or learner recognizes that problem solving ability requires something more than a set of skills and techniques. The ability of monitoring the progress during problem solving process and the awareness of the capabilities and limitations of the individuals are important. To enhance this ability in mathematical problems, conditions and environmental factors can provide progress or failure. What can be seen in schools is the passive teaching-learning process. One of the factors that can lead to the progress in the ability of solving math problems is the use of active teaching-learning methods. One of these methods is Mathematician's Chair strategy and schema teaching. Teaching in small groups, is one of the main components of learning and problem solving. Students learn to monitor and evaluate the accuracy of their work, while working in small groups. A classroom that is arranged for small groups makes a much longer time to interact and discuss compared to a classroom where all students individually make up a whole. In small groups, learners will wield more power to talk, explore...
ideas, explain objects to their group, ask and learn from each other, have arguments and personal ideas which are challenge able in a warm environment. Therefore, as concluded in this study, using Mathematician's Chair strategy helped students raise their ability to participate and consult in solving problems. the use of this approach for students has, ostensibly, brought about a new look to teaching and learning math abstract concepts. In fact, Mathematician's Chair strategy could explicitly identify the problems and views of students at the time of its implementation. Furthermore, the use of schema strategy could evaluate and compare the problems of students with addition and subtraction from a number of angles. Schemas are a mental organization in which knowledge and relevant experience are organized. Facilitating learning and developing new knowledge in an educational status is the most important function of schema. Appropriate development of schema lead to the ones’ optimal use of mental capacities and facilitate the information processing operation by him that it has important impact on significant learning and ideal math behavior.

Research suggestions are as following:

- It is suggested that the effects of using Mathematician's Chair strategy in word problem-solving in single-grade classrooms be practiced and studied.
- It is suggested that the effects of using schematic strategy in word problem-solving in multi-grade classrooms be practiced and studied.
- It is suggested that the effects of using Mathematician's Chair and schematic strategy in other lessons and other grades be practiced as well.

References


