

Teaching Mathematics Based on Integrating Reading Strategies and Working Memory in Elementary School

By Farideh Hamidi^{*}, Shokoofeh Soleymani[±], Sara Dazy[•] & Maryam Meshkat[◦]

This study strived to determine the effectiveness of integrative teaching of reading strategies and working memory on basic math and problem-solving skills. It is a quasi-experimental pretest-posttest study carried out on 50 second-graders from Chahashk Shandiz village in the academic year of 2020-2021 who were randomly selected by cluster sampling and randomly divided into experimental and control groups. The intervention was performed by cellphone software through virtual education in two steps. The experimental group underwent integrative training for 20 sessions, but the control group did not receive any intervention. Colored Progressive Matrices (1956) and a researcher-made story problem-solving and arithmetic skills test were used to collect data. Descriptive statistics (mean and standard deviation) and one-way multivariate analysis of covariance were used to analyze the data. The results showed that the integrative teaching of reading strategies and working memory enhanced the basic math skills, with an effect size of 0.67 in second-grade elementary students ($P < 0.001$). According to the results, integrative teaching improved students' problem-solving skills but did not affect their skills in arithmetic operations. Therefore, second-grade elementary teachers can use this method to enhance their story problem-solving skills.

Keywords: *integrative teaching, reading strategies, working memory, basic math skills*

Introduction

Whenever political and educational leaders speak or write about how the economic success of nations depends on the academic success of their students, the focus turns to mathematics (Pellegrini et al. 2018). Basic math skills the prerequisites for learning and understanding math (Fernandez-Abella et al. 2019). Mathematics education faces two crucial challenges. Firstly, more than half of the world's children do not currently learn the essential numerical skills needed for independent living in modern societies. Second, there are millions of children who need guidance and extra attention to learn, even in a good learning environment (Rasanen et al. 2019).

Basic mathematics refers to a wide range of basic concepts such as counting (like 1,2,3); quantity (more and less); shapes (circle, square, etc.); spatial

^{*}Associate Professor, Shahid Rajaei Teacher Training University, Iran.

[±]Graduate Student, Shahid Rajaei Teacher Training University, Iran.

[•]PhD Student, Shahid Rajaei Teacher Training University, Iran.

[◦]Associate Professor, Shahid Rajaei Teacher Training University, Iran.

relationships (up and down); size (long, short, larger and smaller); pattern discovery (Patterson 2018). Children's basic math skills do not develop in isolation from other cognitive competencies. Research has shown that basic math skills are related to executive functions. Success in mathematics is predicted by actual knowledge of a particular field, procedural skills, conceptual understanding, and general executive performance skills (Cragg et al. 2017, Belarski and Babik 2020). Working memory and math calculation skills (Friedman et al. 2018) and symbolic basic numerical skills (number line and magnitude comparison) are related to executive functions of the brain (Gashaj et al. 2019) and literacy (Ghasemi et al. 2019).

Many math tasks, such as memorizing counting units, carrying out mental calculations, or understanding a math word problem, require temporary storage of information during processing or transfer of data to long-term memory (Lewis et al. 2022). Wickstrom et al. (2020) found students with learning difficulties supported by The Individualized Education Plan [IEP] were more likely to show a decline in math achievement from grades 3 to 6.

Another factor influencing the development of math skills is the ability to read. Numerous studies have shown that reading skills play a role in mathematical performance (Marasigan 2019, Mutaf-Yıldız et al. 2020, Salihu et al. 2018). Jordan et al. (2007) found that reading difficulties impaired children's math development. Reports also suggest that weak reading skills, reading comprehension and mathematics are related and share common cognitive background (cited by Salihu et al. 2018). Another thing that proves the connection between reading and math is when students have trouble solving story problems. Such students may fail to solve the problem despite sufficient computational skills (Swanson et al. 2015). As the cognitive processes involved in solving math problems are different and more numerous than basic computational skills (Zhang et al. 2022), students need to integrate several cognitive aspects to solve math story problems. In other words, they must extract important information through text comprehension, succeed in adequate mental representation, and continue the process (Agarwal 2022).

Narrative as a game design feature constantly yields mixed results for learning in the literature. Based on the literature (Bruner 1964, Darejeh et al. 2021, Dickey 2006, Ke 2016), the narrative in this study serves as a set of events, tasks, and outcome feedback. In simulated real-world scenarios used for the active representation of problem-solving through storytelling, the results showed that students who use visual-schematic representation in word problem-solving are up to six times more successful than students who do not use it. Interestingly, Fung and Swanson's (2017) research showed that the working memory storage component predicts problem-solving accuracy in a fully intermediate model. The direct effect of the working component of working memory was entirely mediated by the criteria of reading, calculation, and fluid intelligence. These results challenge the idea that basic skills and fluid intelligence fully mediate the effect of working memory on higher levels of processing, but also the notion that the executive component plays a significant role in higher-order processing.

Programme for International Student Assessment (PISA) study has shown that reading comprehension is vital in solving math problems (Mevarech et al. 2018). However, knowledge of mathematical strategies is not the only

metacognitive skill that might be beneficial for solving complex word problems in mathematics. Given the importance of reading literacy for solving these types of tasks, it is reasonable to assume that knowledge about reading strategies may also be helpful (Strohmaier et al. 2022).

Work-integrated learning (WIL) is a national priority and a strategic direction for Australian universities. The preliminary qualitative phase comprised a literature review, workshops, and interviews. Examples of emerging WIL models, both curricula and co-curricular, were clustered into five models: micro-placements, online projects or placements, hackathons, competitions and events, and incubators/start-ups and consulting. This paper outlines these models and summarizes defining features, enablers, challenges, and opportunities (Kay et al. 2019).

The integrative curriculum in elementary school has an influential role in presenting scientific concepts and creating fundamental structures (Yousefivaghef et al. 2021). Owing to the current state of education in our country in terms of the presence of a high number of students in the classroom, the lack of educational space, the existence of two-shift schools, and the shortage of primary school teachers, officials have turned their attention to integrative approaches (Zaraii Zavarki and Toofaninejad 2017). Zaraii Zavarki and Toofaninejad (2017) compared the effect of integrated teaching on elementary student's learning in mathematics with the traditional (face-to-face) method. Results showed that integrated learning positively affects the teaching-learning process and enhances achievement.

This study focuses on maximizing reading comprehension by reducing the limitations of working memory. Many studies have examined the effects of basic mathematical skills and the factors affecting the improvement of basic mathematical skills (Ghasemi et al. 2017, De León et al. 2020, Salihu et al. 2018), and integrative education (Nedae and Hosseinzadeh 2022).

De León et al. (2020) examined the predictive role of basic numerical math skills in a study entitled Factor Analysis of Basic Mathematical Skills Indices. In this study, basic math skills included number comparison, subtraction, one-digit calculation, multi-digit calculation, and spatial value. The findings of this study explain basic counting skills are a suitable criterion for evaluating numerical ability.

Salihu et al. (2018) conducted a study entitled 'The relationship between math skills and reading comprehension.' This study examines the contexts for the success of children's math skills and focuses on the relationship between comprehension and mathematics. The findings illustrate a high correlation between introductory math and reading skills of fourth-grade students and propose that mathematics and reading problems may arise from a similar cognitive background.

Ghasemi et al. (2017) investigated the effectiveness of counting and recognition strategies instruction on the number skill of pre-schoolers with math problems. Results showed that training counting and recognition strategies have been very effective in improving the number skills of children with math problems and could play a proactive role in solving math disorders. Strategies instruction of counting and number recognition for children with math difficulties will have a

preventive role in future math disorders.

Nedae and Hosseinzadeh (2022) investigated the effect of integrated math training with movement games on the progress of mathematics learning and cognitive function in students. The results showed that mathematics education through movement games increases the scores in mathematics, speed, and accuracy. Such training also reduces errors of attention. The study also showed a significant improvement in math scores and cognitive functions of accuracy, speed, and engagement in the experimental group.

Aragón et al. (2021) conducted a study to analyze the predictive contribution of variables (working memory, processing speed, vocabulary) in the mathematical performance of numbering, comparison, calculation, and understanding of mathematical concepts in preschool children. The study included 158 preschool students (ages 52 to 64 months). The results showed that working memory had the highest predictive effect on basic mathematics.

Fong and Swanson (2017) conducted a study to investigate the components of working memory that predict word problem-solving. The study aimed to explore the effects of the subsystems of the central executive system, phonetic loop, and spatial visual sketch-pad on word problem-solving in children aged 6 to 10 years. This study also examined whether the components of working memory can be tested by reading, calculating, and fluid intelligence. The results showed that all three subsystems of working memory indirectly predict word problem-solving, and among these, the phonological loop has a direct and significant effect. The results also showed that fluid intelligence moderated the relationship between working memory and problem-solving. In addition, reading and computing completely moderated the effect of the operating system on problem-solving accuracy. Nevertheless, few studies have integrated cognitive strategies into the curriculum in Iran.

Research findings suggest that working memory and reading are two influential factors in students' success in math. Despite the limitations of working memory, training programs must be designed to be compatible with and make the most of working memory capacity. Therefore, the present study seeks to investigate the effectiveness of integrated teaching of reading strategies and working memory on the basic mathematical skills of elementary students.

Hypothesis 1: Integrative teaching of reading strategies and working memory improves the problem-solving skills of elementary students.

Hypothesis 2: Integrative teaching of reading strategies and working memory improves the math skills of elementary students.

Method

This research is a semi-experimental pretest-posttest with a control group. Integrative teaching of reading strategies and working memory is considered an independent variable, and basic math skill is a dependent variable with two components; solving the arithmetic story problem and arithmetic operations.

Participants

The participants of the study are 50 female elementary school students. The students are 8-9 years old and studying in the second grade in the village of Chahashk Shandiz in the academic year 2019-2020. The students had Iranian (65%) and Afghan (35%) ethnicity. The study was carried out at a public school, and all students had an average IQ (between 100-110) as assessed by the Colored Progressive Matrices (RCPM). Two groups were formed using random cluster sampling. Each group was considered a cluster, and one group was randomly selected as the experimental group and the other as the control group. Furthermore, according to the following formula, the estimated sample size for each group was 24 individuals. The d-score was 5% of the maximum score that subjects received by responding to the Arithmetic Problem-Solving Test as a dependent variable. Based on the calculated formula, 24 people were estimated for each group, and to prevent the drop of the subjects, 25 people were estimated in each group and a total of 50 people in the sample.

$$\begin{aligned}d &= (5\% \ 33) = 6.6 \\Z &= 1.96 \\SD &= 4.070 \\S &= 16.56 \\95\% - Z \text{ score} &= 1.96\end{aligned}$$

$$n = \frac{s^2 \cdot Z^2}{d^2} = \frac{274.39 \cdot 3.84}{43.56} = 24$$

Then, the pre-test (researcher-made problem-solving test and test of addition and subtraction calculus operations with transfer and without transfer) was performed on both groups. The experimental group then underwent 20 sessions of treatment. They were given training on how to use reading strategies and memory strategies using a cell phone. But the control group received traditional instruction. The intervention was performed in two stages: a virtual platform and cellphone software. The software included instructional videos that categorized story problems into four situations. In the next step, the student added the given information to the software and found the answer to the problem with the help of software diagrams. At the end of each level, there were interactive exercises that assessed students. The educational and interactive content of the software comprising 51 slides, was completed and practiced. Each session presented several problems, and the student completed the problem with the help of diagram boards. Although there were levels of formative training and questions and answers, the teacher had direct supervision over the learning and practice process, which lasted for 20 sessions. The post-test was administered to both control and experimental groups, and the resulting data was analyzed.

Data Collection Tool

The **Colored Progressive Matrices (RCPM)** test is designed for children 5 to 11 years of age, the elderly, and mentally and physically impaired individuals.

This test contains sets A and B from the standard matrices, and an additional set of 12 items; AB. Most of the items are presented on a colored background to make the test visually stimulating for participants. However, the last few items in set B are delivered as black-on-white; in this way, if a subject exceeds the tester's expectations, the transition to sets C, D, and E of the standard matrices is facilitated. This test of 36 geometric shapes is designed as a whole for accurate cognitive assessment of children. Test scores are zero and one. Ghazali et al. (2018) reported bivariate correlation analysis showed that the RCPM sets A, AB, and B were well correlated; set A with set AB ($r=0.811$, $p<0.001$). A total of 115 valid retests were collected, and both bivariate correlation analyses showed a good correlation ($r=0.77$, $p<0.001$).

Arithmetic Problem-Solving Test is a researcher-made test that has been prepared according to the objectives of the second elementary arithmetic book and includes a variety of one-position and combination problems in addition and subtraction operations. The problems and questions in the second-grade elementary textbook were scrutinized. Vanderbilt story problems (Dazy et al. 2018) were used to design the questions. Ten problems were specified, a specification table was prepared, and the content validity was specified. Elementary teachers approved the problems which were then used as pre-test and post-test in this study. The Cronbach's alpha calculated to illustrate the reliability is 0.74. The item difficulty, and item discrimination of the questions were also checked.

Addition and subtraction arithmetic test with transfer and without transfer: The researcher designed arithmetic test was based on the objectives of the second-grade math teacher's handbook. Therefore, the pre-test consisted of double-digit additions and subtractions with transfer and without transfer questions, and the post-test comprised three-digit and two-digit questions. The table of specifications for the test questions was drawn and its validity approved by Shandiz elementary Education Supervisor and several second-grade elementary teachers. The reliability as calculated by Cronbach's alpha was 0.81.

Procedure

The implementation protocol of this method is taken from the schema theory in solving problems (Marshall 1995). Integrative training is implemented in two stages with the help of a computer. Marshall explores a new system of schema development and studies the applicability of the concept as a unified basis for understanding learning, instruction, and assessment. The theory's prescriptions for teaching are direct, and its application to evaluation suggests new directions for tests. After examining the roots of the approach in earlier work by philosophers and psychologists, the author supports the main features of her theory with experimental evidence from students learning to recognize and solve arithmetic story problems. She describes individual performance with traditional empirical studies as well as a computer simulation. Computer simulation reflects a new approach to modeling cognition. Marshall's model links neural networks with symbolic systems to form a hybrid model that uses pattern matching of sets of features as well as logical step-by-step rules. The first stage of the study is carried out using researcher-made software. The first part deals with teaching problem

schemas in four main situations. The second part does not provide additional instructions but acts as a practice area and is followed by practicing skills and monitoring potentials and possible challenges by the instructor. In order to ensure the clarity of the procedure a guide was prepared and approved by an educational technology expert. This training protocol includes two stages of software programming on the mobile phone. The second stage of the study was carried out using diagram boards (boards in which a diagram of four positions is drawn) to help the young participants. Each step of the educational video game is based on a combination of reading strategies and matches the working memory, and consists of two parts: training and interactive exercises. The intervention in the experimental group lasted from November to March. Due to the virtual nature of the activities in two separate groups and the use of software on personal mobile phones, there was no possibility of error in transferring the lesson to the control group. The educational program of integrated training in reading strategies and working memory is provided in Table 1.

Table 1. Integrated Teaching of Reading Strategies and Working Memory

Sessions	Aims and contents
1	Necessary permits, pre-test, explanation of work steps to families, and installation of software
2&3	The first chapter comprised increasingly complex strategies, stories, and the creation of schemas. Aim: To form a schema of 4 problem situations and identify the type of problem
4	Interactive Exercise Chapter One (Position Identification) Aim: Practice and generalize what you have learned through drag and drop exercises. Answers are accompanied by feedback.
5&6	Chapter 2 training (shape and elements of 4 positions) Aim: To help illustrate the problem and understand the content, identify essential problem information, and data relevance.
7	Interactive Exercise Chapter 2 Step 1 Exercises: Identify the problem diagram. Step 2: Put the problem information in the diagram
8&9	Teaching Chapter 3 (Integrative Problem) The training consists of 3 steps. 1- Primary and secondary situation 2- Specific and uncertain information 3- Relationship between chart elements and planning to achieve the answer to the problem
10	Teaching Chapter 4 (Performance) 4 Problem Situations. Aim: The importance of recognizing the position and location of the unknown part in the diagram and its effect on the correct choice of mathematical operations.
11	Interactive practice of the third and fourth chapters. Aim: Practice and generalize what has been learned through interactive exercises of problem software
12&20	Protocol Step 2 (Exercise) Aim: Practice and evaluate what has been learned. If necessary, teacher rehabilitation training. At this stage, problem-solving is done with information presented on a map.
21	Perform post-test. Assessing the problem-solving ability of the sample and control groups

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Results

At the end of the training, a post-test was given to both groups, the descriptive (mean, standard deviation) and inferential (multivariate analysis of covariance) statistics were calculated using SPSS22 software. Table 2 presents the descriptive statistics of scores for problem-solving and arithmetic skills divided by groups. Table 2 shows that the average of the experimental group after the intervention has significantly improved compared to the control group, but arithmetic skills do not show significant improvement.

Table 2. Descriptive Indicators of Pre-Test and Post-Test Scores of Basic Mathematical Skills ($N = 50$)

Variables	Group	Pre-test		Post-test	
		Mean	Standard deviation	Average	Standard deviation
Problem-solving skills	Control group	5.56	2.16	6.24	2.50
	Experimental group	5.87	1.63	8.48	1.67
Arithmetic skills	Control group	8.56	2.06	8.84	2.24
	Experimental group	8.36	2.36	9.34	0.98

According to the present study, a multivariate analysis of covariance was used to control the effect of pre-test and post-test. The results of the Shapiro-Wilk test showed the normal distribution of variables ($P > 0.05$). The Levene's test of equality of variances of problem-solving skills ($P > 0.07$, $F = 44.33$) and arithmetic operations skills ($P > 0.176$, $F = 10.988$) are not statistically significant. Therefore, the variance of post-test error of the groups are not significantly different, and the hypothesis of homogeneity of variances in the post-test stage is confirmed. The homogeneity of the variance - covariances matrix observed was also calculated by the Box's M test ($P = 0.073$, $F = 1.662$, Box 25/251). The significance of the box test is higher than 0.05, so the variance-covariance matrix is homogeneous. The regression slope is the same at different levels of the independent variable. The result of the significance level of the regression slope homogeneity test between the pre-test and the post-test was 0.07 for the problem-solving variable and 0.17 for the arithmetic skills. Hence the null hypothesis is confirmed. Also, Bartlett sphericity showed that the spherical assumption had been fulfilled ($P < 0.05$).

As the assumptions have been met, the multivariate analysis of covariance test was used to evaluate the effect of integrative training on the component of basic math skills (Table 3). In addition, the results of the Analysis of Multivariate Covariance displayed a significant interaction between the two variables ($F = 8.067$, $P < 0.001$). The mean scores show that integrative training has improved basic math skills.

Table 3. Analysis of Univariate Covariance of Integrative Training on Other Problem Solving and Arithmetic Skills

Variable	Groups	N	Average	Standard deviation	Sum of squares	df	F	Sig	Eta squared
Problem-solving	Exp.	25	8.48	1.675	54.294	1	11.509	0.001	0.204
	Cont.	25	6.24	2.505					
Arithmetic	Exp.	25	8.88	1.878	0.402	1	0.139	0.001	0.003
	Cont.	25	8.84	2.249					

Table 3 clearly illustrates a significant difference between the two groups in both problem-solving skills. According to the results, the mean of the problem-solving post-test of the experimental group is 8.48, and the control group is 6.24, which showed that with controlling the pre-test, the problem-solving of the experimental group in the post-test is significantly higher than the control group. Also, the results of integrative training in the post-test phase between the experimental group and the control group are significant in terms of the scores of total arithmetic skills ($F=0.139$, $P<0.001$). Consequently, integrative training has significantly improved arithmetic skills.

Table 4. Analysis of Univariate Covariance of Integrative Training on Addition and Subtraction Skills

Variable	Groups	N	Average	Standard deviation	Sum of squares	df	F	Sig	Eta squared
Addition	Exp.	25	4.82	0.387	0.614	1	1.117	0.296	0.179
	Cont.	25	4.44	1.003					
subtraction	Exp.	25	4.52	0.790	0.022	1	0.019	0.892	0.052
	Cont.	25	4.40	1.354					

As seen in Table 4, among the evaluated components of arithmetic operation skills, the significance of addition and subtraction is not confirmed. So, the results of integrative training in the post-test phase between the experimental group and the control group are not significant in terms of the component of arithmetic skills ($F=1.117$, $P<0.296$; $F=0.019$, $P<0.052$). Therefore, integrative training has not significantly improved addition and subtraction skills.

Discussion

Memory on the basic math skills of elementary students. In the post-test phase, integrative training affected the linear combination of the dependent variables. The present study also confirms the results of previous studies on the effectiveness of integrative education (Agarwal 2022, Kay et al. 2019, Ke 2016, Nedae and Hosseinzadeh 2022, Yousefivaghef et al. 2021). The significant improvement in the problem-solving skills of the experimental group is consistent with the research of Huang et al. (2019) and Dazy et al. (2018). This study did not find a significant difference between the control and experimental group on arithmetic operations, which is inconsistent with the study of Dazy et al. (2018).

The effectiveness of integrative teaching on story problem-solving skills

indicates that students need to integrate several cognitive aspects to solve mathematical story problem-solving. They can fail in the face of a problem for various reasons, including lack of textual and word comprehension, insufficient emotional control when facing the problem, fixation on a solution method, lack of motivation, computational issues, and difficulty in mental functions. The lack of a management strategy is the most crucial obstacle to using rules in problem-solving. Integrative teaching in this project is a step-by-step strategy for problem-solving based on Piaget's cognitive theory. The story problems have different superficial features but similar structures that are organized in long-term memory. The student learns the concepts and structure and acts more successfully in the face of new story problems based on previous experiences with similar problems (Marshall 1995).

On the other hand, understanding the content is considered the first step in solving the problem. In other words, students must understand the actual language and information in the problem, then extract the data from the story and apply it to the equations for a logical solution (Swanson et al. 2015). According to research on the importance of comprehension in problem-solving, one of the most effective ways to improve students' problem-solving skills is to teach reading strategies, which improve readers' comprehension. Reading strategies, such as strategies for complex repetition and review tasks, semantic expansion, and organization, lead to a better understanding of the text and the formation of more robust schemas in problem representation, which results in significant information storing in long-term memory. Students are more successful in dealing with story problems by organizing information to reach a solution. In other words, this is consistent with the cognitive theory of news analysis that learning at the highest level of processing is done meaningfully in long-term memory (Fung and Swanson 2017).

Cognitive load theory asserts that education is effective if it is commensurate with students' working memory capacity. Therefore, training should use the maximum capacity of working memory. Three types of cognitive load are imposed on the learner's working memory; intrinsic load, external load, and dependent load which are assumed to be cumulative (total cognitive load = intrinsic load + external load + dependent load). Consequently, cognitive overload occurs when the overall cognitive load exceeds the learner's working memory capacity. In the present study, applying reading strategy techniques and problem-solving diagrams has reduced the cognitive load. In addition, in the introductory stages of this study, it was emphasized to use story problems with similar themes and numbers (Marshall 1995). New content should be taught taking into consideration working memory capacity. Therefore, when the student is faced with a similar problem, she has learned to focus on the solution method, the necessary strategy, and so on. In other words, the external load of the problem is reduced. Still, when the student is confronted with a story theme and similar numbers, she learns that the keyword method for problem-solving such as increase, add, more, etc., has to make sense in the context of the problem.

Nevertheless, in story problems, it is vital to identify the information necessary to solve the problem. Misunderstanding of a story problem leads to incorrect solutions and arithmetic operations of addition and subtraction, etc. Integrative

method uses diagrams for each problem strengthening the student's accuracy in correctly placing the problem data and ultimately understanding the content and choosing a practical strategy for carrying out each step.

Problem-solving requires remembering small pieces of information and processing new information to strategize a solution that requires working memory resources (Fung and Swanson 2017). To solve a mathematical problem, we store both the components of the problem and the information in the long-term memory related to that problem in the working memory. Due to the multi-stage nature of mathematical story problems, working memory plays an essential role in solution accuracy (Fung and Swanson 2017).

The post-test scores of the experimental and the control groups on arithmetic skills showed no significant difference. Dazy et al. (2017) found that the effect of problem-solving training on algebraic operations was positive. In this integrative method of training, in addition to paying attention to reading strategy and working memory, the use of diagrams is emphasized. Exercise at this stage was expected to improve the performance of arithmetic operations because, in the second stage of integrative training, the student had to place the problem information in the chart sections. In each exercise, the student is taught that the answer to the problem requires different solutions depending on the location of the information in the graph. Practice leads to a better understanding of addition and subtraction, followed by improved calculation.

Another reason for the present results can be the parents' focus on addition and subtraction as it is the chief educational goal of the book. Therefore, parents have had more practice with students in e-learning in this area, helping students to cover possible mistakes resulting in no significant difference between the post-test results of the experimental and control groups.

Conclusion

The present study showed that the integrative teaching of reading strategies and working memory has been influential in improved basic math skills. In the study of number components related to basic mathematical skills, the effectiveness of the integrated training of reading strategies and working memory on the problem-solving skills of arithmetic was confirmed. These results are indispensable when considering the poor performance of students in the TIMSS and PIRLS Tests and the challenges facing teachers in this field. The integrative approach can be effective in times when distance education is needed, such as the outbreak of Corona virus. Therefore, teachers are recommended to improve student performance by using the present teaching method, which leads to meaningful learning instead of maintaining a problem-solving practice. Regarding the second hypothesis of the research, the effectiveness of integrative teaching of reading strategies and working memory on students' arithmetic skills was not significant. In this section, it is necessary to conduct research in normal educational conditions in schools to examine the present findings further.

Due to the outbreak of the coronavirus and the closure of face-to-face training, there is a possibility of interfering factors such as family guidance of test

results, especially during the pre-tests. Virtual education may have hampered the results of integrative teaching. In the second phase of the integrative training, which provided face-to-face practice, a small number of students were present and had the opportunity to ask and answer questions and clarify any ambiguities. The rest of the students watched the video of the sessions.

The present study was performed on average second-grade elementary students. This method can also be tested on students with learning disabilities. Also, it is suggested that this research be done in normal conditions in face-to-face classes with the careful supervision of the teacher. The comparison of such a study with the present one can be interesting. In order to improve external validity in this research, it is suggested to use a factorial design in which gender, two types of teaching methods and classes as independent variables be executed. Therefore by using this design, we implement different teaching methods and to be able to more confidently generalize results to all elementary schools. It is also suggested to expand this study with a large sample of high school students using the three variables of cognitive knowledge, understanding and problem solving. In addition, it is necessary for elementary teachers to learn this method in -service education classes with integrative teaching of basic mathematical skills.

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