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An Action Research on Primary School Students' Reading Comprehension and Reasoning Skills

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Abstract

In this study, the effects of IMPROVE and Fermi problems on the development of reading comprehension skills and reasoning skills of primary school students were investigated in order to improve reading comprehension skills, deep reading strategy was preferred and informative and narrative texts were selected and used from the PIRLS exam texts. In order to develop mathematical reasoning skills, IMPROVE teaching method was preferred and TIMSS exam questions were selected and used in Fermi problems and reasoning. The study group of the research included a total of 17 students in a primary school in Bingöl city center in the second semester of the 2020-2021 academic year. The study was designed with action research, one of the qualitative research methods. The collected data were analyzed using the document analysis method of qualitative research and the statistical method of quantitative research. According to the research findings, it was concluded that the deep reading strategy applied for the development of reading comprehension skills of primary school students and IMPROVE and Fermi problems applied for the development of reasoning skills had a positive effect on students' reading comprehension and reasoning skills. It is suggested that reading comprehension and mathematical reasoning strategies should be taught to teachers.

Keywords: Critical thinking, comprehension skills, Fermi problems.

Introduction

The development of science and technology, changing living conditions, changing needs of the individual and society have also affected the roles expected of individuals. The information age we are in creates the need for individuals who can produce knowledge and use it functionally in life, have various thinking skills, reason, solve problems, contribute to society and culture, instead of individuals with a lot of knowledge (Ministry of National Education [MoNE], 2018). This means individuals with developed reading comprehension, thinking and reasoning skills. Since it is known that it is not possible to show individuals all the problem situations that they may encounter in daily life, individuals who can solve the problem as a result of understanding the problem with the acquired knowledge and using reasoning skills by using the knowledge rather than acquiring knowledge can only be successful in changing life conditions.

In the changing education system, the individual's awareness of his/her own learning process, understanding and reasoning about what he/she reads, rather than the transfer of knowledge, makes the individual successful. Engaging in mathematics provides individuals with skills such as problem solving, mathematical thinking, logical reasoning, and individuals can benefit from the depth of mathematics by developing strong mathematical skills (Trends in International Mathematics and Science Study [TIMSS], 2019). In this context, elements such as reasoning, communicating, associating, applying knowledge to the problem situation are among the requirements of problem solving (National Council of Teachers of Mathematics [NCTM], 2000). Therefore, it is necessary to provide individuals with methods and thinking skills that will help them solve problems and to improve their mathematical thinking skills. One of the basic skills required for problem solving is undoubtedly reading comprehension, mathematical thinking and reasoning. As a matter of fact, information and technology are advancing rapidly today, and our age has made it necessary for individuals to be good problem solvers with the skills of reasoning by understanding what they read.

In order for the exams to achieve their purpose, the questions must also be of high quality. This can be achieved by applying questions that can measure different levels of thinking in the exam. Exams should include not only questions at the knowledge level but also questions that will enable students to think at a higher level. It is seen that the use of questions to measure only lower level thinking skills decreases the distinctiveness of the exam. Questions measuring lower level thinking skills do not allow students to engage in serious mental activity (Dost, et al., 2011). In this context, it is emphasized that since there will not be only knowledge level questions in the exams that students will face, it is necessary for them to use appropriate reasoning strategies, which is one of the elements that will enable them to better understand what they read and reach the upper levels of cognitive domain steps. Reading comprehension and reasoning skills affect the solution of the problems we face in our daily lives and our success in international exams.

According to MoNE (2016), in PISA (Programme for International Student Assessment), which is an international study that enables countries to compare the knowledge and skill levels of their students, their education systems with each other, and to identify the strengths and weaknesses of their education systems, Türkiye ranks lowest in reading and other subjects. The areas in the PISA exam, which is conducted every three years around the world, are mathematical literacy, reading skills and science literacy; however, the concept of "literacy" is taken as a basis for all areas of assessment. In other words, the PISA and PIRLS (Progress in International Reading Literacy Study) exams are exams that measure students' reading comprehension skills and provide an opportunity for cross-country comparison. One of the important aspects of these exams is that they only focus on reading comprehension skills (Mullis, et al., 2016). Indeed, the prerequisite for success in assessment-based exams such as PISA and PIRLS is the development of reading comprehension and reasoning skills.

TIMSS, another international test that paints a picture of countries' education systems, assesses various problem-solving situations in the context of mathematics, and about two-thirds of the questions require students to use application and reasoning skills. Cognitive domains are the same for both grade levels, but their weights vary according to grade level. In the eighth grade, less emphasis is placed on the domain of knowing and more emphasis is placed on the domain of reasoning compared to the fourth grade (MoNE, 2018). In this context, in this study, it is predicted that since students will frequently encounter the field of reasoning in their future educational life, they will be able to successfully overcome the problems they will encounter in their educational life and daily life by understanding and approaching them with appropriate reasoning skills by improving their reading comprehension and reasoning skills. In this context, is there an effect of the in-depth reading strategy on the development of reading comprehension skills and the IMPROVE strategy and Fermi Problems on the development of reasoning skills of primary school students? It was investigated by creating a problem statement and sub-problems as follows.

1. What is the effect of the deep reading strategy on reading comprehension skills?
2. What is the effect of IMPROVE strategy and Fermi problems on reasoning skills?

3. What is the effect of using strategies to improve students' reading comprehension and mathematical reasoning skills on their achievement levels?

Method

Research Model

This study, which aims to examine the effect of the in-depth reading strategy applied for the development of reading comprehension skills and the IMPROVE and Fermi problems applied for the development of reasoning skills of primary school students, was modeled with the action research method of qualitative research design. Action research is a model of professional development related to a process that continually enables educators to improve teaching research, student learning and student learning (Rawlinson & Little, 2004). As it is known, action research is a research conducted by expert researchers, with the participation of practitioners and those who are party to the problem, aiming to determine the measures to be taken to improve the situation by making a critical evaluation of the existing practice (Yıldırım & Şimşek, 2005).

The data in the research were adopted through document analysis. Document analysis can be defined as scanning and collecting first-hand data related to the research and reaching new information by analyzing the collected data (Özkan, 2019). The process of the action research design model in practice is given in Table 1.

Table 1.

Action Research Design Model of the Implementation

	Pre-test	Process	Post-test
Experiment group	O_1 Pre-test	X 5 weeks of activities to improve reading comprehension and reasoning skills (Intervention)	O_2 Post-test

Working Group

The study group of the research includes a total of 17 students studying in the researcher's class in the school where the researcher teaches in the 2020-2021 academic year. While determining the study group, Covid-19 pandemic restrictions were taken into consideration and convenience sampling method, one of the purposeful sampling types, was preferred. Convenience sampling, also known as convenience sampling, provides ease of obtaining permission (Şimşek, 2012). At the same time, the preference for this sampling type is due to the fact that it is more easily accessible to include the study group in the research process (Ekiz, 2009, p.106).

The study was conducted in the school where the researcher was teaching, as it was thought that it would provide the researcher with an easier data collection opportunity since it was the institution where the researcher worked. The role of the researcher was that of the practitioner, the teacher of the class and the researcher as the person who conducted the research. For ethical reasons, the names of the students were not used in the research. In the study, a data collection tool was created from TIMSS and PIRLS questions whose validity and

reliability were ensured. The distribution of the students in the study group according to gender is given in Table 2.

Table 2.

Distribution of Individuals in the Study Group by Gender

Gender	Working group
Male	8
Female	9
Total	17

Data Collection Tools

In order to create the data collection tool, firstly, a total of 36 questions at the 4th grade level from TIMSS 2007, 2011 and 2015, which were included in TIMSS and measured reasoning skills, were accessed. Three different texts taken from PIRLS 2011; Daily Walk (Informative), Fly Eagle Fly (Narrative) and Enemy Pie (Narrative) and 40 questions related to these texts were used. The scoring rubrics of these texts were translated from English to Turkish with expert support. There are 20 multiple-choice and 20 open-ended questions about the texts. The pre-test and post-test questions consisting of open-ended and multiple-choice questions are also scored according to the scoring scale. In the PIRLS 2011 exam, 10 questions were selected from a total of 40 questions consisting of three stories. After the opinions of several experts working at Bingöl and İnönü Universities and experienced classroom teachers, a data collection tool was created from 20 questions consisting of TIMSS and PIRLS questions. In this direction:

Pre-Test Data Collection Tool

The Daily Walk (Informative) text and two multiple choice and three open-ended questions related to this text were selected from the PIRLS 2011 texts. A pre-test was created by selecting five questions from the 36 TIMSS questions with the reasoning domain that were open to access. In order to better investigate the effectiveness of the experimental phase, the post-test was composed of different questions from the pre-test. The pre-test questions were scored according to the PIRLS and TIMSS rubrics.

Post-Test Data Collection Tool

The post-test was created by selecting the text Enemy Pie (Narrative) from the PIRLS 2011 texts, 2 multiple-choice and 3 open-ended questions related to this text, and 5 TIMSS questions with reasoning domains different from the questions selected in the pre-test. Pre-test and post-test equivalence and suitability for the purpose were arranged by taking expert opinions.

Application Process

After the pre-test phase, in the 5-week intervention phase, the researcher, as a classroom teacher, started the implementation phase for the study group in line with the lesson plans prepared in advance. After examining the studies that identified the development of reading comprehension and mathematical reasoning skills in previous research, it was the basis for the implementation phase. In this direction, during the implementation process, it was tried to ensure the development of students' mathematical reasoning skills by solving non-

routine problems, making generalizations in the problem solution phase, developing logical discussions in collaborative groups regarding the solution, estimating and solving problems with the IMPROVE strategy. In this direction, the experimental implementation continued for 5 weeks (20 class hours, 4 hours per week), during which time the students solved 18 problems with the IMPROVE strategy and worked with 3 fermi problems. For the development of reading comprehension skills; 1 PIRLS reading text (fly eagle fly) and 7 multiple-choice and 5 open-ended questions related to this text were practiced with in-depth reading strategy. In order to ensure the development of reading comprehension skills, research has shown that linking, summarizing, predicting, asking questions, visualizing, clarifying and in-depth reading strategies contribute to the development of reading comprehension skills (Özyılmaz, 2010). In the studies examined, it was concluded that the deep reading strategy was more effective in increasing reading comprehension achievement (Burke, 2014; Ensley & Rodriguez, 2019; Fisher & Frey, 2012). In this context, in-depth reading strategy was applied to improve reading comprehension skills. After reviewing the national and international literature, the in-depth reading strategy was adapted to the elementary school level and the strategy stages were created after the opinion of an academician working as a faculty member at İnönü University and expert support was provided.

In-Depth Reading Strategy Implementer Preparations

Before the in-depth reading strategy, three appropriate, short, deep comprehension predictive and complex texts from the 2011 PIRLS exam were identified and the questions and scoring keys of the texts were translated into Turkish. The texts were structurally selected to be narrative and informative. Attention was paid to ensure that the texts contained content that would attract students' attention and interest. Symbolic expressions, which were thought to improve note-taking skills and contribute to deeper comprehension, were created to be with the student during reading. Symbol expressions were projected on the interactive board and colored A4 papers were additionally pasted on the desks in the circle seating arrangement to ensure that all students could see them. In the application, colored highlighters that support note-taking skills, attract attention and are thought to be of interest to primary school students, sticky papers with symbol expressions and colored and differently shaped sticky papers for note-taking were used. The implementation was carried out in the school's STEM classroom and these materials were made available to students in all sessions.

Problem Solving with IMPROVE Strategy and Fermi Problems Implementer Preparations

The 26 questions planned to be solved with the IMPROVE strategy were selected with the help of an expert from the published TIMSS 2007, 2011, 2015 questions in the reasoning cognitive domain and from a total of 36 questions in the question pool created in this domain. For the strategy, permission was obtained for the use of a referral card that had been previously created and used in another study. After conducting a literature review, the researcher added 4 Fermi problems to the question pool by taking the opinion of a professor working as an academician at Bingöl University.

Introducing the In-Depth Reading Strategy to Students

Before the implementation, the strategy was introduced to the students for two class hours and various symbols and skills were explained. The flow brochure, in which the stages of the strategy were introduced, was simplified according to the level of the students and arranged in accordance with their interests and distributed to the students for their review. Then the strategy was introduced practically.

Introducing Problem Solving Stages with IMPROVE Strategy to Students

The researcher first directed the students to have a discussion to express the importance of questioning in mathematics lessons. It also helped students to focus on the importance of determining the appropriate strategy when solving a problem and the importance of reflection in problem solving. At the end of the discussion, the researcher emphasized how to use prompting cards for metacognitive inquiry in problem solving based on the students' conversations.

Pre-Implementation Example Study of In-Depth Reading Strategy

The text "What Does the Brain Do?" was selected from the 4th grade primary school textbook and two lesson hours of sample practice was conducted on this text. In the implementation example, the researcher stated that she and all the students in the class were detectives. He stated that the detective's task was to try to understand the text by using the stages of the deep reading strategy and the symbols of deep reading and to answer the questions by discussing them. By making the students curious, she carried out the text in order by using symbols while applying the in-depth reading stages. Explained the deep reading symbols used. It is stated that words whose meaning is unknown in the text can be guessed by reading the preceding and following sentences. It was mentioned how to use the sticky notes on the text by taking notes and applications were made. The time for reading the text and answering questions related to the text was completed as planned within one class hour. When students asked questions about the texts after the implementation, the implementation was completed in a total of two class hours in order to talk about the symbols and to create a discussion environment, which is one of the important components of in-depth reading. With the sample application, both the strategy learning of the students was reinforced and the strategy was reorganized by providing feedback to the researcher with the necessary gaps and additions.

IMPROVE Strategy and Fermi Problems Pre-Application Example Study

It was considered important to carry out a sample application to determine the operability of the strategies to be applied, how effective the application was and the corrections to be made by the researcher. It is a preliminary study carried out before the actual implementation in order to see the practices to be used in the experimental phase and the deficiencies that may arise in achieving the aim of these practices. It was decided to carry out the implementation within a period of 6 hours. Among the questions in the reasoning cognitive domain in the question pool, 6 TIMSS problems and 1 Fermi problem were used. According to the students' mathematics report card grades, groups of 4 students each were formed with one

high, two medium and one low achievers. The fourth group consisted of five students: one successful, three moderately successful and one low-performing student. After the groups were formed, orientation cards were projected on the interactive board and colored A4 papers were pasted on the desks of the groups in the circle seating arrangement. The students were informed about how to solve the questions with the IMPROVE strategy and the steps of the strategy related to the students. The questions of the students who had questions about the strategy were answered. In the last 2 hours of the implementation, the purpose of the orientation card was explained to the students again. It was decided at which points and what kind of instructions should be included in the implementation of problem solving with the IMPROVE strategy. One fermi problem was solved with the students.

In-Depth Reading Strategy Implementation Plan

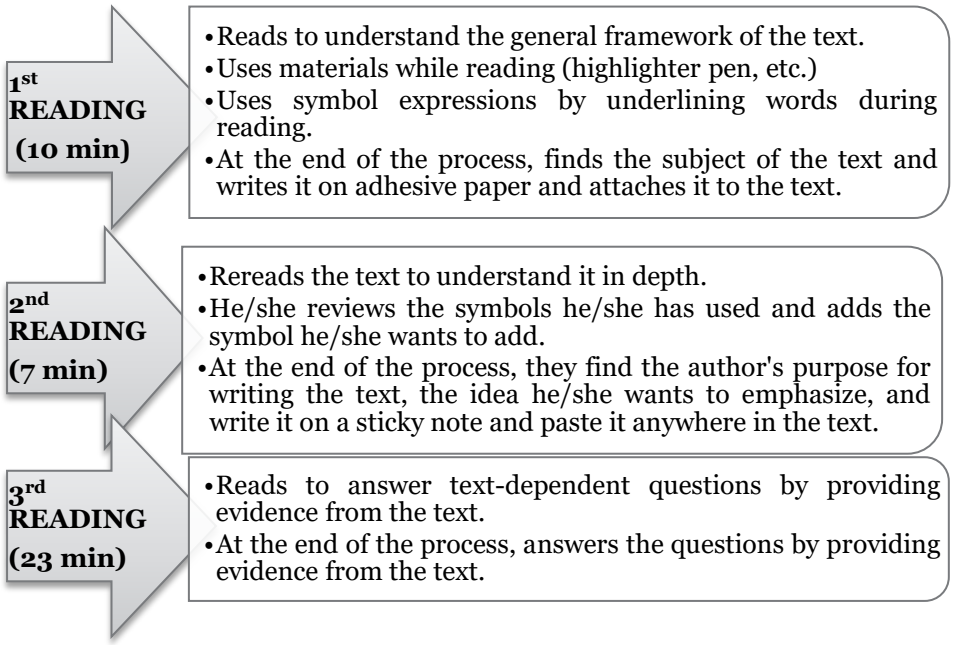
Grade Level: Grade 4

Duration: 30+10 Minutes (10 minutes additional time)

Implementation: The following steps were carried out by distributing the text and materials to the students.

1st Lesson:

Figure 1.
In-Depth Reading Strategy Reading Plan



2nd Lesson:

After the teacher collected the papers at the end of the first lesson, the second lesson was a discussion with the students about the text. They were asked about the difference of the text from the texts covered in the textbook and were asked to express their opinions about the text. The students' thoughts about why they used the symbol expressions they used while reading the text were taken. After the text was explained, the questions related to the text were reviewed and the students were asked to provide evidence from the text about the answer they

wrote and the ideas they defended. At the end of the lesson, the process was completed with an in-depth discussion about the text.

Problem Solving with IMPROVE Strategy and Solving Fermi Problems Application Phase

In the experimental implementation phase of the study, the IMPROVE strategy was used to work with 18 TIMSS problems. The experimental implementation lasted for 5 weeks (20 class hours). In the introductory phase of the implementation, some preparations were made for the implementation of the strategy. The work done in the case study was recalled and how to use the guidance cards was emphasized. The groups formed in the case study were formed and the preparatory work moved on to the actual stages of the strategy. The introductory phase of the strategy was conducted with all students. This phase lasted approximately 12 minutes. Metacognitive questions related to TIMSS questions were asked in order and students were given the right to answer. The teacher was involved in the process with the answers given and provided a brief information. Some of the metacognitive questions used in this process are as follows;

What is the problem about?

What is the appropriate strategy to solve the problem?

What is the purpose of solving this problem?

In what ways is this problem different from the ones we have solved before?

What are the similarities/differences between the problems?

After the introduction phase, the implementation phase started. The students were divided into groups formed by the teacher and started to work. At this stage, the students continued for approximately 28 minutes, and the groups that needed additional time were given 5 minutes.

The work done by the students during the implementation phase:

1. Each student in the group read the problem in turn and tried to explain the problem, its solution and his/her reasoning about the solution to the group members by answering the questions on the guidance card.
2. When there was no consensus about the student's solution and reasoning about the solution, the guiding card questions were taken into consideration and discussed until a consensus was reached.
3. If there was no consensus in the discussion, the teacher intervened in the groups. At this stage, the teacher guided the students to explain their ideas to each other and to think from different perspectives.
4. When the group members agreed on the answer, a different student tried to solve the next problem with the same process.

The questions on the guidance cards prepared by the researcher, for which permission was obtained for each student to engage in mathematical reasoning, were classified as "preparatory comprehension questions", "connection questions", "strategic questions" and "thinking questions" (Pilten, 2008).

At the end of each day, the teacher summarized the work done and made generalizations about the problems. During the process, the enrichment phase was applied to the successful groups and the correction phase was applied to the students with low success rates. In the correction phase, 2 questions were selected from the 6 questions in the case study phase and correction activities were carried out. One class hour was allocated for this activity. These steps were carried out throughout the experimental implementation process.

After the application of the IMPROVE strategy, the formed groups continued to work with 3 fermi problems.

- How much money is spent in your school canteen over the course of a day?

- How many liters of water are spent in your home on average in a week?

- What is the total distance you walk in a week?

First of all, they were reminded of the steps in the sample study related to the given questions and each student in turn read the question aloud and shared their thoughts with their groupmates. Some of the students stated that they needed additional information to solve the questions. In line with their requests, all students went to the canteen and took notes by learning the necessary product, price, and etc. information from the canteen operator. This process took 20 minutes. They were informed and guided in line with their requests regarding other fermi problems. The groups then answered the questions by discussing among themselves.

Data Analysis

The data obtained in the study were analyzed using the document analysis method of qualitative research and the data that needed to be given numerically were analyzed using the statistical method of quantitative research. Statistically, the data were analyzed using t-test and analysis of variance (ANOVA). In the data analysis phase, the data obtained were transferred to the SPSS program and Pearson Correlation Analysis was used to examine the relationship between students' reading comprehension and mathematical reasoning skills and the achievement levels of their use of strategies to improve their reasoning skills.

Ethical Permits of Research:

In this study, all the rules specified to be followed within the scope of "Higher Education Institutions Scientific Research and Publication Ethics Directive" were complied with. None of the actions specified under the heading "Actions Contrary to Scientific Research and Publication Ethics", which is the second part of the directive, have been taken.

Ethics Committee Permission Information:

Name of the committee that made the ethical evaluation = Tokat Gaziosmanpaşa University Social and Humanities Research Ethics Committee

Date of ethical review decision=21.05.2021

Ethics assessment document issue number=01-25

Findings

Results and Interpretation of Normality Tests

In order to examine the distribution of the data, Kolmogorov-Smirnova and Shapiro-Wilk analysis were applied. Normality test findings are given in Table 3.

Table 3.

Normality Test Results

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	*df*	*p*	Statistic	*df*	*p*
Pre-test	.14	17	.20*	.96	17	.69
Post-test	.18	17	.11*	.92	17	.14

Since the p value was greater than .05 in both Kolmogorov-Smirnova and Shapiro-Wilk tests, it was accepted that the series was normally distributed (Tabachnick & Fidell, 2013). In the light of this information, statistical methods based on the assumption of normal distribution were used to analyze the data.

Findings Related to the First Sub-Problem

First Sub-Problem: What is the effect of deep reading strategy on reading comprehension skills?

The data obtained as a result of the t-test conducted to compare the initial and final scores of the students in the research group regarding their ability to use the prepared deep reading strategies are given in Table 4.

Table 4.

T-Test Results to Determine whether the Deep Reading Strategy has an Effect on Reading Comprehension Skills

Score	Groups	*n*	*M*	*SD*	*t*	*p*
Skill score for using reading comprehension strategies	Pre-test	17	8.00	2.03	.92	.36
	Post-test	17	7.52	1.50		

When Table 4 is examined, it is seen that the mean score of the students in the research group for their ability to use reading comprehension strategies before the experimental procedure was 8, while this value was 7.52 after the experiment. It was observed that the mean of the post-test conducted after the experimental phase was lower than the mean of the pre-test. In the t-test, the P* value was analyzed as .36 and it was observed that it gave results greater than .05. Therefore, as a result of the t-test conducted at 95% confidence interval, it was concluded that there was no significant difference in the effect of the development of students' ability to use reading comprehension strategies with in-depth reading strategy in the exams they took before and after the training. The result for the first sub-problem of the research does not support some of the research results in the literature (Fisher & Frey, 2012; Ensley & Rodriguez, 2019). The aforementioned studies were experimental in nature and investigated the effectiveness of the deep reading strategy in terms of students' better comprehension of what they read. It can be said that the deep reading strategy alone is not sufficient to contribute positively to the development of students' reading comprehension skills. Therefore, it can be stated that the deep reading strategy, one of the reading

comprehension strategies, does not contribute positively to problem solving skills since it does not improve reading comprehension on its own. The difference of the research from other studies is that it consists of pre-test and post-test questions consisting of international PIRLS exam questions. The activities in the experimental phase also consist of PIRLS questions.

Findings Related to the Second Sub-Problem

Second Sub-Problem: What is the effect of IMPROVE Strategy and Fermi Problems on reasoning skills?

The data obtained as a result of the t-test conducted to compare the baseline and final scores of the students in the research group regarding their ability to use prepared reasoning strategies are given in Table 5.

Table 5.

T- Test Results to Determine Whether Improve Strategy and Fermi Problems Affect Reasoning Skills

Score	Groups	*n*	*M*	*SD*	*t*	*p*
Skill score for using reasoning strategies	Pre-test	17	6.00	2.44	-3.49	.00
	Post-test	17	8.23	1.71		

When Table 5 is examined, it is seen that while the mean score of the students in the research group for their ability to use reasoning strategies before the experimental procedure was 6, this value was 8.23 after the experiment. It was observed that the final state mean after the experimental phase was higher than the initial mean. In the t-test, the P* value was analyzed as .003 and it was observed that it gave results smaller than .05. Therefore, as a result of the t-test conducted at 95% confidence interval, it was concluded that there was a significant difference in the exams taken by the students before and after the training. When the initial and final scores of the students are compared, it can be said that the teaching process carried out by the researcher with IMPROVE and Fermi problems in the experimental phase improved the mathematical reasoning skills of the students and contributed to their problem solving skills.

No study directly related to the second sub-problem of the study was found in the literature. This result supports some research results in the literature (Çoban, 2019; Erdem, 2015; Kramarski & Hirsch 2003; Mevarech & Kramarski, 2003; Pilten, 2008). All of the aforementioned studies are experimental and it is stated that IMPROVE and Fermi Problems make a positive contribution in terms of investigating the effectiveness of IMPROVE and Fermi Problems against various variables and their effect on the development of reasoning skills. The difference of this study from the other studies is that the pretest and posttest questions used and the questions studied in the experimental phase were formed from the international TIMSS exam questions.

Findings Related to the Third Sub-Problem

Third Sub-Problem: What is the effect of students' use of strategies to improve their reading comprehension and mathematical reasoning skills on their achievement levels?

The data obtained from the Pearson correlation analysis conducted to compare the initial and final scores of the students in the research group in terms of their ability to use strategies to improve their reading comprehension and mathematical reasoning skills are given in Table 6.

Table 6.

Pearson Analysis Result of the Effect of Students' Use of Strategies to Improve Reading Comprehension and Mathematical Reasoning Skills on Achievement Levels

		Pre-test	Post-test
Pre-test	*r*	1	.61**
	p		.00
	n	17	17

There is a positive relationship between baseline and endline. This relationship was analyzed as a very high result with (r=.613, p=.009). It is stated that a correlation value (r) of at least .50 and above accurately represents the desired relationship (Fraenkel et al., 2012). Therefore, it can be said that there is a high level positive relationship in terms of the effect of students' use of strategies to improve their reading comprehension and mathematical reasoning skills on their achievement levels. In addition, according to this finding, it can be said that there is a linear relationship between reading comprehension and reasoning skills and achievement levels.

The result for the third sub-problem of the research also supports some of the research results in the literatüre. The development of reading comprehension and mathematical reasoning skills involves high-level skills and this is stated to increase success. In the literature, it is stated that mathematical reasoning (Çoban, 2010; Erdem, 2011, 2015; Erdem and Gürbüz, 2015; Lithner, 2008; Schliemann and Carraher, 2002) and reading comprehension (Block, 2004; Göktaş, 2010; Güneş, 2000; Reidel et al., 2003; Rose et al., 2000) are high-level thinking skills. The fact that both reading comprehension and mathematical reasoning skills and problem solving skills go through cognitive processes and require similar thinking processes confirms the existence of a highly significant relationship between the development of reading comprehension and mathematical reasoning skills and achievement level, as concluded in the current study.

Discussion and Conclusion

The findings related to the first sub-problem of the research do not support some research results in the literature (Ensley & Rodriguez, 2019; Fisher & Frey, 2012). The mentioned studies were experimental studies and revealed that the effectiveness of the deep reading strategy was investigated in terms of students' better comprehension of what they read. It can be said that the in-depth reading strategy alone is not sufficient to contribute positively to the development of students' reading comprehension skills. Therefore, it can be stated that the in-depth reading strategy, one of the reading comprehension strategies, does not

contribute positively to problem solving skills since it does not improve reading comprehension alone. The difference of the research from other studies is that it consists of pre-test and post-test questions consisting of international PIRLS exam questions. The activities in the experimental phase also consist of PIRLS questions.

There is no direct study in the literature related to the findings related to the second sub-problem of the research. When the initial and final scores of the students are compared, it can be said that the teaching process carried out by the researcher with IMPROVE and Fermi problems in the experimental phase improved the mathematical reasoning skills of the students and contributed to their problem solving skills. The result supports some research results in the literature (Çoban, 2019; Erdem, 2015; Kramarski & Hirsch, 2003, Mevarech & Kramarski, 2003; Pilten, 2008). All of the mentioned studies are experimental and it is stated that IMPROVE and Fermi Problems make a positive contribution in terms of investigating the effectiveness of IMPROVE and Fermi Problems against various variables and their effect on the development of reasoning skills. The difference of the study from other studies is that the pretest and posttest questions used and the questions studied in the experimental phase were formed from the international TIMSS exam questions.

The result obtained from the findings related to the third sub-problem of the research also supports some research results in the literature. The development of reading comprehension and mathematical reasoning skills involves high-level skills and this is stated to increase achievement. In the literature, it is stated that mathematical reasoning (Çoban, 2010; Erdem, 2011, 2015; Erdem and Gürbüz, 2015; Lithner, 2008; Schliemann and Carraher, 2002) and reading comprehension (Block, 2004; Göktaş, 2010; Güneş, 2000; Reidel et al., 2003; Rose et al., 2000) are high-level thinking skills. The fact that both reading comprehension and mathematical reasoning skills and problem solving skills go through cognitive processes and require similar thinking processes confirms the existence of a highly significant relationship between the effect of the development of reading comprehension and mathematical reasoning skills on achievement level, as concluded in the current study.

The study, which aims to examine the effect of the deep reading strategy applied for the development of reading comprehension skills and the IMPROVE and Fermi problems applied for the development of reasoning skills of primary school students, was conducted in the second semester of the 2020-2021 academic year in the primary school where the researcher worked in the second semester of the 2020-2021 academic year in a class of 17 students. In the experimental phase, this class worked on PIRLS questions with the deep reading strategy for the development of reading comprehension skills, worked on Fermi problems for the development of mathematical reasoning skills, and approached TIMSS questions with the IMPROVE strategy. In the study, pre-test and post-test consisting of TIMSS and PIRLS questions to measure reading comprehension and reasoning skills were applied to the students. T-test and Pearson correlation analysis were used to analyze the data obtained from the study. Considering the findings obtained as a result of the analysis of the data obtained for the sub-problems of the research, the following results were determined:

The result of the first sub-problem; ıt was seen that the effect of the deep reading strategy on reading comprehension skills did not create a significant difference at the end of

the teaching processes. In other words, it can be stated that the deep reading strategy has no effect on reading comprehension skills. Conclusion related to the second sub-problem; ıt was analyzed that IMPROVE Strategy and Fermi Problems had a positive effect on reasoning skills. In other words, the development of the skills of using reasoning strategies of IMPROVE Strategy and Fermi Problems shows a significant difference as a result of the teaching processes. Open-ended, thought-provoking problems for reasoning used in learning environments were found to improve mathematical reasoning. As a result of the research, it can be said that students' reasoning improved thanks to open-ended high-level problems. In the literature, it is mentioned that different question types are used to assess mathematical reasoning skills, and it is stated that open-ended and non-routine questions should be used more (Abay & Gökbulut, 2017; Akay, 2006; Cifarelli & Cai, 2005; Erdem, 2011; Erdem & Gürbüz, 2015; Gürbüz & Erdem, 2014; Kosonen, 1992; Lesh & Doerr, 2003; Silver, 1994, cited in Erarslan, 2012; Suzuki, 1997; Taşova & Delice, 2012). Conclusion related to the third sub-problem; the use of strategies to improve students' reading comprehension and mathematical reasoning skills had a high effect on their achievement levels.

Recommendations

Including different reading comprehension strategies in the process as well as in-depth examination of students with different texts such as informative and narrative texts has been found to have a positive effect on success by causing students to better understand the information, to examine the information critically and to communicate with the text. From the studies identified in the literature, it was concluded that success can be achieved by providing the development of mathematical reasoning skills by approaching questions at the reasoning level with Fermi problems and IMPROVE strategy. In the literature review, there were not many studies on mathematical reasoning skills, especially in Turkish sources. In this respect, it would be useful to conduct studies on mathematical reasoning skills.

Teachers should be informed about different strategies and studies since they do not have enough information about strategies to improve reading comprehension and mathematical reasoning skills. In this way, teachers will have the competence to determine the appropriate strategy for their classrooms.

Teachers should follow the international exam questions, ensure that students encounter international exam questions and non-routine problems, bring different text types into the classroom environment and prepare environments where students can reason.

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BIOGRAPHICAL NOTES

Contribution Rate of Researchers

Author 1: 50%

Author 2: 50%

Conflict Statement

There is no material or individual organic connection with the people or institutions involved in the research and there is no conflict of interest in the research.

İlkokul Öğrencilerinin Okuduğunu Anlama ve Muhakeme Becerileri Üzerine Bir Eylem Araştırması

Özet

Bu çalışmada, IMPROVE ve Fermi problemlerinin ilkokul öğrencilerinin okuduğunu anlama becerilerinin ve akıl yürütme becerilerinin gelişimine etkisi araştırılmıştır. Okuduğunu anlama becerilerini geliştirmek için derinlemesine okuma stratejisi tercih edilmiş ve PIRLS sınav metinlerinden bilgilendirici ve öyküleyici metinler seçilerek kullanılmıştır. Matematiksel akıl yürütme becerilerini geliştirmek için ise IMPROVE öğretim yöntemi tercih edilmiş ve TIMMS sınav soruları seçilerek Fermi problemleri ve akıl yürütmede kullanılmıştır. Araştırmanın çalışma grubunu 2020-2021 eğitim-öğretim yılı ikinci döneminde Bingöl il merkezinde bir ilkokulda öğrenim gören toplam 17 öğrenci oluşturmaktadır. Çalışma nitel araştırma yöntemlerinden biri olan eylem araştırması ile desenlenmiştir. Toplanan veriler nitel araştırmanın doküman analizi yöntemi ve nicel araştırmanın istatistiksel yöntemi kullanılarak analiz edilmiştir. Araştırma bulgularına göre, ilkokul öğrencilerinin okuduğunu anlama becerilerinin geliştirilmesi için uygulanan derinlemesine okuma stratejisinin ve akıl yürütme becerilerinin geliştirilmesi için uygulanan IMPROVE ve Fermi problemlerinin öğrencilerin okuduğunu anlama ve akıl yürütme becerileri üzerinde olumlu etkisi olduğu sonucuna ulaşılmıştır. Okuduğunu anlama ve matematiksel akıl yürütme stratejilerinin öğretmenlere öğretilmesi önerilmektedir.

Anahtar Kelimeler: Eleştirel düşünme, okuduğunu anlama, Fermi problemleri.

Giriş

Milli Eğitim Bakanlığı'na (MEB, 2016) göre uluslararası yapılan ve ülkelerin öğrencilerinin bilgi ve beceri düzeylerini, eğitim sistemlerini birbirleriyle karşılaştırma, eğitim sistemlerinin güçlü ve zayıf yönlerini belirleme olanağı sağlayan PISA'da (Uluslararası Öğrenci Değerlendirme Programı) Türkiye'nin başarı sıralamasında okuma ve diğer derslerde en son sıralarda yer aldığı görülmektedir. Bu sınavların önemli yanlarından biri sadece okuduğunu anlama becerisi üzerinde durmasıdır (Mullis, vd., 2016). Nitekim PISA ve PIRLS (Uluslararası Okuma Becerilerinde Gelişim Araştırması) gibi değerlendirmeye dayalı sınavlarda başarılı olmanın gerekli ön koşulu okuduğunu anlama ve muhakeme becerisinin gelişmiş olmasıdır.

Bu bağlamda; ilkokul öğrencilerinin, okuduğunu anlama becerilerinin gelişiminde derinlemesine okuma stratejisinin, muhakeme becerilerinin gelişiminde IMPROVE stratejisi ile Fermi Problemlerinin etkisi araştırılmıştır.

Yöntem

Araştırma Modeli

Bu çalışmada nitel araştırma deseninin eylem araştırması yöntemi ile yürütülmüştür. Araştırmada veriler doküman analizi ile toplanmıştır. Uygulamada yapılan eylem araştırması desen modeli süreci Tablo 1'de verilmiştir.

Tablo 1.
Yapılan Uygulamanın Eylem Araştırması Modeli

	Ön-test	İşlem	Son-test
Deney grubu	O_1 Ön-test	X 5 haftalık okuduğunu anlama ve muhakeme becerilerini geliştirecek çalışmalar (Müdahale)	O_2 Son-test

Çalışma Grubu

Araştırma, araştırmacının öğretmenlik yaptığı okulda 2020-2021 eğitim-öğretim yılında gerçekleştirilmiştir. Çalışma grubu, araştırmacının sınıfında öğrenim gören toplam 17 öğrenciden oluşmaktadır. Çalışma grubu belirlenirken Covid-19 pandemi kısıtlamaları göz önünde bulundurulmuş ve amaçlı örnekleme türlerinden uygun (kolaylı) örnekleme yöntemi tercih edilmiştir. Kolaylı örneklem, bir diğer adı ise hazır örneklem; izin alma kolaylığı sağlamaktadır (Şimşek 2012: s.122). Aynı zamanda bu örnekleme türünün tercih edilmesi, araştırma yapılacak çalışma grubunun araştırma sürecine dâhil edilmesinin daha kolay ulaşılabilir olmasından kaynaklanmaktadır (Ekiz, 2009, s.106).

Araştırmacının rolü hem uygulayıcı hem sınıfın öğretmeni hem de araştırmayı gerçekleştiren kişi olarak araştırmacı rolünü üstlenmiştir. Etik nedenlerden dolayı araştırmada öğrencilerin isimleri kullanılmamıştır. Araştırmada geçerliği ve güvenirliği sağlanmış TIMSS (Uluslararası Matematik ve Fen Eğilimleri Araştırması) ve PIRLS (Uluslararası Okuma Becerilerinde Gelişim Araştırması) sorularından veri toplama aracı oluşturulmuştur. Çalışma grubundaki öğrencilerin cinsiyete göre dağılımı Tablo 2'de verilmiştir.

Tablo 2.
Çalışma Grubundaki Bireylerin Cinsiyete göre Dağılımı

Cinsiyet	Çalışma grubu
Erkek	8
Kız	9
Toplam	17

Veri Toplama Araçları

Veri toplama aracını oluşturmak amacıyla öncelikle TIMSS'de yer alan ve erişime açık akıl yürütme becerisini ölçen TIMSS 2007, 2011 ve 2015 yıllarına ait, 4. sınıf düzeyinde toplam 36 adet soruya ulaşılmıştır. PIRLS 2011'den alınan üç ayrı metin; Günübirlik Yürüyüş (Bilgilendirici), Uç Kartal Uç (Öyküleyici) ve Düşman Turtası (Öyküleyici) ve bu metinlere bağlı 40 tane soru kullanılmıştır. Bu metinlerin Puanlama Cetveli uzman desteğiyle İngilizceden Türkçeye çevrilmiştir. Metinlerle ilgili 20 tane çoktan seçmeli ve 20 tane de açık uçlu soru bulunmaktadır. Açık uçlu ve çoktan seçmeli sorulardan oluşturulan ön test ve son test soruları da puanlama cetveline göre puanlanmaktadır. PIRLS 2011 sınavında yer alan üç hikâyeden oluşan toplam 40 tane sorudan 10 tane soru seçilmiştir. Bingöl ve İnönü Üniversitesinde görev yapan birkaç uzmandan ve deneyimli sınıf öğretmenlerinin görüşlerinden sonra TIMSS ve PIRLS sorularından oluşan 20 adet sorudan veri toplama aracı oluşturulmuştur. Bu doğrultuda:

Ön Test Veri Toplama Aracı

PIRLS 2011 metinlerinden Günlük Yürüyüş (Bilgilendirici) metni ve bu metne bağlı iki çoktan seçmeli üç açık uçlu soru seçilmiştir. Erişime açık bulunan akıl yürütme alanına sahip 36 adet TIMSS sorularından beş adet soru seçilerek ön test oluşturulmuştur. Deneysel aşamanın etkililiğini daha iyi araştırmak için son test ön testten farklı sorulardan oluşturulmuştur. Ön test soruları PIRLS ve TIMSS puanlama anahtarına göre puanlanmıştır.

Son Test Veri Toplama Aracı

PIRLS 2011 metinlerinden Düşman Turtası (Öyküleyici) metni ve bu metne bağlı 2 çoktan seçmeli 3 açık uçlu soru ve ön testte seçilen sorulardan farklı 5 adet akıl yürütme alanına sahip TIMSS soruları seçilerek son test oluşturulmuştur. Ön test ve son test eşdeğerliliği ve amaca uygunluğu uzman görüşleri alınarak düzenlenmiştir.

Uygulama Süreci

Ön-test aşamasından sonra 5 haftalık müdahale aşamasında, sınıf öğretmeni olarak araştırmacı, önceden hazırlanan ders planları doğrultusunda çalışma grubuna yönelik uygulama aşamasına geçmiştir. Daha önceki araştırmalarda okuduğunu anlama ve matematiksel muhakeme becerilerinin gelişimini tespit eden çalışmalar incelendikten sonra uygulama aşamasına dayanak olmuştur. Bu doğrultuda uygulama sürecinde; rutin olmayan problemler çözerek, problem çözüm aşamasında genellemeler yaparak, çözüme ilişkin işbirlikli gruplarda mantıklı tartışmalar geliştirerek, tahmin ederek ve IMPROVE stratejisiyle problem çözerek öğrencilerin matematiksel muhakeme becerilerinin gelişimi sağlanmaya çalışılmıştır. Bu doğrultuda deneysel uygulama 5 hafta (20 ders saati, haftalık 4 saat) boyunca sürdürülmüş, bu süre içerisinde öğrencilerin IMPROVE stratejisiyle 18 problem çözmeleri ve 3 fermi problemi ile çalışmaları sağlanmıştır. Okuduğunu anlama becerilerinin gelişimi için ise; bir adet PIRLS okuma metni (Uç Kartal Uç) ve bu metne bağlı yedi tane çoktan seçmeli, beş tane de açık uçlu sorunun derinlemesine okuma stratejisiyle çalışmaları sağlanmıştır. Okuduğunu anlama becerilerini geliştirmek için derinlemesine okuma stratejisi uygulanmıştır.

Verilerin Analizi

Araştırmada elde edilen veriler nitel araştırmanın doküman analizi yöntemi ve sayısal olarak verilmesi gerekli olan veriler de nicel araştırmanın istatistiksel yönteminden yararlanılarak analiz edilmiştir. İstatistiksel olarak veriler t-testi ve varyans analizi (ANOVA) kullanılarak analiz edilmiştir. Veri analizi aşamasında elde edilen veriler SPSS programına aktarılarak öğrencilerin okuduğunu anlama ve matematiksel muhakeme becerileri ile muhakeme becerilerini geliştirecek strateji kullanımlarının başarı düzeyleri arasındaki ilişkiyi incelemek amacıyla Pearson Korelasyon Analizi kullanılmıştır.

Araştırmanın Etik İzinleri:

Bu çalışmada "Yükseköğretim Kurumları Bilimsel Araştırma ve Yayın Etiği Yönergesi" kapsamında uyulması gerektiği belirtilen tüm kurallara uyulmuştur. Yönergenin ikinci bölümü olan "Bilimsel Araştırma ve Yayın Etiğine Aykırı Eylemler" başlığı altında belirtilen eylemlerin hiçbiri gerçekleştirilmemiştir.

Etik Kurul İzin Bilgileri:

Etik değerlendirmeyi yapan kurulun adı = Gaziosmanpaşa Üniversitesi Sosyal ve Beşeri Bilimler Araştırmaları Etik Kurulu

Etik Kurul Etik inceleme karar tarihi= 21.05.2021

Etik değerlendirme belgesi konu numarası= 01-25

Bulgular

Normallik Testlerine İlişkin Bulgular ve Yorum

Verilerin dağılımını incelemek için normal dağılım analizlerinden Kolmogorov-Smirnova ve ShapiroWilk analizi uygulanmıştır. Normallik testi bulguları Tablo 3'te verilmiştir.

Tablo 3.

Normallik Testi Bulguları

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	*df*	*p*	Statistic	*df*	*p*
Öntest	.14	17	.20*	.96	17	.69
Sontest	.18	17	.11*	.92	17	.14

Kolmogorov-Smirnova ve Shapiro-Wilk testlerinin her ikisinde de p değeri .05'ten büyük olduğu için serinin normal dağılım gösterdiği kabul edilmiştir (Tabachnick & Fidell, 2013). Elde edilen bu bilgiler ışığında verilerin analizi için normal dağılım varsayımına dayalı istatistiksel yöntemler kullanılmıştır.

Birinci Alt Probleme Ait Bulgular

Araştırma grubunda yer alan öğrencilerin hazırlanan derinlemesine okuma stratejilerini kullanma becerilerine ait başlangıçtaki ve son durumdaki puanlarının karşılaştırılması amacıyla yapılan t-testi sonucunda elde edilen veriler Tablo 4'te verilmiştir.

Tablo 4.

Derinlemesine Okuma Stratejisinin Okuduğunu Anlama Becerisine Etkisinin Olup Olmadığını Belirlemek Üzere Yapılan t Testi Sonucu

Puan	Gruplar	*n*	*M*	*SD*	*t*	*p*
Okuduğunu anlama stratejileri kullanma beceri puanı	Öntest	17	8.00	2.03	.92	.36
	Sontest	17	7.52	1.50		

Tablo 4 incelendiğinde, araştırma grubunda bulunan öğrencilerin deneysel işlem öncesi okuduğunu anlama stratejileri kullanma becerilerine ait puanlarının ortalaması 8 iken bu değerin deney sonrasında 7.52 olduğu görülmektedir. Deneysel aşamadan sonra yapılan son testin ortalamasının ön test ortalamasından düşük olduğu gözlenmiştir. Yapılan t-testinde P* değerinin .36 olarak analiz edilmiştir ve .05'ten büyük sonuç verdiği gözlenmiştir. Dolayısıyla %95 güven aralığında yapılan t-testi sonucu öğrencilerin okuduğunu anlama stratejilerini kullanma becerilerinin derinlemesine okuma stratejisiyle gelişim etkisinin eğitim öncesi ve sonrası girdikleri sınavlarda anlamlı bir fark olmadığı sonucuna ulaşılmıştır.

Araştırmanın birinci alt problemi için ortaya konulan sonuç, literatürde yer alan bazı araştırma sonuçlarını desteklememektedir (Ensley & Rodriguez, 2019; Fisher & Frey, 2012,

2014; Kâmil vd., 2008; Tıraşoğlu, 2013). Belirtilen çalışmalar deneysel özellikte çalışmalar olup, derinlemesine okuma stratejisinin öğrencilerin okuduğunu daha iyi anlamaları açısından etkililiğinin araştırılmasını ortaya koymuştur. Derinlemesine okuma stratejisinin öğrencilerin okuduğunu anlama becerilerinin gelişimine pozitif yönde katkı sağlamasında tek başına yeterli olmadığı söylenebilir. Dolayısıyla okuduğunu anlama stratejilerinden derinlemesine okuma stratejisinin okuduğunu anlamayı tek başına geliştirmediğinden problem çözme becerilerine pozitif yönde katkısının olmadığı ifade edilebilir. Araştırmanın diğer araştırmalardan farkı; uluslararası yapılan PIRLS sınav sorularından oluşan ön test ve son test sorularından oluşmasıdır. Deneysel aşamadaki etkinlikler de PIRLS sorularından oluşmaktadır.

İkinci Alt Probleme Ait Bulgular

Araştırma grubunda yer alan öğrencilerin hazırlanan muhakeme stratejileri kullanma becerilerine ait başlangıç durumu ile son durum puanlarının karşılaştırılması amacıyla yapılan t-testi sonucunda elde edilen veriler Tablo 5'te verilmiştir.

Tablo 5.

IMPROVE Stratejisi ile Fermi Problemlerinin Muhakeme Becerilerine Etkisinin Olup Olmadığını Belirlemek Üzere Yapılan t Testi Sonucu

Puan	Gruplar	*n*	*M*	*SD*	*t*	*p*
Muhakeme stratejileri kullanma beceri puanı	Öntest	17	6.00	2.44	-3.49	.00
	Sontest	17	8.23	1.71		

Tablo 5 incelendiğinde, araştırma grubunda bulunan öğrencilerin deneysel işlem öncesi muhakeme stratejileri kullanma becerilerine ait puanlarının ortalaması 6 iken bu değerin deney sonrasında 8.23 olduğu görülmektedir. Deneysel aşamadan sonra yapılan son durum ortalamasının başlangıçtaki ortalamasından yüksek olduğu gözlenmiştir. Yapılan t-testinde P* değerinin .003 olarak analiz edilmiştir ve .05' ten küçük sonuç verdiği gözlenmiştir. Dolayısıyla %95 güven aralığında yapılan t-testi sonucu öğrencilerin eğitim öncesi ve sonrası girdikleri sınavlarda anlamlı bir fark olduğu sonucuna ulaşılmıştır. Öğrencilerin başlangıçtaki durumları ile son durumlarının puanları karşılaştırıldığında; araştırmacı tarafından deneysel aşamada IMPROVE ve Fermi problemleriyle gerçekleştirilen öğretim sürecinin öğrencilerin matematiksel muhakeme becerilerini geliştirdiği ve problem çözme becerilerine katkı sağladığı söylenebilir.

Literatürde araştırmanın ikinci alt problemi ile doğrudan ilgili bir çalışmaya rastlanılmamıştır. Ortaya konulan sonuç, literatürde yer alan bazı araştırma sonuçlarını da destekler niteliktedir (Çoban, 2019; Erdem, 2015; Kramarski & Hirsch 2003; Kramarski & Zeichner, 2001; Mevarech & Kramarski, 2003; Mevarech vd., 2001; Pilten, 2008). Belirtilen çalışmaların tamamı deneysel özelliktedir ve IMPROVE ve Fermi Problemlerinin çeşitli değişkenler karşısında etkililiğinin araştırılması ve muhakeme becerilerinin gelişiminde etkisi bakımından pozitif katkı sağladığı ifade edilmektedir. Araştırmanın diğer araştırmalardan farkı kullanılan öntest, sontest soruları ve deneysel aşamada çalışılan soruların da uluslararası yapılan TIMSS sınav sorularından oluşturulmasıdır.

Üçüncü Alt Probleme Ait Bulgular

Araştırma grubunda yer alan öğrencilerin okuduğunu anlama ve matematiksel muhakeme becerilerini geliştirecek stratejileri kullanma becerilerine ait başlangıçtaki durumları ile son durumları arasındaki puanların karşılaştırılması amacıyla yapılan pearson korelasyon analizinden elde edilen veriler Tablo 6' da verilmiştir.

Tablo 6.

Öğrencilerin Okuduğunu Anlama ve Matematiksel Muhakeme Becerilerini Geliştirecek Strateji Kullanımlarının Başarı Düzeylerine Etkisinin Pearson Analizi Sonucu

		Öntest	Sontest
Öntest	*r*	1	.61**
	p		.00
	n	17	17

Başlangıç durum ile son durum arasında pozitif yönlü bir ilişki mevcuttur. Bu ilişki (r=.613, p=.009) ile oldukça yüksek bir sonuç olarak analiz edilmiştir. Bu korelasyon değerinin (r) en az .50 ve üzerinde olmasının istenen ilişkiyi doğru olarak temsil ettiği belirtilmektedir (Fraenkel vd., 2012). Dolayısıyla öğrencilerin okuduğunu anlama ve matematiksel muhakeme becerilerini geliştirecek stratejileri kullanımlarının artması başarı düzeylerine etkisi açısından yüksek düzeyde pozitif bir ilişki olduğu söylenebilmektedir. Buna ek olarak bu bulguya göre okuduğunu anlama ve muhakemesel beceriler ile başarı düzeyleri arasında doğrusal bir ilişkiye sahip olduğu söylenebilir.

Tartışma ve Sonuç

Araştırmanın üçüncü alt problemi için ortaya konulan sonuç, literatürde yer alan bazı araştırma sonuçlarını da destekler niteliktedir. Okuduğunu anlama ve matematiksel muhakeme becerilerinin gelişimi üst düzey becerileri içermektedir ve bu durumun başarıyı arttırdığı ifade edilmektedir. Literatürde matematiksel muhakemenin (Çoban, 2010; Erdem, 2011, 2015; Erdem ve Gürbüz, 2015; Lithner, 2008; Schliemann & Carraher, 2002) ve okuduğunu anlamanın (Block, 2004; Göktaş, 2010; Güneş, 2000; Reidel vd., 2003; Rose vd., 2000) üst düzey düşünme becerisi olduğu ifade edilmiştir. Hem okuduğunu anlama ve matematiksel muhakeme becerileri hem de problem çözme becerileri bilişsel süreçlerden geçmesi ve benzer düşünme süreçleri gerektirmesi mevcut araştırmada da sonuçlandığı üzere okuduğunu anlama ve matematiksel muhakeme becerilerinin gelişiminin başarı düzeyine etkisinin yüksek düzeyde anlamlı bir ilişkinin varlığını doğrulamaktadır.

Araştırmanın birinci alt problemiyle ilgili bulgular, literatürde yer alan bazı araştırma sonuçlarını desteklememektedir (Ensley & Rodriguez, 2019; Fisher & Frey, 2012, 2014). Belirtilen çalışmalar deneysel özellikte çalışmalar olup, derinlemesine okuma stratejisinin öğrencilerin okuduğunu daha iyi anlamaları açısından etkililiğinin araştırılmasını ortaya koymuştur. Derinlemesine okuma stratejisinin öğrencilerin okuduğunu anlama becerilerinin gelişimine pozitif yönde katkı sağlamasında tek başına yeterli olmadığı söylenebilir. Dolayısıyla okuduğunu anlama stratejilerinden derinlemesine okuma stratejisinin okuduğunu anlamayı tek başına geliştirmediğinden problem çözme becerilerine pozitif yönde katkısının olmadığı ifade edilebilir. Araştırmanın diğer araştırmalardan farkı; uluslararası yapılan PIRLS

sınav sorularından oluşan ön test ve son test sorularından oluşmasıdır. Deneysel aşamadaki etkinlikler de PIRLS sorularından oluşmaktadır.

Literatürde araştırmanın ikinci alt problemiyle ilgili bulgularla alakalı doğrudan bir çalışmaya rastlanılmamıştır. Öğrencilerin başlangıçtaki durumları ile son durumlarının puanları karşılaştırıldığında; araştırmacı tarafından deneysel aşamada IMPROVE ve Fermi problemleriyle gerçekleştirilen öğretim sürecinin öğrencilerin matematiksel muhakeme becerilerini geliştirdiği ve problem çözme becerilerine katkı sağladığı söylenebilir. Ortaya konulan sonuç, literatürde yer alan bazı araştırma sonuçlarını da destekler niteliktedir (Çoban, 2019; Erdem, 2015; Kramarski & Hirsch 2003, Mevarech & Kramarski, 2003; Pilten, 2008). Belirtilen çalışmaların tamamı deneysel özelliktedir ve IMPROVE ve Fermi Problemlerinin çeşitli değişkenler karşısında etkililiğinin araştırılması ve muhakeme becerilerinin gelişiminde etkisi bakımından pozitif katkı sağladığı ifade edilmektedir. Araştırmanın diğer araştırmalardan farkı kullanılan öntest, sontest soruları ve deneysel aşamada çalışılan soruların da uluslararası yapılan TIMSS sınav sorularından oluşturulmasıdır.

Araştırmanın üçüncü alt problemi ile ilgili bulgulardan ortaya çıkan sonuç, literatürde yer alan bazı araştırma sonuçlarını da destekler niteliktedir. Okuduğunu anlama ve matematiksel muhakeme becerilerinin gelişimi üst düzey becerileri içermektedir ve bu durumun başarıyı arttırdığı ifade edilmektedir. Literatürde matematiksel muhakemenin (Çoban, 2010; Erdem, 2011, 2015; Erdem ve Gürbüz, 2015; Lithner, 2008; Schliemann & Carraher, 2002) ve okuduğunu anlamanın (Block, 2004; Göktaş, 2010; Güneş, 2000; Reidel vd., 2003; Rose vd., 2000) üst düzey düşünme becerisi olduğu ifade edilmiştir. Hem okuduğunu anlama ve matematiksel muhakeme becerileri hem de problem çözme becerileri bilişsel süreçlerden geçmesi ve benzer düşünme süreçleri gerektirmesi mevcut araştırmada da sonuçlandığı üzere okuduğunu anlama ve matematiksel muhakeme becerilerinin gelişiminin başarı düzeyine etkisinin yüksek düzeyde anlamlı bir ilişkinin varlığını doğrulamaktadır.

Öneriler

Öğretmenlerin okuduğunu anlama ve matematiksel muhakeme becerilerini geliştirecek stratejiler hakkında yeterli bilgiye sahip olmadıkları düşüncesiyle farklı strateji ve çalışmalar hakkında bilgilendirilmelidir. Bu şekilde öğretmenler farklı stratejilerden kendi sınıflarına uygun olanı belirleme yeterliliğine sahip olacaktır.

Öğretmenlerin yapılan uluslararası sınav sorularını takip etmesi, öğrencilerin uluslararası yapılan sınav sorularıyla ve rutin olmayan problemlerle karşılaşmasını sağlaması, farklı metin tiplerini sınıf ortamına taşıması ve öğrencilerin muhakeme yapabileceği ortamlar hazırlaması gerekmektedir.