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Formation of research skills of students through solving problems in teaching mathematics in primary classes

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Abstract

This study aimed to create students' research skills by solving problems in teaching mathematics in primary school classes and was designed according to this purpose. In this context, it is aimed to conduct a study on teaching mathematics to primary school students. The research was created and implemented in the 2021–2022 spring academic year. 296 primary school students voluntarily participated in the research. In the research, problem-solving training in mathematics teaching was given to the students participating in the study in the form of a 2-week online education. To collect data in the study, the 'mathematics and problem-solving' data collection tool, which was developed by the researchers and whose validity and reliability were obtained, was used. The data collection tool used in the research was delivered and collected by the online method. The analysis of the data was made by using the Statistical Package for the Social Sciences programme, frequency analysis and *t*-test, and the results were added to the research in the presence of tables. As a result of the

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research, it is seen that primary school students' problem-solving situations improved with mathematics teaching and they enjoyed these methods and achieved positive results.

Keywords: Primary school students, teaching mathematics, problem-solving, distance education;

1. Introduction

It is known that scientific development in the living environment is equivalent to the importance it attaches to education (Adlet et al., 2022). At the same time, it is known that cognitive tools and scientific reactions shape technology and mathematics education. In other words, education and mathematics education has a separate meaning to the education module to train students with analytical and creative thinking skills and highly developed problem-solving skills. It should not be forgotten that mathematics education is a subject that is always renewed and developed in the whole environment, as in other courses (Gürbüz, Afacan Fındıklı, & Özdemir Şebnem, 2022). Change and development are indispensable as students create learning for themselves that is constantly changing and in desired dimensions. In its most general sense, mathematical modelling is the process of expressing a real-life situation mathematically (Lusdoc & Namoco, 2019). However, in the same situation as informatics and science, mathematical modelling includes more processes than the meaning mentioned above (Qizi, 2021). It is also known that modelling in the field of mathematics is the process of observing a review, revealing relationships, performing mathematical analyses, obtaining results and reinterpreting the model (Levchyk, Chaikovska, Yankovych, Kuzma, & Rozhko-Pavlyshyn, 2021). It is possible to see mathematics courses in different courses and applications. Assumptions such as the fact that mathematics includes applications in real life, that mathematical knowledge can be used concretely and that it provides the opportunity to produce more analytical and practical solutions to events by using mathematics gives rise to the idea that mathematical modelling should also be used at the level of primary and secondary school mathematics education (Mukhtoraliyevna & Saminjanovna, 2022). Accordingly, in recent times, most mathematics education researchers need to create studies on mathematical thinking in education. The main concerns that direct mathematics educators to work on mathematical modelling are 'What kind of mathematics education should be done so that students can have mathematical knowledge and mathematical thinking skills that they can prefer in their daily lives?' and the inadequacy of traditional methods and problem-solving activities in developing students' problem-solving skills (Dadakhon & Sabohat, 2022).

It is known that when students try to solve an undesirable problem, they are deficient in terms of making way and spending time for the solution, as well as checking the solution by using similar simple problems (Uzunboylu & Yıkmış, 2021). When faced with a problem, it is often necessary to examine the question patterns and quickly apply the necessary operations to the seen numbers and reach the result (Mirzaxolmatovna, 2021). In addition, students have developed some negative attitudes and beliefs towards mathematics and thus problem-solving. Among these negative and hindering attitudes and beliefs, there are ideas such as that ordinary students cannot solve problems on their own, that each problem has only one correct answer, that each problem has only one correct solution and that there are serious differences between the mathematics used in real life and the mathematics at school (Fediy, Protsai, & Gibalova, 2021). This is the case in many parts of the world, as well as in our country. In our country, the inadequacies listed above are observed in the development of problem-solving skills, which are tried to be gained in mathematics lessons in schools

(Yunus, 2021). Undoubtedly, it is known that the way of teaching has an important role in the formation of these inadequacies. In this context, this study will continue to develop to strengthen problem-solving skills in mathematics teaching.

1.1. Related research

Gluzman, Sibgatullina, Galushkin, and Sharonov (2018) aimed to specify the essence and characteristics of the application of pedagogical technology, which forms the basis of the professionalism of future mathematics teachers and as a result, this method is the basis of the professionalism of future mathematics teachers and corresponds to the structure of the holistic pedagogical process and includes the following: It is seen that it has reached the values on which it is based.

Tereshchuk, Kuzma, Yankovych, and Falfushynska (2019) aimed to investigate the appropriateness of applying a successful personality formation technology to a primary school student during the media education application in primary school and as a result, effective forms and methods of school children education have been proven: the creation of electronic books, 'success rules' and 'success stories', which concluded watching movies about successful people with special needs, analysing media products on success and informing families about this issue.

In the study of Soboleva, Sabirova, Babieva, Sergeeva, and Torkunova (2021), it was aimed to include educational computer games in students' mathematical activities and to create additional opportunities to increase the quality of mathematics teaching in a digital school, to support the formation of the required professional competence – computational thinking – and as a result, students will use technology and mathematics. They have concluded that they have reached positive values as well as being successful in activities and also that they have the appropriate skills that determine the essence of special computational thinking.

When the studies shown and applied in related studies are carefully examined, it is seen that it is important that mathematics and technology are at the forefront of students and that these studies are applied to primary school students and their derivatives because they gain positive factors in their behaviours. In this context, it can be said that the same effect is expected from this research.

1.2. Purpose of the study

In the study, it was aimed to create the research skills of the students by solving problems in teaching mathematics in primary school classes and the answers to the following questions were sought for the determined general purpose:

1. What are the timeframes for the use of mathematics problem-solving teaching activities for the participant groups included in the study?

2. What are the distance education use cases of the participant group included in the research?

3. What is the purpose of using problem-solving skills in mathematics teaching in the daily life of the participant group included in the research?

4. Is there a significant difference between problem-solving in mathematics teaching according to the gender variable of the participant group included in the research?

5. What are the views of the participant group included in the study before and after the study?

2. Method

When the method part of the study is examined, it is seen that information is given about the methods and the methods applied to the participant group in the study and there is information on findings of the data collection tool, gender and how the application was formed. It is seen that all of the information given in this section is binding and gathering information for the research.

2.1. Research Model

It is seen that quantitative data and methods are included in the study, so the quantitative research method was also used in the study. In the quantitative research phase, researchers reveal results expressed by the number of participants representing the environment they are connected to. No in-depth analysis is done in quantitative research. It is directly related to the explanations made as a result of numerical data. Some methods are applied while performing quantitative research (Caliskan et al., 2022). In this sense, it was designed on the formation of students' research skills by solving problems in mathematics teaching in primary school classes of the participant group participating in the research.

2.2. Working group/participants

When the research is examined by considering the participants' part, it is stated which regions primarily benefited. Participant group participating in the research receive their training through the live events and lessons.

2.2.1. Gender

In this part of the study, it is seen that information is given according to the gender criteria, in this context, it is seen that the gender information is given in Table 1.

Table 1. Distribution of the participant group included in the study by gender variable

Gender	Boy		Girl	
	F	%	*F*	%
Variable	152	51.35	144	48.65

As seen in Table 1 of the study, gender values are given and it is seen that these values are given by grouping the numerical forms. In Table 1, it is seen that 51.35% (152 people) are male participants, while 48.65% (144 people) are female participants. In the gender section, the findings reflect the actual gender distribution.

2.2.2. The periods of using mathematics problem-solving teaching activities of the participant group included in the study

In the research, activities were prepared following the teaching of mathematics with the help of technology and primary school students were expected to participate in these activities. In this context, the mathematical problem-solving teaching activities of the group are digitised and given in detail in Table 2.

Table 2. Periods of using mathematics problem-solving teaching activities by the participant groups included in the study

Participation timeframes for events	1 hour		2 hours		3 hours or more	
	F	%	*F*	%	*F*	%
Variable	17	5.74	52	17.57	227	76.69

It is seen that the participation in mathematics teaching problem-solving teaching live activities regarding the problem situation of the research and at the same time information about the usage times are given. While expressing this, 17.57% (52 people) stated that they spare time for live events during the day in the range of 2 hours and lastly, 76.69% (227 people) stated that they spare time for live events of 3 hours or more. It is seen that the amount of time to participate in live events is mostly preferred by primary school students as 3 hours or more.

2.2.3. Distance education usage periods of the participant group included in the research

In this section, the distance education usage periods of the participant group included in the research were researched and examined. Detailed information is given in Table 3.

Table 3. Distance education usage periods of the participant group included in the study

Distance education usage time zones	1 Time		2 Times		3 hours or more	
	F	%	*F*	%	*F*	%
Variable	22	7.43	68	22.97	206	69.60

When Table 3 is examined, it is seen that the distance education usage periods of the participant group included in the research were researched and given in Table 3. In this context, 7.43% (22 people) stated that they used it for 1 hour, while 22.97% (69 people) stated that they used it for 2 hours and finally, it is seen that 69.60% (206 people) stated that they spent 3 hours or more.

2.2.4. Class status

In this section, it is seen that the data are given according to the class scale of the participant group included in the research, analysed and added to Table 4.

Table 4. Distribution of the participant group included in the study by class status

Department	2. Class		3. Class		4. Class	
	F	%	*F*	%	*F*	%
Variable	85	28.72	103	34.80	108	36.47

When Table 4 is examined, it is seen that the distribution of the participant group included in the research according to their primary school grades is discussed. In this context, when Table 4 is considered, 28.72% (85 people) are in the second class, 34.80% (103 people) are in the third class and 36.47% (108 people) are in the fourth class. The findings in the class criteria reflect the actual distribution.

2.3. Data collection tools

It is known that the data collection tool given in the research is on a target and purpose line for the participant group participating in the research. In this section, it is seen that information about the data collection tool used in the research is included and given. The data collection tool, on the other hand, was created specifically for this research by the researchers who created the research and it was simplified by removing the unsuitable items from the research after being examined by experts. It is seen that a personal information form called 'mathematics and problem-solving' measurement tool, which was applied to the participants included in the research and created by the researchers, was used. The content validity of the developed measurement tool was examined by experts, two professors and one associate professor, working in the primary school mathematics and technology department and unnecessary items were removed from the measurement tool and simplified and rearranged.

1. Personal information form (demographic data): In the personal information form, gender, class, live event participation status and distance education usage information are included.

2. Mathematics and problem-solving data collection tool: A 5-point Likert-type data collection tool was prepared to measure some values in the participant groups and to prove whether they exist or not. Eighteen items of the measuring tool consisting of 22 items were used and 4 items were removed from the measuring tool, thanks to experts' opinions. Opinions of participant groups from two factorial dimensions, such as 'Mathematics Problem Solving' and 'Technology', were consulted. The Cronbach alpha reliability coefficient of the measurement tool as a whole was calculated as 0.94. The measuring tool was in the range of 'strongly disagree' (1), 'disagree' (2), 'undecided' (3), 'agree' (4) and 'strongly agree' (5). The measurement tool was also collected from the participant group in the form of an online environment.

2.4. Application

Since the application dimension of the research will develop over the Internet, help and support were requested from the families of the participant groups. In the application part, some information will be created and information about mathematics, problem-solving and technology will be given. 296 primary school students, who will be the elders of the future, were determined and live events were created using Google Meet and activities through distance education, mathematical problem-solving and mathematical question-solving techniques were prepared by experts in the field. Students were expected to participate from their technological devices; groups were formed by the people included in the research; and activities were created for groups in mathematics and technology. The 2-week live event was transferred to the participant groups and they were expected to participate every week. After the 2-week training, the information form and the data collection tool were collected with the help of the families via the online application method for the participant group participating in the research and the data are given in the findings section in tables. The

training was distributed into four sections over Google Meet, which is used by most schools, and each determined section was distributed over the weeks to be limited to a maximum of 75 participants. Participants in the study were expected to participate in the training with a video and microphone using smart devices. The data collection tool applied to the people participating in the research was collected using an online questionnaire and transferred to the Statistical Package for the Social Sciences programme by coding in the computing software environment.

2.5. Analysis of data

In the data analysis part, the statistical data obtained from the people participating in the research were analysed in the Statistics programme by using frequency (*f*), percentage (%), mean (*M*), standard deviation (SD) and *t*-test, respectively. The numerical values of the data obtained from the related software are given in tables, accompanied by comments in the findings section.

3. Findings

In this section, the findings related to the mathematical problem-solving and technology status of the participants participating in the research are included. Each finding of the research has been added and presented in this section with comments.

3.1. The purpose of using problem-solving skills in mathematics teaching in the daily life of the participant group included in the research

In this section, the purpose of using problem-solving skills in mathematics teaching in the daily life of the participant group included in the study was investigated and detailed information is given in Table 5.

Table 5. Purposes of using problem-solving skills in mathematics teaching in the daily life of the participant group included in the research

Variable		*F*	%
Problem-solving skills in teaching mathematics purpose of usage	Innovating and developing myself with mathematics	145	48.98
	To be successful in my other lessons by being good in mathematics	136	45.95
	Other	15	5.07
	Total	**296**	**100**

When Table 5 is examined, the purposes of using problem-solving skills in mathematics teaching of the participant groups participating in the research were investigated according to the problem situation of the research and the relevant information is added to the table. It is seen that 135 people chose the option of being successful in other courses as well as being better in mathematics and 5.07% (15 people) chose other fields. In this context, it can be said based on Table 5 that most of

the groups tend to the problem situation according to the problem situation of the research and that their problem-solving skills are strengthened with live activities.

3.2. The situation of the participant group included in the research in problem-solving in mathematics teaching by gender variable

In this section, the data obtained from the research and whether there is a difference in problem-solving situations in mathematics teaching according to the gender variable of the participant group participating in the research are given in Table 6 in detail.

Table 6. Situations between problem-solving in mathematics teaching by gender variable of the participant group included in the research

Problem-solving situations in teaching mathematics	Gender	*N*	*M*	SD	Df	*t*	*p*
	Boy	152	4.44	0.28	296	0.237	0.420
	Girl	144	4.38	0.32			

In Table 6, the problem-solving status of the participant group included in the study in mathematics teaching regarding the gender criterion is examined and it can be seen that there was no significant difference according to the gender criterion [df (296) = .237, $p < 0.05$]. When the problem-solving situations in mathematics teaching of the participant group included in the research are examined, it is seen that the male participant group had an average score in this area ($M = 4.44$), while the female participants have an average score in this situation ($M = 4.38$). In this context, it can be said that the mean score of the boys included in this study is higher than the scores of the female participants, and it is higher by a value of 2.

3.3. Pre- and post-study training opinions of the participant group included in the study on problem-solving education in mathematics teaching

In this section, the pre- and post-study training of the participant group included in the study regarding problem-solving education in mathematics teaching was examined and the values examined are added to Table 7.

Table 7. Educational views of the participant group included in the study regarding problem-solving education in mathematics teaching before and after the study (pre-test–post-test)

No	Variable	Pre-test		Post-test				
		M	SS	*M*	SS	df	*t*	*p*
1	I felt and found better self-confidence in math teaching live activities	3.42	0.87	4.42	0.65	296	-4.61	0
2	With the teaching of mathematics, my confidence in knowledge increased.	3.72	0.83	4.41	0.63	296	-4.03	0
3	When I learned the values in mathematics teaching, I understood where I made mistakes in the problems.	3.69	0.85	4.47	0.63	296	-4.29	0
4	I think that I have reduced my	3.65	0.82	4.34	0.69	296	-3.94	0

	stressful life with mathematics and technology.							
5	The emotional sensitivity of technology made me feel stronger in the field of mathematics.	3.55	0.77	4.39	0.66	296	-4.92	0
6	I saw that I was more successful in cognitive areas with the support of mathematics teaching.	3.35	0.82	4.44	0.61	296	-3.56	0
7	In these studies, I can express my ideas in education very easily with the help of mathematics teaching.	3.69	0.91	4.36	0.73	296	-3.62	0
8	I can watch the work of mathematics teaching in live events over and over.	3.82	0.74	4.34	0.65	296	-3.34	0
9	I would like to use the events and live lesson recordings I took live in different lessons.	3.70	0.85	4.41	0.63	296	-4.29	0
10	I was able to connect from the environment and smart device I wanted to research on this activity that lasted for 2 weeks.	3.65	0.94	4.35	0.74	296	-3.38	0
11	Teaching mathematics with technology gives me the opportunity to do it again in my field during the day.	3.57	0.78	4.36	0.62	296	-4.61	0
12	The education I receive in online education classes of mathematics teaching and activities method allows me to improve myself.	3.62	0.81	4.46	0.63	296	-5.10	0
13	Thanks to the activities I took, my old habits towards the field made a difference.	3.62	0.76	4.62	0.58	296	-5.12	0
14	I take more responsibility to be more successful in mathematics with technology	3.72	0.81	4.43	0.63	296	-4.40	0
15	Using this training I received with the live event method allows me to better understand live events.	3.95	0.87	4.49	0.55	296	-3.32	0
16	I would like to see this training that I have received in different courses.	3.55	0.95	4.51	0.63	296	-5.21	0
	Overall Average	3.64	0.83	4.42	0.64	296	-4.23	0

In Table 7, it is can be seen that the pre test–post-test results of the students included in the study about teaching mathematics and problem-solving situations are given. It is also seen that there is a higher and significant difference between the pre-test and post-test scores of the post-test compared to the pre-test ($p < 0.005$). Although it was seen that all expressions had a significant value of 1, according to the pre-test results, one of the most prominent statements given by the participant

group was 'I saw that I was more successful in cognitive areas with the support of mathematics teaching', with a pre-test score average of *M* = 3.55 and post-test evaluation finding of *M* = 4.44. In addition, in the pre-test, one of the most prominent expressions of the participant groups included in the study was 'Emotional sensitivity given by technology and made me feel stronger in the field of mathematics', with a pre-test score of *M* = 3.55 and a post-test score of *M* = 4.39. In addition, it is seen that the pre-test point average of 'My old habits have gained a difference against the field thanks to the activities I have taken' is *M* = 3.62, while the post-test average point is *M* = 4.62.

Although positive results are seen in each item of the research, among the opinions of the students who participated in the research, 'Teaching mathematics with technology gives me the opportunity to repeat in my own field during the day' had a pre-test score average of *M* = 3.57 and a post-test score of *M* = 4.36. 'Using this training I have received with live event method allows me to understand live events better' had a pre-test mean score of *M* = 3.95and a post-test mean score of *M* = 4.49. Finally, it is seen that the pre-test average of the people participating in the research is *M* = 3.64, while the post-test average is *M* = 4.42.

4. Discussion

In their study, Chotimah, Wijaya, Aprianti, Akbar, and Bernard (2020) aimed to know how important the effect of dynamic mathematics software is on the reasoning ability of primary school students and as a result, it is possible to use dynamic mathematics software as a learning environment and to compare students' reasoning skills about plane geometry in a controlled and experimental classroom. In this context, when this value is compared with the results of the research, it is seen that the primary school students participating in the research have concluded that there are positive values between their pre- and post-research views. In this context, it can be said that the research made benefits the field of mathematics and students.

In the study of Abdiraxmanov (2021), in addition to the educational goals of mathematics education, they aimed to realise the developmental and pedagogical goals through problem-solving in applied lessons. In this context, when this value is combined with the results of the research, it is seen that the problem situations of primary school students develop and their research abilities are formed with this method.

Gafurova (2022), reflecting the problem-solving way in her study, aimed at the feedback from the students and the formation of certain actions performed in the activities and as a result, when such research activities became a need to stimulate their cognitive activities, the students reached the values that they got results and solved different kinds of problems. She stated that solving problems, changing the form of problems according to the conditions and applying thinking processes serve as a means of shaping students' interest in learning.

Considering all the research conducted, it has come to the fore once again that mathematics is important for primary school students and it should not be forgotten that they will be more successful in this field in their future lives. It is among the goals of this research to be a sound and light to other research.

5. Results

When this section is examined and looked at carefully, it is seen that the number of participants is formed first. In this context, it is seen that 296 primary school students participated in this research. As a result, it is seen that primary school students preferred 3 hours or more online. Another value of the research is that since most of the study will take place in a distance education environment, the distance education usage periods of the participant groups included in the study were investigated and as a result, it is seen that the students used it the most for 3 or more hours. When another value of the research is considered, the purpose of using problem-solving skills in mathematics teaching of the participating groups was investigated according to the problem situation of the research and as a result, it was concluded that primary school students chose the option of adding innovation and development to themselves with mathematics and being better in mathematics lessons and being successful in other lessons. In this context, it is seen that according to the problem situation of the research, most people tend to the problem situation and it is concluded that the problem-solving skills of mathematics teaching are strengthened with live activities.

When another positive value of the research is considered, the problem-solving status of the participants in the study regarding the gender criterion in mathematics teaching was examined and it was seen that there was no significant difference according to the gender criterion. It was also concluded that it is higher by a value of 2. When the final value of the study is examined meticulously, the pre-test–post-test results of the students included in the study on mathematics teaching and problem-solving situations were examined and it was seen that there was a higher and significant difference between the pre-test and post-test scores. From the statements given by the students, they believe that they are more successful in cognitive fields with the support of mathematics teaching, that they feel stronger in the field of mathematics and emotional sensitivity given by technology, that they gain a difference in their old habits with the activities they take and that they have the opportunity to teach mathematics with technology in their field during the day. In this context, it is seen that the results of the mathematical problem-solving skills of the people participating in the research are formed.

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