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REFLECTIONS OF AUTHENTIC LEARNING ON STUDENTS' SCIENTIFIC PROCESS SKILLS AND ACHIEVEMENTS IN MATHEMATICS*

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Abstract: In this research, the effect of authentic activities on the scientific process skills of 7th grade students was investigated. Research has been studied in a secondary school with 37 students in Turkey. In the research, authentic learning based education was carried out for 5 weeks in the 2017-2018 academic year. In this semi-experimental model, academic achievement and scientific process skills test, interview form, students' worksheets and observer notes were used as data collection tools. The quantitative data obtained were analyzed statistically in SPSS 20 program, and qualitative data were analyzed by content analysis. It was found that the quantitative data and the experimental and control groups differed statistically as a result of the application as an academic achievement, but did not differ according to the scientific process skill test results. With the qualitative data of this research, it was revealed that the students of the experimental group generally reflect the scientific process skills more than the control group students.

Keywords: Authentic Learning, Authentic Activity, Scientific Process Skills, Elementary Education, Mathematics Education.

1. Introduction

The word authentic can be expressed in terms such as the truth, the real, the original. Authentic learning is an approach that can be explained with these concepts. There are many definitions in the literature about authentic learning (Cholewinski, 2009; Holmes, 2005; Lombardi, 2007; Newmann & Wehlage, 1993; Reeves, Herrington & Oliver, 2002). When the definitions of these researchers about authentic learning are examined, the keywords of real life, task, activity and evaluation and process are common. It can be stated that the authentic learning method from these keywords is a teaching process consisting of tasks and activities that include real life situations and resulting in evaluation. Authentic learning is a process that starts with authentic tasks and continues with authentic activities and evaluations. Authentic activities are defined as interdisciplinary activities that students can make use of from various sources, which can take days, weeks or months that contribute to collaboration in students and result in real world evaluation (Reeves, Herrington & Oliver, 2002). Therefore, it is seen that preparing an authentic avtivities is not an easy and one-way process.

In this research, the effect of authentic activities on the scientific process skills of 7th grade students was investigated. For this purpose, the answer to the following problem was tried to be sought in the research: *What are the effects of the 7th grade ratio-proportion authentic activities on the scientific process skills and acedemic successes of the students?* Such a study can present important data to the literature at two points. The first is to examine students' scientific process skills under the mathematics program. As a matter of fact, it is seen that almost all studies on scientific process skills are in science education and these studies were carried out mostly by quantitative methods (eg, Aydınlı, 2007; Sayer, 2018; Turkoz, 2015). The second is to aim at acquiring scientific process skills in research. Today's education system cares about information as well as methods of obtaining information. The use of the methods of obtaining the information mentioned here can be possible by providing students with

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scientific process skills (Tan & Temiz, 2003). Students who acquire scientific process skills develop their problem-solving skills, contribute to their mental development, provide permanence in their learning, and support their scientific literacy.

1.1. Theoretical framework

1.1.1. Authentic Learning. Authentic learning is a learning process in which real world problems are expressed as tasks and effective evaluations are made in the process, resulting in meaningful learning (Newmann & Wehlage, 1993). Authentic learning focuses on the complex problems and solutions of the real world, with role-playing exercises involving problem-based activities, case studies and participation in virtual practice studies (Lombardi, 2007). Authentic learning is an approach that aims to provide some skills such as critical thinking, creative thinking, research, communication, problem solving, entrepreneurship, decision making in activities involving the real world. These skills are acquired through authentic activities and learning is provided through applications in which the student is active in order to gain these skills in the real world context (Bektas & Horzum, 2014). Authentic activities are one of the basic elements of authentic learning. The fact that real world problems are frequently included in education increases the importance of authentic activities. Authentic activities are vital to help students understand the world outside the learning environment. Authentic activities improve students' critical thinking and analytical skills, increase motivation, offer better learning opportunities, facilitate the meaning of a complex concept and prepare a good future with real life problems it contains (Bektas & Horzum, 2014; Bhagat & Huang, 2018; Hui & Koplin, 2011).

Authentic learning involves a process that starts with authentic tasks and continues with authentic activities and evaluations (Kocyigit & Zembat, 2013). Authentic activities should encourage students to connect with real-world issues using their experience, support the provision of multiple resources, create multiple perspectives based on collaboration, provide scope for critical thinking, allow the link between students' current understanding and new information presented (Bortwick, Bennett, Lefoe & Huber, 2007). The common point of these features is that they are related to real life situations. The tasks in the activities are not easy to understand or solve. These tasks are a number of complex and poorly defined real-life problems with multiple solutions that are open to interpretation. The tasks in the activities consist of the main task and the sub-tasks that make up the main task. Tasks can take a long time to complete. This may require rigorous research and a good literature search. In this direction, students can progress in cooperation. It can be said that the cooperation between students develops social skills like peer learning. In addition, the importance of listening to different perspectives and reflective and critical thinking within the framework of respect can be adopted by enabling students to share their thoughts in the classroom environment with authentic activities. Multiple intelligence environment can be created by providing interdisciplinary content with activities. Thus, a successful result can be achieved with disciplines. Authentic activities are concluded with an evaluation. Assessment can be carried out by contemporary methods without losing its connection with real life, which is the basis of authentic activities. In the evaluation, different products from the original are discussed. The evaluation of the products is done by considering the process (Rule, 2006).

1.1.2. Scientific Process Skills. In today's education system, real life problems are considered important in every field. In the Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS), which are known as popular works of our time, real life problems are considered important and include such problems. With the PISA mathematics literacy test, the students evaluated their mathematical knowledge and skills in the application skills they performed in solving a wide range of real life problems (OECD, 2010). In PISA, it is aimed to measure the skills such as solving the problem, creative thinking, understanding, interpreting and drawing conclusions with the applicability measure of the theoretical knowledge acquired by the student in real life (Savran, 2004). TIMSS, on the other hand, involves measuring students' knowledge, practices and cognitive skills such as reasoning to solve mathematical problems identified in real life contexts (Ozcan & Kostur, 2019). As it is seen, in PISA and TIMSS studies, concepts such as daily life, mathematical skills and literacy are at the forefront. One of the most important goals of mathematics curriculum, which has been continuously renewed in recent years, is to train students with advanced mathematical thinking skills as good problem solvers (Ministiry of National Education [MoNE], 2018, p. 9). Indeed, according to the National Research Council (2005), this is one of the main objectives of mathematics education. In the central exams held in our country, it is seen that the scientific knowledge, which includes the comprehension and interpretation skills expressed as literacy belonging to the field, which is far from memorization, has questions related to daily life. With the self-improving education suitable for the modern age, the upper skills desired to be acquired by the students take their place in the system. It is very difficult to directly acquire such high-level skills to individuals. It is necessary to go through a certain stage and process (Saat, 2004). Meaningful learning occurs as a result of this process being effective. The meaningfulness of learning ensures that information can be transferred to permanent and developing conditions. In this regard, the ways to access information constitute scientific process skills. The student reaches the scientific process skills consisting of process and steps with his own experiences.

Scientific process skills are behaviors that guide and apply the skills applied to reach information through mental and psychomotor studies (Turiman, Omar, Daud & Osman, 2012). Researchers working on this subject tried to explain their scientific process skills with different classifications (eg, Cepni, Ayas, Johnson & Turgut, 1997; Martin, 1997; Viti & Torres, 2006). These classifications were generally made in two stages and it was stated that scientific process skills consisted of basic skills and higher skills. MoNE (2018) has defined scientific process skills as the field that covers the skills used by scientists during their studies, such as observing, classifying, experimenting, recording data, measuring, using and modeling data, setting hypotheses, changing variables, and controlling. The program related to mathematics lessons taught in schools is designed to gain these skills to individuals.

2. Method

2.1. Research Model

This research is a semi-experimental model. In the semi-experimental model, there are experiment and control groups and the effect of the independent variable on the dependent variable is tested (Tabachnick and Fidell, 2007, pp. 2-3). While the independent variables of this study are authentic learning methods, dependent variables are students' scientific process skills and academic successes.

2.2. Participant

In this year of 2018-2019 academic research studying in a public school in Turkey it has been working with 7th grade students. The experimental group (n=18) and the control group (n=19) were chosen for the application. In the selection of the groups, students' average mathematics achievement averages were effective. It was decided to include two classes that did not differ in terms of success. It was preferred that the class with a low average of success among the two groups determined was the experimental group.

The qualitative data of the study were collected with three students selected from each group and from different levels of success (high, medium, low). The main determining factor in this selection is the principle of volunteering. School mathematics achievement scores and test scores applied in the process were effective in the selection of students at determined levels. Student names are pseudonyms. Individual interviews were held with Melis, Yagiz, Onder (experimental group) and Emre, Ferda, Ilker (control group), whose success level was high, medium and low, respectively.

2.3. Data Collection Tools

2.3.1. Development of Tests. Academic achievement test (AAT) and scientific process skills test (SPST) have been developed to test the effectiveness of the application. Application acquisitions were taken into consideration for the AAT and a draft structure with easy, medium and difficult questions was created. This test was applied to 133 8th grade students. After the item analysis, a total of 20 multiple choice tests, 5 easy and 5 difficult and 10 medium-level tests, were developed. Cronbach Alpha reliability value (KR-20) of the test was found to be 0.82. SPST is a test that measures students' scientific process skills. The application, which was developed by taking into account the test development steps suggested by Baykul (2000), was carried out with 353 7th and 8th grade students and a total of 35 multiple choice questions were included in the test after item analysis. Cronbach

Alpha reliability value (KR-20) of the test was found to be 0,90. It is stated that the tests developed with this result are reliable. Detailed information on the development processes of the tests can be accessed from the thesis study by Ozkan (2019).

2.3.2. Interview form. Semi-structured interview form was used in the research. In order to determine the questions in the form, firstly, a detailed literature review was conducted. In the draft form prepared, there are 8 open-ended questions regarding the ratio-proportion subject. With the help of a specialist, it was determined which scientific process skills the questions predicted, and the questions with the most inclusiveness were taken into priority. Kappa coefficient of the opinions of the expert and the researcher was found as .82. While interpreting this coefficient, Landis and Koch (1977) stated that there is a very good level of agreement between the observers for the value between 0.81-1.00. In addition, the response times of the questions were taken into consideration and it was decided that there should be 5 open-ended questions in the form. The purpose of the math questions in the form is to determine the students' point of understanding the problem and the problematic point of view and the scientific process skills.

The first question in the form is about determining the relationship between the number of steps and the duration, and the ability to make comparisons and interpret according to the data. Scientific process skill sub-steps envisaged in this problem; observation, classification, inference, estimation, measurement, communication, data interpretation, operational definition, number space relationship, determining variables, modeling. The second problem is a rate question, he was asked to compare the quantities given in the mixture. Scientific process skills steps envisaged here; observation, classification, inference, estimation, measurement, communication, data interpretation, operational definition, number space relationship, determining variables and modeling. In the third problem, a different method was followed. With this method, geometric shapes were asked to be created by the students participating in the interview. In this problem where it is desired to determine the relationship between the edge length and the area and the perimeter, the course materials were used. Process researcher was applied in line with his commands. For this purpose, a mathematical experiment process was requested. In the third problem, the problem was asked to determine the relationship between the edge and the perimeter. Scientific Process Skills steps foreseen for the problem; observation, classification, inference, prediction, measurement, communication, data interpretation, space-time relation, operational definition, hypothesis, experiment, determining variables and modeling. It also includes 13 of the Scientific Process Skills steps examined in the research. In the fourth problem, it is aimed to look at how students understand the problem, the structure it has created in mind for the solution of the problem, whether it relates the proportion and the problem. The scientific process skills measured in this problem are observation, inference, estimation, measurement, communication, interpretation of data, operational definition, number space relations, defining variables and establishing hypotheses. In the case of the fifth problem, it was asked to see how the students solved the problem that includes the daily life problem and which path in the solution step. Also, it was examined whether they used the proportion algorithm when they faced this question related to the acquisition of the "Ratio and Proportion" topic. Scientific process skills determined by the fifth problem are observation, inference, estimation, measurement, communication, interpretation of data, number space relationship and defining variables.

2.3.3. Unstructured Observation Notes. In the unstructured observation method, expressions of researchers' observations are obtained without limitation. In the notes held by the researcher, the process is addressed objectively until the fine detail.

2.4. Application Process

In the experimental group, the course process was taught with authentic activities prepared by the researcher in line with the achievements, while the control group was taught in accordance with the current learning program. The application is limited to 5 weeks. Before the implementation process, the school administration was informed about the research and necessary permissions were obtained. The researcher took part in the process as a teacher. AAT and SPST were applied as a pre-test before starting the application and posttests at the end of the application. In addition, students started the process in a prepared manner with the pilot study carried out before the application. In this process, it was ensured that the students got used to the group work and the appropriate seating arrangement was determined. The application was carried out with the help of authentic activities prepared by the researcher by taking advantage of the expert opinion within the framework of all the acquisitions in the “Rate and Proportion” sub-learning area.

The course process was recorded with observer notes and camera. In addition, the interviews were recorded with the camera. Each interview lasted approximately 15 minutes. A total of 10 activities, 7 authentic *(Golden Ratio Board, Ratio in Our Body, Mobile Phones, Volleyball Field, Balloon, Prevent Water Wastage, Pizza)* and 3 practical *(Beads, Let's Go to Market, Let's Make Our School Beautiful)*, were prepared by the researcher. Various mathematical resources, colleague and expert ideas were used in the preparation of the activities. A sample activity on how authentic events are prepared and implemented is given in Appendix.

2.5. Data Analysis

The quantitative data obtained were analyzed in SPSS 20 program. In order to determine whether the data show a normal distribution, the normality test results were examined first. Shapiro-Wilk test was preferred in the selection of the test since the sample size was less than 50. According to this test result, the data were found to have a normal distribution. Independent groups t-test was used to see if there is a significant difference between groups. The data obtained as a result of the research were evaluated at the level of .05 significance.

In the qualitative dimension of the research, the records obtained after the interviews were transcribed and turned into written texts. Both these transcripts and student worksheets were subjected to content analysis. Short notes were made on how scientific process skills reflect on behavior, and these notes helped researchers during content analysis. For example; it is seen that Melis, who is in the experimental group, saves and interprets the data in the problem solutions by methods such as drawing diagrams and creating tables. These studies of Melis show that they reflect their scientific process skills in interpreting and recording data. For the analysis process, the data were first coded by the researcher, and then assistance was received from a specialist for re-coding. At different times, the percentage of harmony formula developed by Miles and Huberman (1994) was utilized to look at the percentage of compatibility between two different encoders, and a coherence of 0.85 was achieved between the encoders. During the application, the researcher had the opportunity to take notes on his observations, as he was also in the setting as an observer. The notes that the researcher kept in the process were handled as written documents and analyzed by content analysis to provide data for the research.

3. Results

3.1. Results of quantitative data

AAT and SPST were applied to the students in the experimental and control groups as pre-test and post-test. In the pretest, it was aimed to determine the students' prior knowledge and to see the equivalence between the groups in this direction (Table 1).

Table 1. *Independent groups t-test results regarding the AAT and SPST scores of the groups*

		Before Application							After Application						
	Group	N	$\bar{X}$	SS	Sd	F	t	p	N	$\bar{X}$	SS	Sd	F	t	p
AAT	Experimental group	18	28.33	5.42	35	0.153	-0.62	0.539	18	69.17	7.33	35	0.154	3.004	0.005
	Control Group	19	29.47	5.75					19	61.84	7.54				
SPST	Experimental group	18	37.00	14,62	35	0.078	-0.802	0.428	18	50.00	19.47	35	2.130	-0.237	0.814
	Control Group	19	40.74	13,72					19	51.32	14.03				

According to Table 1, it was observed that the average of the experimental group for both tests did not differ statistically from the control group's success average before the application (p> .05). However, after the application, it is seen that there is a statistically significant difference in terms of AAT of the experimental and control groups according to the post-test results (p <.05). In addition, there was no significant difference between the two groups in terms of SPST. In this case, the SPST scores of the groups were examined (Table 2).

Table 2. *Comparison of the mean scores of SPST within the group*

	Test	N	$\bar{X}$	SS	Sd	t	p
Experimental group	Pre-test	18	37.00	14.62	17	-4.546	0.000
	Post-test	18	50.00	19.47			
Control Group	Pre-test	19	40.74	13.72	18	-4.851	0.000
	Post-test	19	51.32	14.03			

Looking at Table 2, there was a significant increase in scientific process skills test scores in both groups (p <.05). In this case, qualitative data was needed to explain the quantitative data obtained.

3.2. Results from qualitative data

3.2.1. Experimental Group Findings. It was determined that the three students in the experimental group reflected the scientific process skills measured by each question from their behavior. As a result of the analysis obtained, it can be said that these students exhibit behaviors such as generally drawing conclusions from the problem, expressing themselves, making transactions, and reflecting what they have learned during the course. By linking these behaviors with scientific process skills, the scientific process skill levels of each student were determined. For example, a dialogue is given from Melis' data regarding the third problem, whose success is good:

A193: What do you think we are trying to achieve from what we find?

M51: We calculated the area, we calculated the perimeter. Information about these can be accessed.

A194: What kind of information can it be?

M52: The area remains the same, the perimeter has changed.

A195: How have the perimeter changed?

M53: The areas are the same, the edge lengths of these shapes are different. Let me say the short edges, the perimeter increases as the long edges increase.

A196: What if it increases or decreases?

M54: By the edges.

A197: Short edge will decrease?

M55: Short edge will decrease and long edge will increase. Inverse proportion.

A198: When I say the inverse proportion?

M56: There will be an inverse proportion between the short edge and the long edge, one will increase as one decreases.

It was observed that Melis performed the perimeter and area calculations for the third problem correctly. It can be said that Melis can establish a relationship between the data as a result of his calculations. Based on the concept of the field, Melis stated that there is an inverse proportion between the short and long sides while the field is constant. When asked to draw a conclusion from Melis about his actions and what he found, it was seen that he expressed his thought correctly. Here it is understood that Melis expresses the concept of inverse proportion only as one of the qualities increases and the other decreases (M55, M56). Melis was asked to further explain his thought. The other expression expected in the problem is the relationship between the edge and the perimeter. Accordingly, the researcher continued to ask questions based on what Melis wrote:

A205: Then what can we say?

M63: If the difference between the edges increases, its perimeter increases.

A206: How were these rectangles at first?

M64: The area is equal. If the difference between the lengths of the edges increases, the perimeter increases.

When the speech text above is examined, it is seen that Melis correctly associates the edge with the perimeter. Melis expressed this relationship with the concept of inverse proportion. It was observed that Melis saved his data by making tables and drawings while establishing a relationship between the transactions he made and his results. In this process, by establishing a relationship between the data, he determined the variables (edge and perimeter, edge and area) and came to a conclusion. This result is generalizable.

In the following worksheet example, the problem situation created by Melis and its solutions are given.

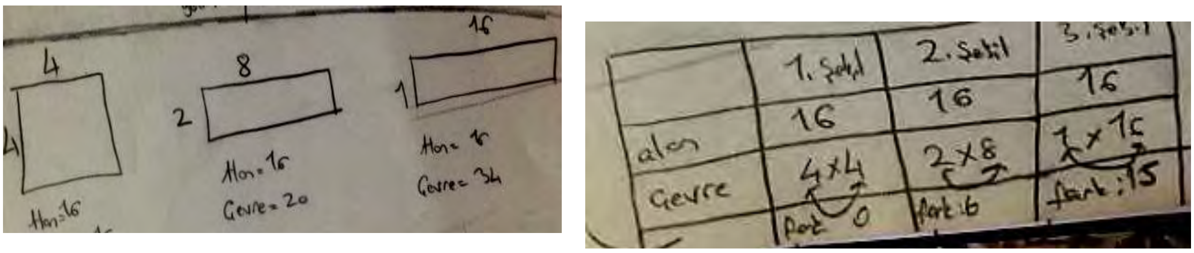

Figure 1. *Melis' representation for the third problem*

Melis expressed her thoughts easily in the third problem question, interpreted the information about the question correctly, realized the number space skill by forming the figures correctly, recorded the data by taking notes, explained the reasons for the predictions she made, made use of the table while saving the data, and successfully grouped the perimeter and the area (Figure 1). As a result, he created a hypothesis by establishing an environmental relation from the relationship between the edges. It can be said to be successful for his inference. In addition, it correctly defined the concepts of the subject. He explained the solution of the problem successfully.

Another situation that is encountered is that students approach the solution with the modeling method in the problem situations they encounter, they embody in the mind and perform a successful communication process in expressing themselves. In the dialogue with Yagız, which is in the experimental group, the process of reaching a value and generalizing the student is given below:

A16: Would you share your thoughts on problem solving?

A1: Now Ayse takes 5 steps in 25 seconds. Nil takes 3 steps in 10 seconds. Actually the Nile arrives first.

A17: Could you explain how you reached this estimate?

A2: Because seconds are less. The steps are different but I thought it was the same. When this is the case, I think that the Nil will arrive before looking at the second.

A18: So let's check this forecast by trading?

A3: … My teacher, 25 and 10 are different so let's sync them in 50 seconds. Nil takes 15 steps in 50 seconds, and Ayse takes 10 steps in 50 seconds. When the times are the same, we can look at the step they took. I think Nil reaches faster.

A19: You chose to solve the question by looking at the step taken at the common time?

A4: Yes. The step distances are equal so I did not look at the distance thrown.

A20: So what conclusion can we get from this question?

A5: The number of steps is related to time. This shows us the speed. Like first arrives, like later arrives.

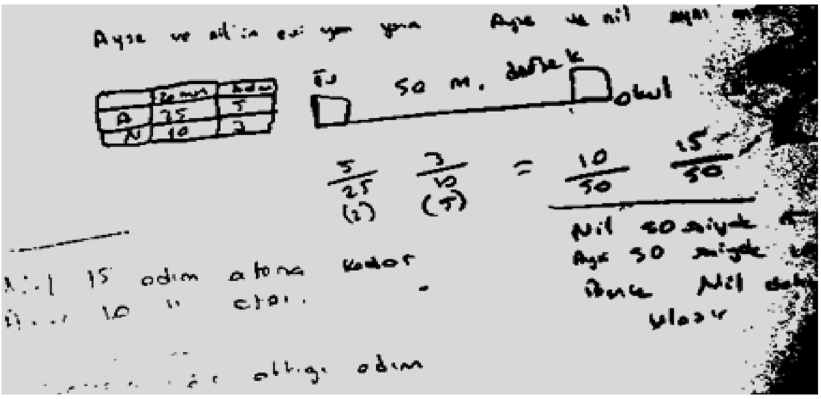

Figure 2. *Yagız's representation of the first problem*

It was observed that Yagız expressed himself comfortably during the meeting. He was not able to directly use what was given in the problem. Therefore, Yagız made the definition of speed term based on the relationship between operational description and number of steps and time. In addition, Yagız made an inference by defending the reasons. Another situation in the students of the experimental group in general is that the predictions made are expressed in terms of logic. When the problem notes of Yagız were examined, it was seen that he recorded the data systematically (Figure 2). It has been observed that Yagız performed the measurement and number space skills correctly with the rates and calculations he established. We see this situation as an approach to Onder's fourth problem in the experimental group:

A344: How many days do you think would be enough for you?

S44: They go to the camp with enough food for 20 days for 30 students. This is 600 in total.

A345: Can you explain what you think?

S45: I found the total food. I multiplied 30 by 20 and found 600.

A346: Can you guess the number of days?

S46: I will find more than 20 results. Because the number of students sharing food has decreased.

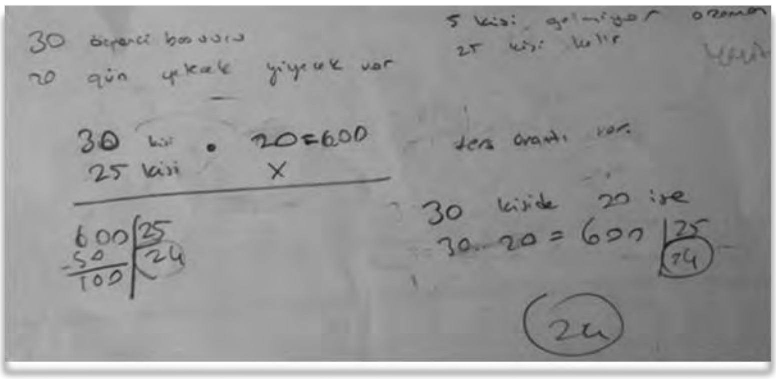

Figure 3. *Onder's representation of the fourth problem*

It has been observed that Onder has developed an idea about the outcome of the problem (O46). It can be said that Onder made the correct prediction. Another conclusion reached by Onder of the fourth problem is related to the concept of proportion. It was observed that Onder realized that the problem was an inverse proportion and correctly understood the relationship between the number of students and the number of days the food would be enough.

3.2.2. Control Group Findings. In the control group, there was a general lack of skills in interpreting data, measuring, determining variables, and number space relationship. It can be said that the process was difficult for the control group as these deficiencies are also thought to affect higher level skills. Features such as data interpretation, determining variables, and communication show the understanding levels of the problem. In this regard, it can be said that the students in the control group had difficulties in understanding the problem. It was observed that the problem experienced in understanding the problem caused confusion of the concepts learned in the course. We can clearly see this situation in the interview data with Ferda below.

A369: What do you think we should do, what should we think about this problem?

F62: Here he wants the proportion of the food for the student and the students.

A370: Aren't you enough days to eat?

F63: Yes.

A371: What proportion is there?

F64: There is the right proportion. For example, 30 students come and there is enough food for 20 days. Then 5 students go and the need for food increases.

A372: Then what (The researcher allows him to think)?

F65: Inverse proportion.

Ferda responded without thinking about the problem (F64). In the dialogue with Ferda, it was seen that he can distinguish between the concepts of right and inverse proportion. However, in the case of problems, it was understood that he had difficulties in placing the concepts to the problem he belonged to. It was noticed that Ferda experienced the problem about the concept in transactions. When the note paper of Ferda is examined, the situation is understood (Figure 4).

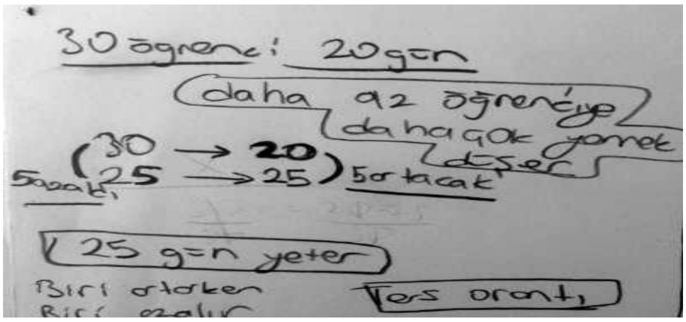

Figure 4. *Ferda's representation for the fourth problem*

Ferda thought that he would solve the problem by establishing proportion. He expressed his opinion about the problem verbally (less students eat more days). He stated that there was an inverse proportion. However, it can be seen that Ferda does not deal with the amount of ratio in proportion, that is, multiplication or division operations, but only looks at the problem as increase and decrease. He did not think that the increase or decrease between the multiplicities should be at the same rate. Ferda handled this idea in the opposite proportion as the same amount and did not take into account the ratio. It can be said that Ferda also has a misconception about the subject. Ferda knows that the result will be more than 20 (F64). However, it was noticed that Ferda did not use the rate in her transactions, so she could not reach the correct result because she could not perform the transaction. It was obvious that Ferda had difficulty in measuring skills. If we examine the data of Emre in the control group for the same problem situation;

E46: We said the inverse proportion. I wrote what was given. If 20 days is enough for 30 students, how many days is enough for 25 students, but it will not be out of here.

A364: Why?

E47: 500 does not divide to 30.

A365: As if the result you found doesn't give the number of days?

E48: Yes, the result is not an integer.

A365: How did you find 500 (With this question, it was tried to determine whether Emre set the proportions wrong or made a operation error)?

E48: It came out of here (It seems that it hits 20 to 25 on the paper. Emre made a mistake in proportion). We were doing the multiplication inside and outside but it didn't come out (He thinks a little). Now I remember we will multiply 30 to 20. Flat product (Emre continues to make operations). I found 24.

A367: How many days will the food be enough?

E50: It was 20 first, now it is 24, it has increased.

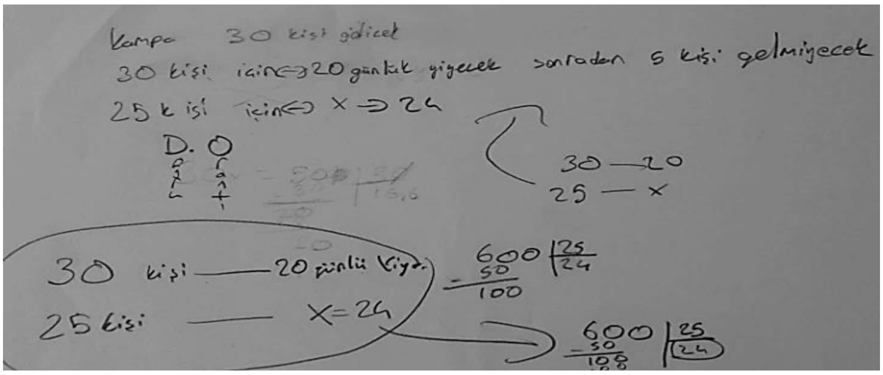

Figure 5. *Emre's representation for the fourth problem*

Emre said that he had the right proportion for the problem and asked the researcher to explain his thought and realized his mistake. After realizing that there is an inverse proportion, it was seen that Emre made a mistake in resolving the inverse proportion. It is understood that concept knowledge is important here. Since the student thinks there is an inverse proportion between the characteristics in the problem, he knows in advance whether the answer will be more or less in that direction. It was observed that the control group students generally knew the concepts related to the course by definition, but they experienced difficulties while using these concepts in problem situations. Since they had trouble interpreting the data, it took time to reach the correct result in the problem.

In the control group, unlike the experimental group, confusion was noted in recording data other than the difficulty experienced in interpreting the data. In the third problem of the interview, it was seen that Ilker's problem was in recording the data as well as interpreting the data. In the problem, the students were asked to notice themselves by showing how the perimeter changed. The student was confused because he did not save his accounts. The steps for the solution were started again and the student was asked to note especially the data he calculated. Because, when it is necessary or when it is spoken for that shape again, it has been forgotten from place to place. For this, it is stated that it is necessary to save the data by taking notes. After this process, the meeting continued as follows.

A326: What changed the perimeter in equal quadrilaterals?

I64: Length.

A327: What length do you mean?

I65: The perimeter...

A328: Okay, what changed the perimeter?

I66: Area.

A329: But are the areas not equal?

I67: Yes, equal areas. This is what changes the environment. 16 to 1 (He showing edges).

A330: What do we call it?

I68: Around.

A331: Between the short edge and the long edge?

I69: Distance.

A332: Okay, what are the distances and the perimeter changed?

I70: When the distance was long, it became more. The right proportion.

As can be seen from the above dialogue, Ilker did not reach the conclusion himself. He could not bring together and express what was achieved with his work. The researcher asked the orientation questions in order to reach the result in the process. İlker's ability to make inferences has remained weak. Therefore, he could not establish a hypothesis. It can be said that the ability to interpret and record data does not improve. In Figure 6, it is seen that İlker wrote the data mixed and incomplete. İlker used the concept of right proportion in the wrong place. In addition, it can be said that he had problems with the use of the concept as in the statements of I68 and I70. It was observed that İlker turned to short answers and had difficulty in expressing his thoughts.

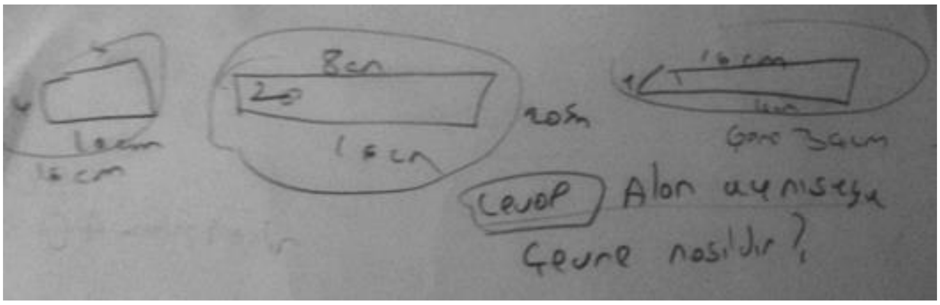

Figure 6. *Ilker's representation for the third problem*

When the interview note of İlker was examined in Figure 6, it was seen that he did not write properly and he chose short statements in the article as well as in his speech. Communication can be verbal or written. İlker was found to be inadequate in communicating.

4. Conclusion and Discussion

As a result of the application, it was determined that there was a statistical difference in the AAT of the groups, but it did not differ according to the SPST results. Also, the results show that the teaching in both groups is successful. A similar situation is observed in the study of Gencoglan (2017). In this study, it was stated that there was no statistically significant difference between the SPST scores of the groups. However, it was stated that the scientific process skill average score of the experimental group was higher than the control group. As a result of the research, it was stated that it would not be true to say that authentic learning does not make any difference between the groups. In this case, qualitative data will be useful and necessary in revealing the effectiveness of teaching. With the qualitative data of this research, it was revealed that the students of the experimental group generally reflect the scientific process skills more than the control group students. Chinn and Malhotra (2002) state that authentic learning is more successful in scientific reasoning than traditional teaching. In the interviews, it was revealed that the experimental group students were more successful in high-level skills such as data interpretation, communication, defining variables, and establishing hypotheses. Considering the comments on complex situations in the last two questions of the interview questions, it can be said that the experimental group students are more successful. According to these findings, it can be stated that authentic teaching in the experimental group is successful. Sousa (2008) thinks that reflecting students' real life into mathematical contexts and conducting such a teaching will facilitate mathematics.

In this study, the researcher took part in the role of teacher. In this process, the researcher encountered situations in which students helped with their friends in group studies, researched, communicated, socialized with each other, and reflected their knowledge in the problem solving process. In addition, performing activities in the process brought the students and teachers closer, so it was observed that the students' ability to answer problems increased. According to Nelson (1999), it is a problem solving activity with authentic learning cooperation. It can be said that the positive atmosphere created by authentic activities is effective in expressing students' thoughts more easily and reflecting their knowledge. In their study, Yunos, Atan, Said, Mokhtar & Samah (2017) stated that cooperative learning encourages the higher level of thinking through the implementation of authentic environment and exchange skills, and also supports the development of young minds through group discussions in their activities. Gundogan and Gultekin (2017), on the other hand, found that authentic task-based learning environments develop positive emotions such as improving students' higher-order thinking skills and developing different perspectives. Luo, Murray and Crompton (2017) also stated that authentic activities in their research increased the students' reflective thinking skills with collaborative interaction. They also demonstrated in the same study that the students were able to communicate strongly with the counselor teacher through authentic tasks.

Another situation that is considered important in the interview process is the importance of the step of interpreting the data from scientific process skills. Interpret data; to express what is understood from the given problem and data. In the study, there was a lack of ability to interpret the data in the control group. These deficiencies are also thought to affect higher-level skills. Interpretation of the data is an important step towards the realization of higher skills. It can be said that authentic activities involving daily life problems have a direct effect on high level skills. According to Cobb and Jackson (2011), more sophisticated skills can be gained through authentic learning. Rule (2006) states that it will be easier to acquire complex skills with authentic learning.

Another situation that is considered important in the research process is that the experimental and control group students choose different solution strategies. Experimental group students were observed to use modeling method more frequently for problem solving than the control group students. In the modeling process, it was noticed that the experimental group used the most tables and graphics. It was seen that the students of the experimental group showed success in saving and interpreting data by using tables and graphics in problem solving. Cobb and Jackson (2011) state that authentic mathematics learning is effective with authentic learning by using different mathematical representations and linking students in symbolic, graphic, numerical or table form. Also National Council Teachers of Mathematics [NCTM] (2011) stated that the cognitive concept is closely related to the skills in the problem solving process.

Another result obtained with regard to the process processed with authentic activities is related to the concepts used by the students in the explanations regarding the ratio-proportion subject. It was observed that the control group students knew the definitions of the concepts related to the subject. However, it was observed that they could not match the concepts to the problems in the subject problems and they could not reflect the definitions they learned in the problems. From this, it can be concluded that the activities associated with daily life help students to make sense of the lesson. In other words, it can be said that the experimental group students are more successful in reflecting the knowledge they have gained. In addition, Franke, Kazemi and Battey (2007) state that students must engage in authentic learning in order to better comprehend mathematical thoughts. Herrington and Oliver (2000), on the other hand, are said to be through authentic learning. Especially recently, it is stated that authentic activities should be encouraged for the future of both the research and the Science, Technology, Engineering and Mathematics (STEM) education that schools are interested in

(Hollister, 2018). In addition, according to Cho, Claeon & Kapur (2015), authentic learning is required to help students acquire 21st century skills.

5. Suggestions

In the research, it was found that the course process, which is carried out with authentic activities, positively contributes to the scientific process skills of the students in the experimental group. In the study conducted by Acil, Karakaya and Kara (2017), 7th grade math activities were examined and authentic tasks were determined in very few of the activities. Considering that authentic activities affect the teaching process positively, it is recommended to enrich the curriculum with such activities. In addition, since the researcher is the teacher who performs the application, he cares about activities in order to gain scientific process skills in other courses. This situation reveals the importance of interdisciplinary approach. Therefore, it is recommended to conduct interdisciplinary studies to acquire scientific process skills.

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Appendix

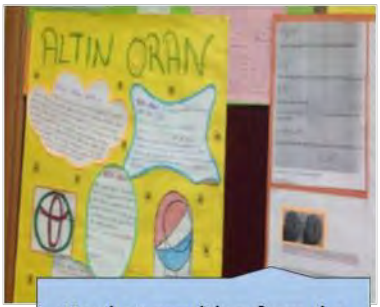
Activity: Golden Ratio Board

"The golden ratio is the name given to geometric and numerical values that reflect the harmony between the parts based on a certain consistency, which are used in architectural and artistic fields, especially in various disciplines. It was first used by the Egyptians and Greeks in architectural structures, sculptures and other artistic areas. Basically, it is based on the principle that the two parts brought together by a dividing whole constitute the other large part and the numerical value of the golden ratio is 1.618. Since the golden ratio reflects the harmony between the parts of a whole in general, it is the total of numerical and geometric values used in many different fields such as aesthetic surgery, medicine, art, architecture, technique, science. Basically, it is based on the principle that the sum of the two parts in terms of numbers or figures form the next part. The Fibonacci index, which is compatible with this principle, is one of the best examples of the golden ratio. When two consecutive numbers are added according to this numerical sequence, it must give the next number itself. For example; Such as 2, 3, 5, 8, 13, 21. The difference occurring in such a progressive order is always 1,618 and this difference is considered as the golden ratio. "

In this activity, you are asked to reach more information and pictures about the golden ratio in this activity, to bring them together, to prepare posters and present them on the math board. Internet, resource books and magazines can help you to research.

In order to make an intriguing introduction to the subject at the Golden Ratio Board event, the researcher entered the text by reading a remarkable text on the Golden Ratio topic. Students stated that they heard this concept for the first time. The researcher asks the students to perform the first task of the process by reading the task instructions included in the activity. Below are photos of the board formed at the end of the process.

The study of transforming the information gathered by the students into the product.



Product resulting from the study: Golden Ratio Board

Product resulting from the study: Golden Ratio Board

It has been observed that students willingly participate in the board preparation process. During the panel preparation process, students exhibited a successful collaborative work. Everyone in the group was involved in the process and made a joint contribution to the product formed as a result. As a result, they were motivated to create a product of their own and see it on the board. The boards prepared by each group were exhibited in their own classes and in other classes. In addition, students were asked to gather information from various sources about the topic previously given as an authentic task. Students were given the opportunity to present their presentations prepared on the smart board to their friends. The students were motivated to prepare the information they collected in the form of a presentation and present it as a product of their own in the classroom. Each group presented their products to the class by making different presentations. Thus, the issue was reinforced better.