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Article Name	Teacher and Student Opinions on Teaching Four Operations with Integer Numbers in 7th Grade with Counting Stamps

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Abstract

The study examines the views of middle school mathematics teachers and 7th-grade students on using counting stamps to teach four operations with integers. The study was conducted with ten mathematics teachers with different professional seniority and ten 7th-grade students studying in these schools. The teachers were asked six open-ended opinion form questions, and the students were simultaneously asked five open-ended opinion form questions. In this qualitative study, the interview technique was used to analyze the views of teachers and students. A structured interview form was preferred as a data collection tool. A qualitative research method was adopted in collecting, analyzing, and interpreting the data of this study. Content analysis was used to analyze and interpret the data. According to the study results, it was determined that teachers and students did not find counting stamps functional and that they needed to be more adequate in operations with integers. Therefore, there is a need for new models that can replace counting stamps.

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Research Article

Teacher and Student Opinions on Teaching Four Operations with Integer Numbers in 7th Grade with Counting Stamps *

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Abstract

The study examines the views of middle school mathematics teachers and 7th-grade students on using counting stamps to teach four operations with integers. The study was conducted with ten mathematics teachers with different professional seniority and ten 7th-grade students studying in these schools. The teachers were asked six open-ended opinion form questions, and the students were simultaneously asked five open-ended opinion form questions. In this qualitative study, the interview technique was used to analyze the views of teachers and students. A structured interview form was preferred as a data collection tool. A qualitative research method was adopted in collecting, analyzing, and interpreting the data of this study. Content analysis was used to analyze and interpret the data. According to the study results, it was determined that teachers and students did not find counting stamps functional and that they needed to be more adequate in operations with integers. Therefore, there is a need for new models that can replace counting stamps.

Keywords: Mathematics teaching, integers, four operations, counting stamps, modelling.

1. INTRODUCTION

The models used in mathematics education aim to help individuals develop strategies to solve real-life problems. In this regard, using models in mathematics education is vital in achieving the goals of mathematics education. The use of models was recommended in the secondary school mathematics curriculum, which was implemented in 2018, and models and modeling were among the process skills that students should acquire. The effects of model use on student success in this program are listed as follows: it helps students develop positive attitudes and behaviors towards mathematics, contributes to learning mathematical concepts more meaningfully, allows establishing a relationship between real life and mathematics, makes it easier to keep information in mind, helps students develop communication skills, and It helps to use the mathematical language effectively. Different researchers have made different definitions of the models and modeling used in mathematics education. Niss (1998) defines the concept of a model as a system built on mathematical concepts and the relationships between these concepts for the representation of real-life situations. He defines the physical and cognitive activities involved in the two-way transition process between mathematics and real life as modeling. As can be seen, model and modeling are concepts that complement each other. Sriraman (2005) likened the difference in meaning between model and modeling to the difference in meaning between product and process. In this sense, modeling refers to creating an abstract, symbolic or

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physical model of a situation, while the model refers to the product formed at the end of this process. Recently, the use of mathematical modeling at all levels of education and training has become increasingly important. The latest declarations published by the Ministry of National Education (MoNE) have initiated a mathematics mobilization, and the essential part of this is the idea that students should learn mathematics in a more meaningful and understandable way by associating it with real life. The fact that current teaching conditions are insufficient to achieve this goal has been the primary source of the idea that models should be used in mathematics education (MoNE, 2024).

In order to understand the term mathematical modeling, it would be helpful to understand the term mathematical model. There are many definitions regarding this concept in the literature. Mathematical model, It is a mathematical representation of the relationship between multiple variables related to an existing situation or problem (Berry & Houston, 1995). It is expressing a situation in real life mathematically, that is, with a figure, table, graph or formula, that is, formulating a model in mathematical language (Kapur, 1998). It is all the systems created with the idea of mathematically defining, explaining, interpreting and representing this model to students about any subject (Lesh & Doerr, 2003). Considering the definitions in the literature, it can be seen that mathematical models are some forms of representation used to explain and define abstract structures. One of the common emphases in the definitions is the intense involvement of mathematics and mathematical skills in these forms of representation. The mathematical modeling process/cycle has been defined in different ways by different researchers over time (Berry & Houston, 1995; Kutluca & Kaya, 2023). Berry and Houston (1995) stated that the stages of the mathematical modeling process are non-linear and classified the stages of the process as formulation, solution, validation and report. A cycle of the mathematical modeling process was also developed by Lesh and Doerr (2003). There are four basic steps in this mathematical modeling cycle created by researchers. The definition in these steps is transferring the given real-life situation to the model world.

Modeling in Integers

Mathematical models are very effective in concretizing mathematical subjects that are difficult to understand. The subject of integers, which has an abstract structure, is one of the subjects in which students fail and have difficulty. Research shows that integers, especially negative integers, pose difficulties for students. Because students try to form integers based on their assumptions about natural numbers and accept that what they know about natural numbers is also valid for integers (Gallardo, 2002). Erdem et al.(2015) stated that students have the most difficulty in making sense of the minus (-) sign, and the most effective way to overcome this problem is for students to conceptualize the real-life equivalent of negative integers or the minus (-) sign. Researchers have stated that most students have difficulty determining whether the minus sign in front of the number indicates an operation or a direction. It is emphasized that the use of number lines or counting scales will be effective in overcoming this difficulty. Researchers state that students have difficulty comparing negative integers and that the number line model is an effective method to overcome this (Erdem, 2015; Işıksal-Bostan, 2009). Bozkurt and Polat (2011) also stated that counting scales is an understandable and convenient method for adding and subtracting integers.

Many studies have shown that integers are one of the subjects that are difficult to learn and teach in mathematics (Altıparmak & Özdoğan, 2010; Bozkurt & Polat, 2011; Erdem, 2015; Işıksal-Bostan, 2009; Kilhamn, 2011; Kutluca & Akın, 2013; Tutak et al., 2019). Students used to operating with natural numbers in primary school may experience difficulties encountering integers in secondary school. For example, a student accustomed to adding natural numbers can efficiently operate 2+3=5 but may experience confusion when faced with an operation such as (-2)-(-3). It is stated that this confusion is caused by students encountering negative numbers for the first time and transferring the operations they do on natural numbers to these numbers in the same way (Erdem, 2015). In the literatüre, it is stated that students have difficulty with negative numbers (Altıparmak & Özdoğan, 2010; Erdem, 2015; Işıksal-Bostan, 2009; İşgüden, 2008; Kilhamn, 2011). There are many studies available. For example, İşgüden (2008) determined that seventh and eighth-grade students had difficulties in deciding whether the number zero belongs to the set of integers or not, in defining positive and negative integers, in comparing negative numbers and placing them on the number line, in the meaning of absolute value, in taking the powers of negative numbers and in the priority of operations.

Kilhamn (2011) stated that both teachers and students have difficulties with integers and that in order to learn negative integers meaningfully, 3-7=-4 is similar to the situation of someone who owns three units and needs to pay seven units, meaning that this person owes four units-explained that it should be explained. Altıparmak and Özdoğan (2010) stated that in traditional teaching, students have difficulty finding the result of the 6-9 operation and not making an explanation, such as "Since the number 9 is greater than the number 6, the result is a negative number" regarding the result of this operation being -3, may lead to difficulties in understanding negative numbers. In teaching integers, mathematics educators have proposed and used many models. To date, models such as stamps, elevators, thermometers, hot air balloons, sea level models, directional objects, and debt receivable models have been expressed (Mayer et al. 1995). These models have been introduced into the literature as quantitative and directional models (Çetin, 2016). Two models are commonly used to help students understand integers, compare integers, and perform the four operations on integers (addition, subtraction, multiplication, and division), one addressing quantity and the other addressing linear operations. These are counting scales and number line models. Apart from counting scales and number lines, modeling real-life situations is also used to teach the subject of integers. In the Secondary School Mathematics Curriculum (Ministry of National Education [MoNE], 2018), temperature, receivable-debit, profit-loss, income-expense, altitude, timetables, direction, calculators, etc. It is desired to use real-life situations. Floors in the elevator, distances above and below sea level, temperatures below and above zero, etc. are used to make students understand that positive and negative integers are used to express opposite directions and values. It has been stated that models can be used (MoNE, 2019).

1.1. Literature Review

When the literature is examined, it is seen that the opinions of teachers and teacher candidates regarding modeling with counting scales were taken and that modeling skills were examined for only some of the operations with integers (Bozkurt & Polat, 2011). It was determined that these studies focused on addition and subtraction operations. The results obtained from Durmaz's (2017) study indicate that although prospective teachers and teachers find modeling with counting scales for multiplication and division operations more complex than other operations, they do not find modeling with counting scales functional for multiplication and division operations, so they prefer methods that are easier for them. When the literature is examined, it can be seen that various studies have been conducted on the use of counting scales or number lines in addition, subtraction, multiplication and division of integers. Battista (1983) explained how to use positive and negative electric charges in performing four operations on integers. Cemen (1993) showed how to perform addition and subtraction operations of integers with a number line model. Cunningham (2009) explained how to use the number line in addition, subtraction and multiplication of integers. Bosse et al. (2016) investigated using representations in operations with integers. Researchers have stated that operations other than NxP (multiplying a negative integer by a positive integer), NxN (multiplying a negative integer by a negative integer) and P:N (dividing a positive integer by a negative integer) can be performed with counting stamps. The same researchers used the number line model with P-N (subtraction of a negative integer from a positive integer), NxP (multiplying a negative integer by a positive integer), NxN (multiplying a negative integer by a negative integer) and P:N (multiplying a positive integer by a positive integer). It is stated that operations such as dividing by a negative integer cannot be performed. It has been stated that the operation N-N (subtracting a negative integer from a negative integer) can be done in a limited way, and operations other than these (NxP, NxN P:N and N-N) can be done with the number line model. Özdemir (2021) said that although the operations are described with counting scales, it will be difficult for students to understand, especially multiplication and division operations. Although the study is significant, it has been stated that multiplication and division cannot be understood with counting scales. When the curriculum book currently used by the Ministry of National Education for 7th grades is examined, it is seen that the multiplication and division of integers is modeled with counting scales, and in the multiplication process, only PxP (multiplying a positive integer by a positive integer) and NxP (multiplying a negative integer by a positive integer). It is seen that the acquisition is modeled with counting scales, and the acquisition of N:P (dividing a negative integer by a positive integer) is included in the division operation. The fact that the curriculum book explains counting stamps by giving only some of their achievements has, of course, revealed that counting stamps are insufficient in fully explaining and learning the subject (MoNE, 2019). Therefore, it is anticipated that this study will enable the curriculum book to be reviewed and renewed. Considering all these studies, this research is essential in combining the teaching of integers with counting scales in the same study from the perspective of teachers and students. It is thought that it may be the starting point for new modeling to be done in the future.

2. METHOD

2.1. Research Model

The qualitative research method was adopted in this research. In qualitative research, the aim is to investigate an event or organization in depth rather than superficially scanning a population. The interview method was also used in this research. Interview is a data collection technique used in qualitative research (Punch, 2005). An interview is a conversation to gather information. In other words, interviewing is the activity of understanding the feelings and thoughts of individuals included in the research about a subject or situation (Karataş, 2017). Meeting: It is an effective technique for understanding people's feelings, thoughts, attitudes, experiences, and complaints (Sevecan & Çilingiroğlu, 2007). The interview technique includes all efforts to obtain the desired data. According to this perspective, the interview technique is likened to a miner's deep digging in search of precious metals (Türnüklü, 2000). The interview technique is also referred to as an interview in some sources. According to this description, interviews are conversations held between two or more people for a particular purpose and in a specific order (Coşkun et al., 2019). The purpose of the interview is to enter the participant's inner world and understand his perspective on the relevant issue or situation (Patton, 2014).

2.2. Research Group

In qualitative studies, the nature of the research and the resources the researcher has are essential in selecting the sample (Yıldırım & Şimşek, 2008). Criterion sampling, one of the purposeful sampling methods, was used to determine the study group. Purposeful sampling is used to determine in-depth the situations that are thought to have rich information. Büyüköztürk et al. (2012) stated that criterion sampling consists of events, people, objects or situations that have determined qualities related to the problem. Sample size poses an essential problem in qualitative research. There are no rules regarding sample size. The sample size depends on what we want to know, the researcher's purpose, what will be helpful, what will be reliable, and what can be done within the resources and time available (Patton, 2014). The study group in this research was determined as ten secondary school mathematics teachers and ten 7th-grade students working in Elazığ. Teachers in the study were selected voluntarily. The students participating in the research were selected through purposeful sampling among the students studying at the school where the researcher worked. The teachers participating in the study were coded as T_1, T_2, T_3, ..., T_{10}. The students participating in the study were given codes S_1, S_2, S_3, ..., S_{10}. Within the scope of the ethics of the study, personal information was not requested from any mathematics teachers or students and was not used in the content of the study. The demographic characteristics of the teachers and students participating in the research are given in Table 1 below.

Table 1. Demographic characteristics of teachers participating in the research

	Faculty or School Graduated from	Professional Experience	Gender
T_1	Faculty of Education	1-5 year	E
T_2	Faculty of Education	1-5 year	K
T_3	Faculty of Education	1-5 year	E
T_4	Educational Institute	6-10 year	K
T_5	Faculty of Education	6-10 year	K
T_6	Faculty of Education	6-10 year	E
T_7	Faculty of Education	11-15 year	K
T_8	Faculty of Education	11-15 year	K
T_9	Faculty of Education	11-15 year	E
T_{10}	Faculty of Arts and Sciences	16-20 year	E

The teachers selected in the research were graduates of two types of faculties. Three teachers from each seniority year were selected, with professional experience between 1-5, 6-10, 11-15 and 16-20 years. Five of the selected teachers are men and five are women. The demographic characteristics of the students participating in the study are given in Table 2.

Table 2. Demographic characteristics of students participating in the research

	Grade Level	Gender
S_1	7th grade	E
S_2	7th grade	E
S_3	7th grade	E
S_4	7th grade	E
S_5	7th grade	E
S_6	7th grade	K
S_7	7th grade	K
S_8	7th grade	K
S_9	7th grade	K
S_{10}	7th grade	K

Of the ten 7th grade students participating in the research, five are boys and five are girls. The students participating in this research were determined on a voluntary basis and no personal information was requested, acting within the framework of ethical rules.

2.3. Data Collection Tools

2.3.1. Teacher opinion form

In this study, a structured teacher opinion form developed by the researcher was used. Before preparing the interview questions, studies on the subject were examined by conducting a literature review at home and abroad. The subject was mentioned to three mathematics teachers, and their approaches were evaluated. Opinions were obtained from two academics working on a similar subject, and the interview forms they used in their research were obtained. A teacher interview form was prepared due to the literature review, mathematics teachers' approaches to the subject, and data obtained from two academics who conducted similar studies in the country. Open-ended questions were asked in the interview form. This interview form was presented to the opinions of ten experts in the field (2 Measurement and Evaluation Experts, 4 Education Experts and 4 Mathematics Educators) to ensure the content validity of the study. After the suggestions and necessary changes, the questions were applied to five mathematics teachers who were not included in the study group in order to determine content validity and reliability. As a result of the examination, it was concluded that the questions prepared thoroughly reflected the subject. Thus, an interview form for teachers was obtained. Structured interview forms are used to ensure that the interviewees express themselves thoroughly (Büyüköztürk et al., 2012). For structured interviews, a set of questions is prepared for all interviews. The structured interview technique is an interview method in which questions are asked to everyone interviewed in the same order, and everyone is allowed to answer the questions as they wish (Yıldırım & Şimşek, 2008). The structured interview technique aims to obtain in-depth information. This technique has advantages such as ease of analysis, the ability of the individual to express himself/herself better, and arranging questions according to the course of the interview (Ekiz, 2003).

2.3.2. Student interview form

During the creation of the Student Interview form, an extensive literature review was first conducted on the subject. Then, a comprehensive question pool was created by the researcher. Afterward, interview questions were selected by taking into account factors such as the relevance of the questions to the research target, the usability of the questions, and their suitability for the interview technique. Expert opinions were used to determine whether the selected questions met the study objectives. In this context, the scope validity of the study was tried to be ensured by presenting it to ten different experts (2 Measurement and Evaluation Experts, 4 Education Experts and 4 Mathematics Educators). After the suggestions and necessary changes, a pilot application was conducted with six students who were not included in the study group in order to determine the content validity and reliability. As a result of the examination, it was concluded that the questions prepared thoroughly reflected the subject. Thus, an interview form for students was obtained.

2.4. Analysis of Data

The data obtained from the research were analyzed using the content analysis method. Content analysis allows verbal, written and other materials to be examined objectively and systematically (Tavşancıl & Aslan, 2001). In the study, the interview forms were read and coded after they were transferred to the computer environment. Categories were created from these codes. The frequencies of the codes have been arranged and turned into tables to facilitate interpretation. In addition, the percentage of agreement formula developed by Miles and Heberman (1994) was used to measure the reliability of qualitative data in the study. It is calculated with the formula Percentage of Agreement(P)=consensus(Na)/[consensus(Na)+disagreement(Nd)]x100. It is possible to say that reliability is achieved when the coding reliability is 90% or above (Saban, 2008). Accordingly, the agreement percentage of the structured interview forms was calculated as (P) = 10/[10+1]x100 = 90.9% for both tests. This result shows that the internal reliability of qualitative data is ensured.

3. FINDINGS

Data regarding the examination of the opinions of secondary school mathematics teachers and 7th grade students about teaching four operations in integers with counting scales were analyzed with descriptive statistics. The first question of the research was "*Do you think counting stamps are useful in teaching whole numbers?*" The question was asked and the findings related to the question are presented in Table 3.

Table 3. Teachers' opinions on the usefulness of counting markers for whole numbers

Theme	Category	Code	f	%
Counting Stamps Metaphor	Functionality	Addition and subtraction	7	70
		Embodiment	3	30

As seen in Table 3, the "*functionality*" category related to the "*Counting stamps metaphor*" theme and two different codes belonging to this category were formed. While 70% of the teachers participating in the research emphasized that counting scales were only useful in modeling addition and subtraction in teaching integers, 30% emphasized that they were useful in concretization. Sample teacher opinions regarding these findings are as follows:

T_2: *"Students love modeling, especially in addition and subtraction. Since multiplication and division are a little more based on memorization, they are difficult to learn and quickly forgotten. I think it defeats its purpose."*

T_6: *"It is necessary to convey information more concretely to secondary school students. Such manipulative representations are valuable for middle school students to learn and embody."*

The second question of the research was "*Do you include modeling about integers during the course?*" The question was asked and the findings related to the question are presented in Table 4.

Table 4. Teachers' opinions on including modeling in whole numbers

Theme	Category	Code	f	%
Use in Class	Place of use	Partially	5	50
		Only Addition and subtraction	4	40
		Where it is included in the curriculum	1	10

As seen in Table 4, the "*Place of Use*" category related to the "*Use in the Course*" theme and three different codes belonging to this category were formed. 50% of the teachers who participated in the research stated that they explained it partially, 40% stated that they explained it only when teaching addition and subtraction, and 10% stated that they had to explain it because it was in the curriculum. Sample teacher opinions regarding these findings are as follows:

T_9: *"Yes, I include it, it is in the curriculum and appears in the exams. That's why space should be given."*

T_3: *"Yes, I include it in the initial stage (addition and subtraction). It cannot be said that I gave too much space in the sequel."*

T_4: *"Yes. "I model with counting stamps, visual cards, stories and drawings."*

The third question of the research was "*Can you show the (-8).(-2) operation by modeling it with counting scales?*" The question was asked and the findings related to the question are presented in Table 5.

Table 5. Teachers' answers regarding modeling negative multiplications with counting scales

Theme	Category	Code	f	%
Modelling	Multiplication Modeling	Accurate Modeling	1	10
		Wrong Modeling	3	30
		No Modeling	6	60

As seen in Table 5, the "*Collision Modeling*" category related to the "*Modelling*" theme and three different codes belonging to this category were formed. 60% of the participants in the research could not model, 30% modeled incorrectly, and 10% could model correctly. Sample teacher opinions regarding these findings are as follows:

T_{10}: *"Meaning, the sign of the first cross is important when modeling that there will be no 8 double negative checkers. The first sign here is "-". "Zero pairs come into play to prevent the stamps from being found. In this example, we need 8 double zero pairs. If we subtract the negatives from these pairs, there will be 16 stamps left."*

T_4: *"I do not find it appropriate to model the multiplication of two negative numbers in the textbooks with counting stamps, and I do not model the operations with counting stamps."*

T_5: *"No"*

The fourth question of the research was "*Can you demonstrate the (-24)÷(-3) process by modeling it with counting scales?*" The question was asked and the findings are presented in Table 6.

Table 6. Teachers' answers regarding modeling negative sections with counting scales

Theme	Category	Code	f	%
Modelling	Divide Modeling	Non-use	8	80
		Wrong Modeling	2	20

As seen in Table 6, the "*Divide Modeling*" category related to the "Modelling" theme and two different codes belonging to this category were formed. 80% of the teachers who participated in the research said that they do not use modelling, and 20% of them modeled incorrectly. Sample teacher opinions regarding these findings are as follows:

T_1: *"It used to be there, it was removed."*

T_9: *"I think it is pointless to teach it since the divisor here is "-"."*

The fifth question of the research was "*Do you think counting scales are sufficient for modeling multiplication and division of integers?*" The question was asked and the findings related to the question are presented in Table 7.

Table 7. Teachers' opinions on the adequacy of counting scales in modeling multiplication and division of integers

Theme	Category	Code	f	%
Usefulness	Perception of Competence	Not enough	8	80
		Sufficient for multiplication, insufficient for division	2	20

As seen in Table 7, the "*Perception of Competence*" category related to the "*Usability*" theme and two different codes belonging to this category were formed. 80% of the teachers participating in the research stated that the counting checkers were not sufficient and 10% stated that they could be used in multiplication but not division. Sample teacher opinions regarding these findings are as follows:

T_9: *"I think the signs for multiplication and division should be removed because they are very confusing."*

T_4: *"No, it is not enough."*

The sixth question of the research asked, "*Do you think counting stamps should be removed from the curriculum?*" The question was asked and the findings related to the question are presented in Table 8.

Table 8. Teachers' opinions on the removal of counting stamps from the curriculum

Theme	Category	Code	f	%
Curriculum	Requirement status	Should be removed	8	80
		Should not be removed	2	20

As seen in Table 8, the "*Requirement Status*" category related to the "*Curriculum*" theme and two different codes belonging to this category were formed. 80% of the teachers who participated in the research said that it should be removed from the curriculum and 20% said that it should not be removed because it is useful for addition and subtraction. Sample teacher opinions regarding these findings are as follows:

T_4: *"I think it is very useful, especially in addition and subtraction operations. As far as I can see, I think that it has positive contributions to the students' impressions in multiplication and division operations, such as the division or multiplication of two positive integers, the multiplication or division of a negative integer with a positive integer."*

T_{10}: *"I think it should be removed because it gets confusing in multiplication and division."*

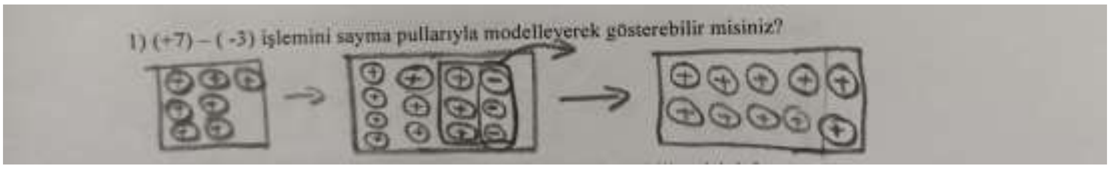
Data regarding the examination of 7th grade students' views on learning four operations in integers with counting scales were analyzed with descriptive statistics. The tables made for the questions asked to the students and the opinions received are given below, respectively. In the research, the first question to the students was "*Can you show the (+7)-(-3) operation by modeling it with counting scales?*" The question was asked and the codes and answers to the question are as follows:

Table 9. **Students' answers regarding subtracting a negative integer from a positive integer**

Theme	Category	Code	f	%
Ability to Use Modeling	Subtraction Modeling	Correct Answer	6	60
		No Answer	2	20
		No action	2	20

As seen in Table 9, the "*Subtraction Modeling*" category related to the "*Ability to Use Modeling*" theme and three different codes belonging to this category were formed. When the table above is examined, 60% of the students participating in the research correctly solved the question about modeling the subtraction operation, 20% made an error in the calculation and 20% could not answer. Sample student opinions regarding these findings are as follows:

S_1:



S_9 : "*No answer*"

S_{10} : *"No action"*

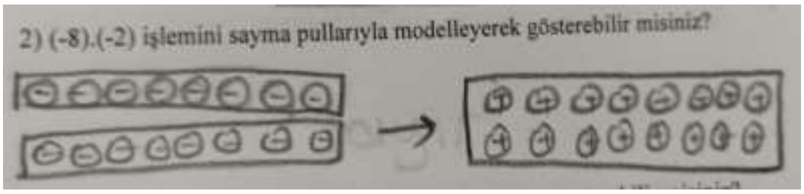
Secondly, in the research, the students were asked: "*Can you show the (-8).(-2) operation by modeling it with counting scales?*" The question was asked and the findings are presented in Table 10.

Table 10. **Students' answers regarding modeling negative multiplications with counting scales**

Theme	Category	Code	f	%
Ability to Use Modeling	Multiplication Modeling	No Answer	8	80
		Wrong Answer	2	20

As seen in Table 10, the "*Multiplication Modeling*" category related to the "*Ability to Use Modeling*" theme and two codes belonging to this category were formed. 80% of the students who participated in the research could not solve the given question. 20% answered incorrectly. Sample student opinions regarding these findings are as follows:

S_1:



S_5: *"the second cannot be negative."*

Thirdly, in the research, the students were asked: "*Can you show the (-24)÷(-3) operation by modeling it with counting scales?*" The question was asked and the findings related to the question are presented in Table 11.

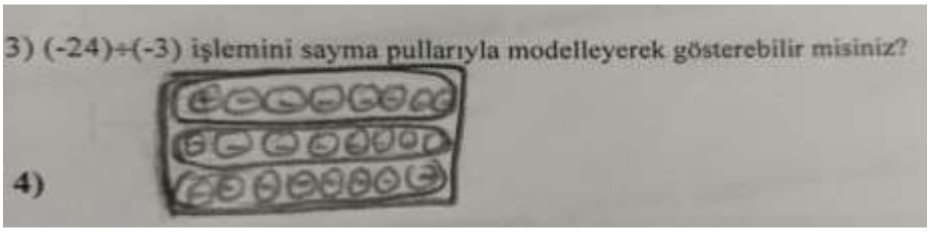
Table 11. **Students' answers regarding modeling negative sections with counting stamps**

Theme	Category	Code	f	%
Ability to Use Modeling	Divide Modeling	No Answer	8	80
		Wrong Answer	2	20

As seen in Table 11, the "*Partition Modeling*" category related to the "*Ability to Use Modeling*" theme and two codes belonging to this category were formed. 80% of the students participating in the research could not solve the given question. 20% of them answered incorrectly. Sample student opinions regarding these findings are as follows:

S_4: "*This process cannot be modeled with stamps"*

S_8:



The fourth question in the research was asked to the students: "*Do you think that learning the subject becomes more difficult with counting stamps?*" The question was asked and the findings related to the question are presented in Table 13.

Table 13. **Students' opinions on the difficulty of learning whole numbers with counting scales**

Theme	Category	Code	f	%
Counting Stamps	Perception of Counting Stamps	It makes it harder	8	80
		It partially strengthens	2	20

As seen in Table 13, the "*Perception of Counting Stamps*" category related to the "*Counting Stamps*" theme and two codes belonging to this category were formed. 80% of the students stated that counting scales made the subject difficult, and 20% stated that it made it partially difficult. Sample student opinions regarding these findings are as follows:

S_4: *"Yes, I think counting stamps are very unnecessary. "It's very boring and makes the subject difficult."*

S_6: *"It makes it difficult for some questions, but it helps me understand some questions."*

The fifth part of the research was "*Do you think you would understand the subject better if this subject was taught through a digital game?*" The question was asked and the findings related to the question are presented in Table 14.

Table 14. **Students' opinions on the use of digital games in teaching integers**

Theme	Category	Code	f	%
Digital Game	Modeling with Digital Game	Interesting	7	70
		Motivation Enhancer	3	30

As seen in Table 14, the "*Modelling with Digital Game*" category related to the "*Digital Game*" theme and two codes belonging to this category were formed. 70% of the students stated that digital games were interesting and 30% stated that they could increase motivation. Sample student opinions regarding these findings are as follows:

S_8: *"Yes, I would understand it better and the game would interest me."*

S_4: *"It would be a lot of fun and I could learn better."*

4. DISCUSSION AND SUGGESTIONS

In the study, first of all, it was investigated whether counting scales were useful in teaching whole numbers in interviews with teachers. While most teachers stated that they used counting scales only for addition and subtraction, a small number used them to concretize the subject. These results may be because counting scales are handy, especially in addition and subtraction. These answers are similarly parallel to the results of Durmaz's (2017) study. In this study conducted by Durmaz (2017), the study of mathematics teachers and teacher candidates modeling four operations with integers with counting stamps, teachers and teacher candidates were more successful in modeling the addition operation with integers than other operations. However, they had difficulty modeling the operations of subtraction, multiplication and division determined their experiences. When the literature is examined, the findings obtained in the studies (Bozkurt & Polat, 2011) in which the opinions of teachers and prospective teachers were taken about modeling with counting scales and their modeling skills were examined for only a part of the operations with integers are parallel to our study. It is seen that these studies also focus on addition and subtraction operations. The results obtained from Durmaz's (2017) study indicate that although prospective teachers and teachers find modeling with counting scales for multiplication and division operations more difficult than other operations, they do not find modeling with counting scales functional for multiplication and division operations, so they prefer methods that are easier for them. The second question asked in the study was to investigate whether modeling on integers was included during the course. When the opinions regarding this question were examined, the results were obtained that half of the teachers explained partially, some only taught addition and subtraction, and the minority were forced to explain because it was included in the curriculum. The reasons for these results may be that teachers do not have much knowledge about modeling, or they avoid explaining the subject with modeling. This study was carried out by Bilgili et al. (2020), similar to the findings obtained in their study. In the study, it was determined that there were teachers who stated that the statement about modeling was not in the curriculum, as well as teachers who thought using the counting stamp model was unnecessary. It has been revealed that teachers have difficulty making sense of the counting scale model. In a similar study, Durmaz (2017) stated that mathematics teachers and prospective teachers were more successful in modeling the four operations with integers with counting scales than in other operations. However, they had difficulty modeling the operations of subtraction, multiplication and division (Bilgili et al., 2020). When the opinions regarding the third question asked in the study, modeling the multiplication of integers with counting scales, were examined, most teachers either could not model or modeled incorrectly, and only one teacher used correct modeling. The reason for these results may be that the multiplication of negative numbers is not included in the curriculum book. This situation was reported by Bilgili et al. (2020) and is consistent with the findings obtained in their study. At the end of the study, it was determined that most of the teachers had difficulty distinguishing between correct and incorrect solutions when evaluating the solution. This situation also emerged in our research. Zwaneveld et al. (2017) also agree with the idea that teachers are lacking in mathematical modeling. In addition, according to Bikić et al. (2021), the reason why mathematical modeling has not yet been fully integrated into mathematics teaching in Bosnia and Herzegovina is that teachers have deficiencies in this regard and stated that teachers should be supported in order to apply mathematical modeling in mathematics teaching successfully. The results obtained in this study coincide with the results in our research. When the opinions about modeling the division of integers with counting scales, which was the fourth question asked in the research, were examined, the majority of the teachers said no, they could not model it, and two people modeled it incorrectly. The reason for these results may be that the division of negative numbers is not included in the curriculum book. It is in parallel with the results obtained in other studies. Bosse et al. (2016) state that operations other than NxP (multiplying a negative integer by a positive integer), NxN (multiplying a negative integer by a negative integer), and P:N (dividing a positive integer by a negative integer) are counted with counting scales. They stated that it could be done. This result is consistent with our research. When the opinions about the fifth question in the research, about the sufficiency of counting checkers in modeling the multiplication and division of integers, were examined, the majority of the teachers said no, counting checkers was not sufficient, and only one person said that they could be used in multiplication but not in division. Again, the sixth question of the research was, "Do you think counting stamps should be removed from the curriculum?" The majority said it should be removed from the curriculum, and only one teacher said it should not be removed because it is useful for addition and subtraction. When these two questions were examined together, teachers did not find counting stamps functional and said that they should be removed from the curriculum. This study coincides with the opinions of teachers about counting scales in whole numbers in the findings section of Bozkurt and Kuran's (2016) study. Therefore, the data obtained from the research overlaps with other studies. It turned out that the data obtained was consistent. In addition, when teachers' responses to multiplication and modeling and students' opinions about these operations are examined, a very consistent correlation appears to emerge. This once again demonstrates how accurate and consistent it is that the research examines two views simultaneously.

When the first question asked in the interviews with the students was examined, it was revealed that they were fine in modeling the subtraction process and making sense of the model. This situation is parallel to the results obtained from teachers in the study. Because teachers mostly prefer counting scales to model addition and subtraction. This caused students to be more successful in modeling addition and subtraction with counting scales. The findings obtained in this study are parallel to the results of the study conducted by Erdem et al., (2015). In that study, teachers also mentioned that students did not have difficulties in showing addition and subtraction operations with counting scales. When we look at the second and third questions about modeling multiplication and division operations in the interviews conducted with the students in the research, almost most of the students could not answer or answered incorrectly. The reason for this situation may be that most multiplication and division models are not included in the curriculum and that teachers do not explain these models or do not know them incompletely. In this study, the data obtained by Hacısalihoğlu-Karadeniz and Hodancı (2022) revealed that students could not make number line modeling related to integers. Student opinions obtained in our research are parallel to the findings obtained in this research. When the students' opinions about the fourth question asked in the research, whether learning the subject becomes more difficult with counting stamps, are examined, all students say yes, and it turns out that counting stamps is not functional for the students and makes learning difficult. This may be because the counting scales are uninteresting and complex. The findings obtained in the research coincide with the teachers' opinions about counting stamps in whole numbers in the findings section of the study conducted by Bozkurt and Kuran (2016). In addition, it has similar characteristics to the results obtained from the teachers' perspective towards counting stamps in the study. When the fifth question asked in the study, whether teaching four operations in integers with a digital game would be more instructive, was examined, most students evaluated it as exciting and motivation-enhancing. This may be because the counting scales are not understandable or because the subject has become more interesting with more technological modeling in the age of technology. The data obtained in the study of Çakmak-Gürel and Işık (2016) are parallel to the findings in our research. Mathematics education with technological tools is engaging in an age where technology is such a part of our lives that it may have produced such a result. In the suggestions section of their study, Çakmak-Gürel and Işık (2016) say that students' involvement in the process in different ways will increase the student's motivation and interest. This suggestion is consistent with the answers received to the questions asked to the students in the research. It is parallel to the findings obtained from the study conducted by Soydaş-Çakır and Akyazı (2021), which also contains similar results. Students have now become more open to learning through digital means. Digital learning motivates students more. The fact that the majority of both groups could not give correct answers to the multiplication and division modeling questions asked to teachers and students in the research revealed how correct it was to examine the opinions of students and teachers together in the research because teachers' incomplete learning of multiplication and division modeling, their avoidance of explaining the modeling, or their failure to choose counting scales may have resulted in students being deficient in this modeling. Similarly, in the study conducted by Büyükadıgüzel (2019), it was found that technology-related teaching positively affected seventh-grade students. With a similar result, Hattie (2009) stated that using calculators in mathematics has a positive, albeit low, effect on success. At the end of his study, Kandemir (2011) observed a significant difference in students' thoughts about using calculators in problem-solving in favor of the experimental group. In addition, it was observed that students who solved mathematical modeling problems for the first time showed positive attitudes toward mathematical modeling activities. Moreover, again, students viewed calculators and computers as cognitive facilitators in the mathematical modeling process. Saka (2016), in his study, found that the use of technological tools contributed to the elimination of difficulties encountered in the modeling process and was recommended for enriching students' learning environments.

4.2. Limitations and Suggestions

This research is limited to 10 primary school mathematics teachers with different seniority and graduation who teach together with ten students in the 7th grade of a secondary school in the Central District of Elazığ province; the application period and the measurement tools used in the research. In order to avoid these limitations, students were selected with a heterogeneous distribution in terms of gender, and instructors were selected with a heterogeneous distribution in terms of gender and seniority. Additionally, validity and reliability studies of the data collection tools were carried out. Research results showed that counting stamps were not functional for teachers and students. In some cases, this type of modeling hinders learning. Therefore, the curriculum can be adjusted by considering these situations. In a time when we live in the age of technology, alternative learning situations can be used in learning processes instead of counting stamps. Therefore, instead of this type of modeling, teaching can be carried out with games. Teachers model multiplication and division operations incompletely, especially in counting scales. Teachers can be trained by organizing development seminars and can be helped to create different models. Edits can be made in the curriculum books for counting stamps by evaluating the study results. The current curriculum on this subject can be revised. In addition, new generation models for daily life can be developed on this subject.

Ethics Committee Decision

This research was carried out with the permission of Fırat University Publication Ethics Board with the decision numbered 13578 dated 09.01.2023.

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