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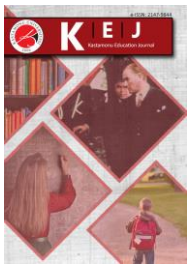

| Research Article / Araştırma Makalesi |

The Effect of Writing for Learning and Model-Based Learning Activities on Success and Permanence in the Fourth Grade Simple Electrical Circuits Unit

Dördüncü Sınıf Basit Elektrik Devreleri Ünitesinde Öğrenme Amaçlı Yazma ve Model Tabanlı Öğrenme Etkinliklerinin Başarıya ve Kalıcılığa Etkisi[1]

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Keywords

1. Writing for learning
2. Model-based learning
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Anahtar Kelimeler

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Abstract

The purpose of this study is to investigate the effect of writing for learning and model-based learning activities on academic achievement in the "Simple Electrical Circuits" unit of the fourth-grade science course and the views of students and classroom teachers about these activities. In the quantitative part of the research, which has quantitative and qualitative designs, quasi-experimental design with a pretest-posttest control group and in the qualitative part, student and teacher opinion forms consisting of open-ended questions were used. Three experimental and one control group were selected among the fourth graders according to the simple random sampling method. The achievement test related to the "Simple Electrical Circuits" unit was applied to these groups as a pre-test, post-test and permanence test. In the study, writing for learning purposes in a randomly selected group, model-based learning in the other, and both writing for learning and model-based learning activities were carried out together in the third group. In the control group, the lessons were carried out according to the current method. ANOVA was used in the analysis of quantitative data, and content analysis was used in the analysis of qualitative data. Findings related to the post-test of the experimental groups and the control group showed a significant difference in favor of the experimental group students who performed the model-based learning activities. According to the permanence test, there was no statistically significant difference between the experimental groups and the control group, but the mean of the experimental groups was higher than the mean of the control group. According to the data obtained from the interviews with students and teachers, it can be stated that students and teachers exhibited a positive approach towards writing for learning and model-based learning activities. In addition, the experimental group students stated that they did the activities with fun, while the teachers stated that they believed in the benefits of the activities used, but it was difficult to implement them in the current system. Based on these results, new research can be carried out at the third-grade level, in different lessons or in different units of the same lesson.

Öz

Bu çalışmanın amacı, dördüncü sınıf fen bilimleri dersinin "Basit Elektrik Devreleri" ünitesinde öğrenme amaçlı yazma ile model tabanlı öğrenme etkinliklerinin akademik başarıya etkisini ve öğrencilerle sınıf öğretmenlerinin bu etkinliklerle ilgili görüşlerini araştırmaktır. Nicel ve nitel desenlere sahip araştırmanın nicel kısmında ön test-son test kontrol gruplu yarı deneysel desen, nitel kısmında açık uçlu sorulardan oluşan öğrenci ve öğretmen görüş formları kullanılmıştır. Dördüncü sınıf öğrencileri arasından basit tesadüfi örnekleme yöntemine göre üç deney ve bir kontrol grubu seçilmiştir. Bu gruplara "Basit Elektrik Devreleri" ünitesi ile ilgili başarı testi ön test, son test ve kalıcılık testi olarak uygulanmıştır. Çalışmada, rastgele seçilen bir grupta öğrenme amaçlı yazma, diğerinde model tabanlı öğrenme, üçüncü grupta ise hem öğrenme amaçlı yazma hem de model tabanlı öğrenme etkinlikleri birlikte gerçekleştirilmiştir. Kontrol grubunda dersler, mevcut yönteme göre yürütülmüştür. Nicel verilerin analizinde ANOVA, nitel verilerin analizinde içerik analizi kullanılmıştır. Deney grupları ile kontrol grubunun son testine ilişkin bulgular, model tabanlı öğrenme etkinliklerini gerçekleştiren deney grubu öğrencilerinin lehine anlamlı bir farklılık göstermiştir. Kalıcılık testine göre deney grupları ile kontrol grubu arasında istatiksel olarak anlamlı bir farklılığın olmadığı, ancak deney gruplarının ortalamalarının kontrol grubunun ortalamasından daha yüksek olduğu görülmüştür. Öğrenci ve öğretmenlerle yapılan görüşmelerden elde edilen verilere göre öğrencilerin ve öğretmenlerin öğrenme amaçlı yazma ve model tabanlı öğrenme etkinliklerine yönelik olumlu yaklaşım sergiledikleri ifade edilebilir. Ayrıca deney grubu öğrencileri etkinlikleri eğlenerek yaptıklarını, öğretmenler ise kullanılan etkinliklerin faydasına inandıklarını ancak onları mevcut sistemde uygulamanın zor olduğunu belirtmişlerdir. Bu sonuçlardan hareketle üçüncü sınıf düzeyinde, farklı derslerde veya aynı dersin farklı ünitelerinde yeni araştırmalar yapılabilir.

[1] This study was produced from the master's thesis titled "The Effect of Learning Purpose Writing and Model-Based Learning Activities on Success in the Fourth Grade Simple Electrical Circuits Unit" conducted by the first author under the supervision of the second author.

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INTRODUCTION

In today's world, where science and technology are developing very rapidly, the importance of knowledge has been understood and in parallel, an intensive knowledge has been formed (Aksakal et al., 2015; Erduran & Akçay, 2013). In order for countries to progress in every field and reach the level of development required by the period, it has been necessary to keep up with the rapid developments in science and technology (Bozat & Yıldız, 2015). Ideas about the characteristics that individuals ought to own have changed for a better quality and productive life as a result of these developments (Tümay & Köseoğlu, 2011). Traditional learning methods have been insufficient in acquiring the characteristics that individuals should have, and constructivist and new education approaches have begun to replace traditional education (Erduran & Akçay, 2013; Takaç, 2019). Despite the changes in the education system and curriculum, there have been difficulties in transferring the desired features to teachers, students and the education process. Similarly, the tendency towards new searches in science education has revealed more than one non-traditional method (Erduran & Akçay, 2013).

Science education, which clarifies many subjects such as the existence and lifestyles of all living things in the universe, rather than being a lesson isolated from daily life (Takaç, 2019), has an important place in terms of the development and progress of countries. Therefore, science education is gaining importance day by day and countries are increasing their investments in science education. In Turkey, science education is carried out by the Ministry of National Education (MNE) within the scope of science courses in private schools and public schools affiliated to the MNE (Aydın, 2018). The course, which is expressed as science in primary schools, is gaining importance day by day and therefore the importance of being scientifically literate is increasing. Science literacy is a combination of attitudes, values, skills, and knowledge that are necessary for people to be lifelong learners, to develop skills such as critical thinking and problem solving, and to maintain their sense of curiosity about the world (Demir, 2012; Koçak, 2013).

The lack of equal physical conditions in educational environments, economic, social, cultural and individual differences prevent every student from being scientifically literate. Due to the individual differences of the students, the programs implemented ought to be flexible in order to gain the target behaviors to the individuals. Therefore, the education system necessarily directs educators to different methods and techniques (Aydın, 2018). In addition, the fact that each student learns differently makes it necessary to diversify the methods and techniques used in today's education (Gülcü, 2019). Writing for learning (Daşdemir, 2017; Öztürk et al., 2016; Yıldız, 2009) and model-based learning (Birinci & Apaydın, 2016) are among these methods and techniques.

Writing for Learning

The writing was thought of by Mason and Boscolo (2000) as a tool used to improve student's ability to organize their knowledge and reflect on their own beliefs. Writing (Elbir & Yıldız, 2012), which is one of the best tools to transfer cultural accumulation to future generations, is not only a recording tool (Aktepe & Yıldız, 2020), but also the expression of ideas and feelings in writing (Sever, 2015). In addition, it can be said that writing, which allows people to communicate with each other today, is a cognitive activity that provides the use of the mind and mediates learning rather than a system of signs (Aktepe, 2020). Therefore, writing is used as a part of the education process in many countries today (Kavaklı, 2016). In this process, the teacher is responsible for guiding and supporting the student rather than evaluating the student by considering technical criteria such as word use, grammar, punctuation, spelling and form. It is not enough for the teacher alone to guide and motivate the student to write. The person who will write the article should also fulfill the stages of determining the subject, forming the main and auxiliary ideas of the subject and its purpose, and limiting the subject. After these stages, it is considered important to carry out the stages such as reaching the ideas supporting the subject and sorting them, resting the article, and reading and sharing the article one by one (Beyreli et al., 2017). A text created by following these stages can be used as a learning tool in the education process as well as interesting.

Writing for learning is not the student writing exactly in his notebook without changing what the teachers say in the lesson, that is, it is non-traditional writing. Traditional writing activities mostly include copying what is written on the board into a notebook, taking notes about what is told, making book summaries, and creating laboratory reports. On the other hand, non-traditional writing activities include learning tools such as letters, diaries, poems, brochures, songs, concept maps, posters, stories, and diagrams (Aydın, 2018; Koçak, 2013; Özyurt, 2011; Uzoğlu, 2014; Yeşildağ-Hasançebi et al., 2017). The fact that the learning processes of the students differ from each other makes the selection of the specified activities important for the effectiveness of writing for learning purposes. Hand and Prain (2002) identified five elements with important dimensions in their model of how to select the most appropriate writing activities for students. These elements are the purposes of writing, the types of writing, the audience or the reader, the subject structure, and the method of writing. One of the main components of the created model is the subject. The first thing to be done in the writing process is to determine on which subject the text will be shaped. Another component of the model is purpose. The execution time of the writing activity can change the purpose of the text. Writing activities can sometimes be used to reveal misconceptions at the beginning of the subject and to motivate the student to the lesson, sometimes to deepen the subject during the subject, and sometimes to make the learning permanent at the end of the subject or for evaluation purposes. Another component is the addressee. The addressee is who the text is addressed to. After the addressee has been determined, the language of the text should be adjusted according to the reader. The text production method, on the other hand, is a component related to how the text will be structured. The structuring of the text can be done both in groups and individually. After the text production method is determined, the font type should be selected. According to Tynjala (1998), there is inevitably a need to elaborate on what type of writing can enhance learning. Types of writing can include traditional writing

activities such as summarizing and note-taking, as well as non-traditional writing activities such as stories, brochures, journals, travel writings, poems, concept maps, diagrams, letters, plays, and posters. Despite the components that Hand and Prain (2002) have created and defined about how to choose writing for learning activities, it has been observed that in some studies, how to use writing for learning has not been emphasized yet. In this context, it has been stated that writing activities for learning can be shaped by research results (Daşdemir et al., 2015; Kieft et al., 2006). In this direction, researchers have conducted studies to define what writing for learning is and how it can be used.

Balgopal and Wallace (2013) stated that writing for learning is an effective education and training strategy based on the process of organizing and describing thoughts by focusing on the written product. Takaç (2019) expressed writing, which is used as a learning method, as "using various writing activities in case a concept or subject is learned or taught". Bozat (2014), on the other hand, defined writing for learning as a process in which students take responsibility for learning and construct meaning. In this direction, it is an inevitable fact that writing for learning purposes is very important for individuals to make progress and serves different functions (Günel et al., 2009).

Above all, writing for learning improves students' research and thinking skills (Akar, 2007; Ay & Başıbüyük, 2018) and increases their confidence in writing skills (Reaves et al., 1993). Writing for learning ensures active participation in the lesson and establishing a relationship between knowledge and the target (Günel vd., 2010; Özkan, 2019; Şahin, 2019). On the other hand, it helps students to have better communication skills and to reinforce their knowledge (Ay, 2018; Yıldız & Büyükkasap, 2011b). In addition, it helps to get used to the types of writing required in different fields of specialization and disciplines (Yıldız & Büyükkasap, 2011c) and improves the skills of reinforcing, interpreting, and remembering (Günel et al., 2009). The use of writing for learning helps students to express their thoughts clearly and facilitates their understanding of the new subject through conceptual change (Biber, 2012). Writing not only helps people develop and understand themselves, but also enables them to empathize in society (Tarikdaroğlu, 2019). In addition, writing activities help students make connections between what they know and understand, enable them to make inferences, repeat previous information and develop critical thought-provoking skills (Bozat, 2014). Moreover, it can be stated that writing not only contributes to the development of activities in the brain but also provides benefits in emotional and stressful situations.

Contrary to the benefits of writing, very little time is allocated for writing-related activities, especially in science classes in Turkey. The main reasons for this are that writing is seen as a time-wasting activity and teachers perceive writing only as a note-taking tool (Daşdemir et al., 2015). Considering the importance and benefits of writing, it can be thought that some conditions should be met for writing activities to result in learning and to be used more effectively in the classroom as a learning strategy. In a study by Yıldız (2014), it is stated that while performing a writing activity for learning purposes, it may be more beneficial for students with a higher-grade level or age to write to younger addressees and for the writers to conduct research on the subject. In the same study, it was emphasized that primary school students were motivated in a shorter time due to their age, and that student motivation would increase the expected effect of writing. In the interviews conducted by Koçak and Seven (2016), teachers found the writing activity to be more effective due to situations such as using more instructive language and including every detail about the subject when writing below the peer level as the addressee level. It may be necessary for writers to engage in some mental activities during the writing process to try to get down to the level that young interlocutors can understand and to think about how to express a subject more easily for them. In addition, activities writing for learning should not be made routine. If the activities are prepared in different ways, both success and interest of the student can increase. Fulfillment of the listed conditions and measures to be taken can increase the effectiveness of writing for learning purposes and contribute to more reliable results in writing for learning research.

Model-Based Learning

Science, which has a structure that is difficult to grasp, contains concrete concepts that are difficult to understand and reach for students, as well as abstract concepts such as magnetic field lines of force that students cannot interact with. Making abstract concepts understandable, clear, and simple to facilitate students' understanding is a problematic situation. In addition, the same problem can sometimes be experienced for concrete concepts (Gülçiçek et al., 2003). Problems and difficulties related to teaching have forced science instructors to produce different solutions in making abstract expressions concrete, transferring, and teaching concepts and exemplary solutions such as using rods instead of chemical bonds and balls instead of atoms revealed the importance of modeling in science education (Güneş, Gülçiçek et al., 2004). From this point of view, it can be stated that models are important materials in the transfer of events, processes, and concepts that cannot be directly interacted with.

It is noteworthy that the terms model and modeling (Yiğit & Özmen, 2006) that come to mind first when it comes to model in science education are different from each other when the literature is reviewed. Ünal and Ergin (2006) defined the model as tools used in abstract situations that cannot be observed most of the time, and sometimes in concrete situations where scaling is needed even if it can be observed. In addition, according to the test results that Harman (2012) applied to teacher candidates, models are expressed as materials that help embody abstract concepts, represent reality, contribute to meaningful learning, and provide permanent learning and motivation. Modeling, on the other hand, is defined as using models, creating and designing, the paths followed during model creation, and representing reality. In other words, it can be thought that the models in which the modeling consists of a process are the products obtained at the end of this process (Sağırlı-Özturan, 2010; Yetim, 2015; Zeytinli-Ünal, 2018). Since it is difficult to draw the limitations of the scope of the model, many researchers have classified the models instead of making a general model definition. In studies, models are classified as models in terms of appearance, scientific/non-scientific models,

and models in terms of function (Gülçiçek & Güneş, 2004; Güneş, Gülçiçek et al.,2004). In addition, Çökelez (2015) tried to explain the models in four groups: physical models, analogical models, symbolic models, and theoretical models. In studies on the classification of models in the literature, it is possible to come across many classifications such as these, which were created based on the structure, usage areas and functions of the models (Gülcü & Taşçı, 2020).

Despite classifications and definitions, teachers do not fully know what models are and do not actively use all models to base knowledge in their classrooms. Considering the relationship between learning and models, teachers' inadequacies in emphasizing the features of the models or not using the models correctly and effectively may cause misconceptions in students (Güneş, Bağcı et al., 2004). Models that are prepared incompletely or haphazardly without attention may create misconceptions that are difficult to compensate for in the future academic life of students (Gülçiçek et al., 2003). Therefore, pre-service teachers should be given the skills to use and develop course support materials before starting their profession. Based on this, the purpose of the models to be prepared should be well defined, and what they will represent, and what materials they will be formed from should be determined. In Harman's (2012) study, pre-service teachers state that models should be useful, economical, high representative of the target, clear and understandable. In Koçak's (2006) study, it is emphasized that the models should be made from the waste and simple materials and that the models that will represent an object should be personally made by the student himself. However, while making a model, students' psycho-motor skills and their knowledge about models according to their grade level should be taken into consideration.

It can be said that model-based education, which will be carried out by taking into account the knowledge of the students about the models according to their grade levels, will provide many benefits for both students and teachers. The model-building process not only supports rapid learning in students, but also increases the student's interest in the lesson, distracts the student from memorization, and makes the lesson more productive (Işık & Mercan, 2015). Model-based learning improves students' estimation skills (Çökelez, 2015) and helps them behave like scientists (Güneş, Gülçiçek et al., 2004). Modeling activities increase students' understanding and mental model development (Bozdemir-Yüzbaşıoğlu & Sarıkaya, 2018). On the other hand, it makes the subjects that are difficult to learn easier to be perceived and affects success positively (Gümüş et al., 2008; Örnek, 2010). In addition, model-based learning is effective in identifying misconceptions (Alkan et al, 2016; Harman & Çelikler, 2020) and increasing communication skills (Ergin et al., 2011). Moreover, model-supported education contributes to making learning permanent (Aktan et al., 2019), improving students' cognitive structures (Gülcü & Taşçı, 2020), and forming theory (Güneş, Bağcı et al., 2004). Additionally, model activities are effective in making the teaching process more fun and enjoyable (Aksakal et al., 2015). A well-designed visual material or model can deliver more of the message that tens of pages of written text wants to convey, in a shorter time and more effectively (Düzgün, 2000).

Contrary to the benefits of modeling studies on different subjects such as stars, electricity and magnetism, sound, and fractions, very little time is spared for model-making activities in the Turkish Education System (Ilk & Apaydın, 2016; Günbatar & Sarı, 2005; İyibil & Sağlam-Arslan, 2010; Yavuz-Mumcu, 2018). Also, although handmade activities are important tools of science teaching, these activities are not given enough attention in education (Demirayak, 2006). The main reason for this may be that teachers find model activities as inadequate in learning and consider the limitations of models rather than their benefits. Therefore, the limitations of the models to be used in the lessons should be learned by the teachers to enable the students to understand the concepts more easily and to prevent them from getting incorrect thoughts (Günbatar & Sarı, 2005). Modeling activities cause difficulties in supplying materials (Ayvacı et al, 2016), they are not suitable for every subject and limit creativity and thinking (Işık & Mercan, 2015). Modeling causes a shortage of content knowledge and time (Ayvacı et al., 2015; Ergin et al., 2011) and does not appeal to every student (Işık & Mercan, 2015). In addition, according to Harman's (2012) study, reasons such as models not attracting the attention of every student, and making students passive are seen as disadvantages of using models. Despite its limitations, the model-based teaching process, which is renewable, should be one of the basic applications of education.

Considering the basic philosophy of science education, the roles of both writing for learning purposes and model-based learning in gaining scientific thinking and the ability to transfer what they think to live cannot be ignored. Therefore, students should be given the opportunity to understand the nature of model use and writing activities in the classroom and to study these activities in groups or individually. There are two important reasons for determining the research topic. Although the field of writing for learning is an important issue in the international literature, the number of studies on the subject in Turkey is at a minimum level. Although letters and diaries have been used in most of the studies, poster preparation activities have not been included enough. In addition, the use of model and writing together makes the research important.

When the literature is examined, it is found that there are studies that contain the thoughts and expectations of teachers who are practitioners of writing for learning and model-based learning activities. However, it is predicted that studies that include the views of primary school teachers, who teach many affective, mental and behavioral skills, about writing for learning and model-based learning activities are insufficient. In addition, the current research is considered important in terms of educating students who reach information, apply information, produce new information and solve problems by using this information, instead of students who receive the information exactly from the teacher. In this respect, it is thought that the study will contribute to the literature and the data obtained from the study will contribute to the knowledge of field educators in science teaching.

The Purpose of the Study

The purpose of this study is to investigate the effect of writing for learning and model-based learning activities on academic achievement in the "Simple Electrical Circuits" unit of the fourth-grade science course and the views of students and classroom teachers about these activities. For this purpose, answers to the following sub-problems were sought:

1. Is there a significant difference between the pre-test scores of the experimental groups and the control group students?
2. Is there a significant difference between the post-test scores of the experimental groups and the control group students?
3. Is there a significant difference between the permanence test scores of the experimental groups and the control group students?
4. What are the opinions of the experimental group students about writing for learning and model-based learning activities?
5. What are the opinions of primary school teachers about writing for learning and model-based learning activities?

METHOD

The Research Method

The research has quantitative and qualitative patterns. In the quantitative part of the study, a quasi-experimental design with pretest-posttest control group was used. Quasi-experimental designs are those in which group matching on existing groups but no random assignment is made (Büyüköztürk, 2016). The experimental method is the most appropriate method in studies whose aim is to control the variables and to reveal the cause-effect relationships between these variables (Metin, 2015). In the study, one of the application groups carried out random writing for learning activities, one model-based learning activities, and the other both writing and model activities together. In addition, no intervention was made to the control group and the lessons were conducted according to the current method. Each student in the experimental group, who would perform the writing for learning activity, prepared posters that clearly explained and visualized simple electrical circuits. In the experimental group that will carry out the model activities, the lessons were taught through models in accordance with the learning outcomes. The students in the control group solved the evaluation questions in the "Simple Electrical Circuits" unit in the fourth-grade science textbook or the questions at the same level as them.

In the qualitative part of the research, semi-structured interviews were conducted with 14 students randomly selected from the students participating in the writing and modeling activities, and 3 classroom teachers who carried out the application, about writing for learning and model-based learning activities. The interview form was created by taking the opinion of an expert in the field of science education. The form consists of 7 open-ended questions to reveal students' views on the methods used, and 4 open-ended questions to reveal teachers' views. During the interview, audio and video recordings were made over the Zoom Cloud Meeting program, with the permission of the students and teachers. Interviews with students lasted 15-25 minutes, while interviews with teachers lasted 10-15 minutes.

Study Group

The study was carried out in a public primary school in Erzurum city center in the spring term of the 2020/2021 academic year. The primary school, located in a neighborhood where middle-class families live in socio-economic terms, was preferred because of the large number of classes that could be the research group. The data of the study were obtained from the fourth-grade students, 3 in the experimental group and 1 in the control group. The selection of the groups was made by using simple random sampling method among seven branches with similar pre-test results. When choosing the experimental and control groups from the class branches, the probability of choosing each branch is the same. After each branch selection, the branch was included in the election again and other branches were determined. If the same branch came, the branch was thrown into the bag again and the selection continued until a different branch came from the experimental group. There are 25 students in the experimental group that prepares the poster (12 boys, 13 girls), 20 in the experimental group that prepares the model (11 boys, 9 girls), 20 in the experimental group that prepares the poster and model activities together (11 boys, 9 girls), and 20 in the control group (7 boys, 13 girls). The total number of students in the research groups is 85.

Data Collection

In the research, Science Achievement Test (SAT) and semi-structured interview form, which includes the topics in the "Simple Electrical Circuits" unit, were used as data collection tools. The SAT was prepared by compiling the exams for different schools and educational institutions in previous years and the evaluation questions of the fourth-grade science textbooks. In order to ensure the reliability and validity of the questions, necessary corrections were made by taking into account the opinions and suggestions of 2 lecturers who experts in their fields and 2 classroom teachers are who taught science courses before. In addition, a pilot application was carried out to determine the reliability coefficient of the questions. In this direction, a preliminary study was conducted by asking 58 students in the fifth grade before the SAT was conducted to the experimental and control groups. As a result of the study, the item difficulty and item discrimination indexes of each question were evaluated separately. After item analysis, item averages, item standard deviations and item reliability were calculated. Items that were too difficult or too easy according to the item difficulty index data and which should not be used according to the item discrimination index data were removed from the measurement tool and the achievement test was finalized by taking the necessary analysis measures. Considering the data obtained from the remaining questions, the reliability of the test was determined using the Kuder-Richardson

20 [KR-20] method. KR-20 is a method used to calculate reliability in cases where the test is heterogeneous in terms of item difficulty level (Başol, 2019). In the study, the reliability of the achievement test was found to be 0.79 by using the KR-20 method. The finalized SAT consists of a total of 21 questions, including 13 multiple choice, 4 true-false and 4 fill-in-the-blank questions. The overall test was scored out of a total of 100. In order for the scoring to be reliable, an answer key was created showing the distribution of points and correct answers before examining the tests. After the post-test, it was tried to determine the opinions of only the experimental group of students and teachers about both writing for learning and model-based learning activities. In this direction, semi-structured interviews were conducted with a total of fourteen (14) students and three (3) teachers according to the maximum diversity sampling method, considering the scores obtained from the achievement test. While preparing the interview questions, necessary corrections and changes were made in line with the suggestions of a faculty member who an expert in his field is.

Analysis of Data

The evaluation of all quantitative data obtained at the beginning of the study and after the implementation of the methods was carried out using the SPSS 26 (Statistical Package for Social Sciences) package program. With the program, firstly, the reliability of the achievement test and item analyzes were calculated as a result of the pilot application, and then the main findings were obtained. In the study, the Shapiro-Wilks normality test was used to determine the normality of the data obtained from the tests, since the sizes of the experimental groups and the control group were smaller than 50.

In the study, firstly, one-way analysis of variance (ANOVA) was used as a statistical method to determine whether there was a significant difference between the pre-test, post-test, and permanence test scores of the experimental groups and the control group students. The statistical significance level was taken as .05 for all tests. As a result of ANOVA, the effect size (η2) value was examined in order to determine how effective the methods applied in the groups were. The value of η2 indicates how much of the total variance in the dependent variable is explained by the independent variable. The value of η2 varies between 0.00 and 1.00 and is interpreted as 0.01-0.09 (small), 0.09-0.25 (medium) and 0.25 and above (large) effect sizes (Büyüköztürk, 2009; Can, 2020). Duncan Multiple Comparison Test was used to make multiple comparisons as a result of ANOVA. Duncan test is one of the multiple interval tests used when variance between groups is equal (Kayri, 2009).

To determine the thoughts of the experimental group students and fourth-grade teachers about writing for learning and model-based learning activities, all the data obtained by using the student and teacher interview form were evaluated by content analysis technique. Content analysis is one of the qualitative analysis methods that require an in-depth analysis of the collected data and allows for revealing previously unclear dimensions (Sözbilir, 2009). While the opinions of students and teachers were used in the study, a code name different from their real names was given to each individual in order to keep their identity information confidential according to research ethics. While determining the code names, the names of any student and teacher in the four groups were not used. The names of students and teachers are shown with initials in the tables. The data obtained by video recording during the interviews with the students and teachers were converted into written documents by the researcher. In order to avoid data loss, the video recordings were examined repeatedly and corrections were made. The data obtained from students and teachers who did not allow video recording was recorded by the researcher. Afterward, participant opinions were classified by considering their similarities and differences. As a result of classification, all data were categorized and their frequencies and percentages were calculated.

FINDINGS

Findings Regarding the First Sub-Problem

“Is there a significant difference between the pre-test scores of the experimental groups and the control group students?” is the first sub-problem of the study. Before the analysis of the problem, the normality test was conducted to determine whether the pre-test scores of the experimental groups and the control group obtained from the academic achievement test showed a normal distribution. In addition, Levene's Test was performed to test the homogeneity of variances. According to the results of the normality test, it was observed that the pre-test scores of the Experimental Group 1 (DG1), Experimental Group 2 (DG2), and Control Group (KG) from the academic achievement test were normally distributed, but the Experimental Group 3 (DG3) was not normally distributed. In addition, it was determined that the Levene value was .87 and this value was not significant ($p = .462$). In other words, the condition of equality of variances is met.

ANOVA was used when comparing the pre-test scores of the experimental group students who prepared a poster, conducted the science lesson with models, and performed the poster-model activities together, and the control group students who were educated based on the current method. ANOVA results for the pre-test data of the groups are given in Table 1.

Table 1. ANOVA results on pre-test scores of experimental and control group students

					95% Average Confidence Interval			
Pre-Test	n	$\bar{X}$	Std. Deviation	Std. Error	Lower Limit	Upper Limit	Minimum	Maximum
DG1	25	42.0	9.9	2.0	37.9	46.0	23	62
DG2	20	43.1	8.7	1.9	39.0	47.1	29	57
DG3	20	42.7	12.3	2.7	36.9	48.4	26	82
KG	20	42.0	12.5	2.8	36.1	47.9	23	70
Total	85	42.3	10.7	1.2	40.1	44.7	23	82

ANOVA

		Sum of Squares	Degree of Freedom	Mean Square	F	p
Pre-Test	Inter Group	17.728	3	5.909	.050	.985
	In Group	9622.460	81	118.796		
	Total	9640.188	84			

According to Table 1, the pre-test averages were found to be 42.0 in the poster group, 43.1 in the model group, 42.7 in the group that prepared the poster-model activities together, and 42.0 in the control group. According to the pre-test ANOVA results of the experimental and control groups, no statistically significant difference was found between the groups (p = .985). In other words, it can be said that the groups were equivalent to each other before the application was made. In addition, the effect size value was found to be η2 = .00. It can be said that this value has a small effect.

Findings Regarding the Second Sub-Problem

"Is there a significant difference between the post-test scores of the experimental groups and the control group students?" is the second sub-problem of the study. Before the analysis of the problem, the normality test was conducted to determine whether the post-test scores of the experimental groups and the control group obtained from the academic achievement test showed a normal distribution. In addition, Levene's Test was performed to test the homogeneity of variances. According to the results of the normality test, it was observed that the post-test scores of the experimental groups and the control group obtained from the academic achievement test were normally distributed. In addition, it was determined that the Levene value was 1.97 and this value was not significant (p = .126). In other words, the condition of equality of variances is met.

ANOVA was used when comparing the post-test scores of the experimental group students, who prepared a poster, conducted the science lesson with models, and performed poster-model activities together, and the control group students who were educated based on the current method. ANOVA results for the post-test data of the groups are given in Table 2.

Table 2. ANOVA results on post-test scores of experimental and control group students

					95% Average Confidence Interval			
Post Test	n	$\bar{X}$	Std. Deviation	Std. Error	Lower Limit	Upper Limit	Minimum	Maximum
DG1	25	54.7	15.3	3.1	48.4	61.1	31	90
DG2	20	71.7	18.6	4.2	63.0	80.4	37	98
DG3	20	57.1	17.7	4.0	48.8	65.4	28	90
KG	20	56.3	22.0	2.1	46.0	66.6	20	98
Total	85	59.6	19.3	2.1	55.5	63.8	20	98

ANOVA

		Sum of Squares	Degree of Freedom	Mean Square	F	P
Post Test	Inter Group	3842.104	3	1280.701	3.79	.014
	In Group	27405.590	81	338.341		
	Total	31247.694				

According to Table 2, the posttest averages were 54.7 in the poster group, 71.7 in the model group, 57.1 in the group that prepared the poster-model activities together, and 56.3 in the control group. According to the post-test ANOVA results of the experimental and control groups, a statistically significant difference was found between the groups (p = .014). In other words, after the application, it can be said that the groups are not equivalent to each other. In addition, the effect size value was found as η2 = .12. It can be said that this value has a moderate effect. The Duncan test multiple comparison chart in Table 3 was looked at to see the differences between the means of the groups.

Table 3. Duncan test results on post-test scores of experimental and control group students

Groups	Post Test
DG2	71.7±18.6[a]
DG1	54.7±15.3[b]
DG3	57.1±17.7[b]
KG	56.3±22.0[b]

p<.05

When the Duncan test results of the "Simple Electrical Circuits" unit post-test scores of the experimental and control group students are examined, it is seen that the post-test average of the experimental group students who prepared the model is higher than the other groups. According to the post-test results of the experimental groups and the control group, two different subgroups emerged. The experimental group that prepared the model was in one group, and the other groups were in another group.

Findings Regarding the Third Sub-Problem

"Is there a significant difference between the permanence-test scores of the experimental groups and the control group students?" is the third sub-problem of the study. Before the analysis of the problem, the normality test was conducted to determine whether the permanence-test scores of the experimental groups and the control group obtained from the academic achievement test showed a normal distribution. In addition, Levene's Test was performed to test the homogeneity of variances. According to the results of the normality test, it was observed that the permanence test scores of the experimental groups and the control group obtained from the academic achievement test were normally distributed. In addition, it was determined that the Levene value was .71 and this value was not significant (p = .548). In other words, the condition of equality of variances is met.

ANOVA was used when comparing the permanence test scores of the experimental group students, who prepared a poster, conducted the science lesson with models, and performed poster-model activities together, and the control group students, who received education based on the current method. ANOVA results for the permanence test data of the groups are given in Table 4.

Table 4. ANOVA results regarding permanence test scores of experimental groups and control group students

					95% Average Confidence Interval			
Permanence Test	n	$\bar{X}$	Std. Deviation	Std. Error	Lower Limit	Upper Limit	Minimum	Maximum
DG1	25	73.6	17.8	3.6	66.3	81.0	24	100
DG2	20	69.7	20.7	4.6	60.0	79.4	31	100
DG3	20	70.7	19.0	4.3	61.8	79.6	34	100
KG	20	64.4	16.6	3.7	56.6	72.1	18	95
Total	85	69.8	18.5	2.0	65.8	73.8	18	100

ANOVA

		Sum of Squares	Degree of Freedom	Mean Square	F	P
Permanence Test	Inter Group	978.984	3	326.328	.951	.420
	In Group	27808.710	81	343.317		
	Total	28787.694	84			

According to Table 4, the permanence test averages were 73.6 in the poster group, 69.7 in the model group, 70.7 in the group that prepared the poster-model activities together, and 64.4 in the control group. There was no statistically significant difference between the experimental groups and the control group according to the permanence test ANOVA results (p = .420). In other words, after the permanency test, it can be said that the levels of remembering the information of the groups are equivalent to each other. In addition, the effect size value was found as η2 = .03. It can be said that this value has a small effect.

Findings Regarding the Fourth Sub-Problem

"What are the opinions of the experimental group students about writing for learning purposes and model-based learning activities?" is the fourth sub-problem of the study. The opinions of the experimental group students about model-based learning and writing for learning purposes were tried to be revealed by the answers given to the open-ended questions. The questions were asked according to the writing and model-based learning activities for each group, and the interviews were recorded. The findings obtained from fourteen students selected from the experimental groups by the maximum diversity sampling method were examined under the title of each research question and presented in separate tables.

The students were first asked the question "Do you think that preparing posters/models/models and posters helps you understand the topics, how?". So, it was tried to determine the general impressions of the students about the activities during the

implementation process. The answers from the students were brought together with appropriate codes and themes. Student opinions regarding this question are given in Table 5.

Table 5. Students' answers regarding the question "Do you think that preparing posters/models/models and posters help you understand the subjects, how?"

Student Answers	Effect	Coding for Answers	Students	Total (N)	Percentage (%)
Yes	Positive	Ensuring Lesson Understanding	R, Z, Y, H, F, M3, Ö, E	8	16,7
		Instructive	B1, G, M1, R, F, M3	6	12,5
		Entertaining	G, M2, Y, F, M3, B3	6	12,5
		Ensuring Permanency	R, A, M2, Ö	4	8,3
		Developing Skill	M2, H, M3, Ö	4	8,3
		Increasing Confidence	Z, Y, M3, Ö	4	8,3
		Reinforcing	B1, M3	2	4,1
		Thought-provoking	H, Ö	2	4,1
		Using Time Efficiently	F, M3	2	4,1
		Attracting Attention	R	1	2,1
		Informative	M2	1	2,1
		Arousing Excitement	H	1	2,1
		Pleasing	F	1	2,1
		Developing Imagination	Ö	1	2,1
	Negative	Waste of Time	H	1	2,1
		Tiring	H	1	2,1
		Confusing	H	1	2,1
		Insufficient Feedback	F	1	2,1
		Being Costly	F	1	2,1
No		-	-	-	-
Indecisive		-	-	-	-

When Table 5 is examined, it is seen that the experimental group students emphasized that the activities were effective in terms of comprehension, instruction, entertainment, permanence, skill development, attracting attention, and increasing self-confidence. Some students stated that the activities stimulated their thinking, helped them manage their time, sparked excitement, made them happy, and helped them expand their imaginations. According to Table 5, it is noteworthy that, contrary to the positive thoughts of the students about the activities, they have some negative thoughts such as tiring, confusing, insufficient feedback, time-consuming and costly. In addition, it is important that none of the students expressed an opinion that the activities do not help to understand the subjects.

Secondly, the students were asked the question "Would you like to use the poster/model/model and poster preparation activities in other units of the science course, and why?". The answers from the students were brought together with appropriate codes and themes. Student opinions regarding this question are given in Table 6.

Table 6. Students' answers regarding the question "Would you like to use the poster/model/model and poster preparation activities in other units of the science course, why?"

Students' Answers	Coding for Answers	Students	Total (N)	Percentage (%)
Yes	Entertaining	G, B3, F, H, E, M3	6	25
	Instructive	B1, M1, R, E	4	16,6
	Ensuring Permanency	G, F, M3, Ö	4	16,6
	Ensuring Lesson Understanding	F, H, E	3	12,5
	Reinforcing	M3, Ö	2	8,3
	Informative	M3	1	4,2
	Making the Lesson More Effective	M2	1	4,2
	Suitability for the Subject	A	1	4,2
	Concretization	Y	1	4,2
No	Suitability for the Subject	Z	1	4,2
Indecisive	-	-	-	-

Almost all the students (n=13) who participated in the interview stated that posters or models should be in other units of the science course. Students who answered positively to the research question supported their ideas in terms of entertainment, instruction, permanency, comprehension, reinforcement, informing, making the lesson more effective, relevance to the subject, and concretization. In addition, a student thought that the models were not suitable for every subject and stated that the activities should not be in other units.

Like the previous question, the students were asked the question "Would you like the poster/model/model and poster preparation activities to be used in other lessons, and why?". The answers from the students were brought together with appropriate codes and themes. Student opinions regarding this question are given in Table 7.

Table 7. Students' answers regarding the question "Would you like the poster/model/poster and model preparation activities to be used in other lessons, and why?"

Student Answers	Coding for Answers	Students	Total (N)	Percentage (%)
Yes	Entertaining	G, M1, R, B3	4	20
	Ensuring Permanency	G, R, M3	3	15
	Facilitation	G, R, H	3	15
	Instructive	M	1	5
	Ensuring Lesson Understanding	A	1	5
	Suitability for the Subject	F	1	5
	Pleasing	H	1	5
No	Suitability for the Subject	Y, E, Ö	3	15
	Confusing	Z	1	5
	Tiring	Ö	1	5
Indecisive	-	B1, M2	1	5

Almost all the interviewed students (n=10) stated that the poster/model/poster and model preparation activity should be used in other lessons. According to Table 7, students who answered positively to the research question found the activities entertaining, facilitating, and instructive. In addition, three of the students supported their ideas by emphasizing the permanence of the activities, one being appropriate for the lesson, and the other giving happiness. Four students found the activities insufficient in terms of suitability for the lesson. In addition, these students thought that the activities were tiring and confusing. However, findings were obtained showing that one student, who performed poster activities and prepared a model, was undecided about using the activities in other lessons.

Afterward, the students were asked the question “Would you like more such writing/modeling/modeling and writing activities in science lessons, and why?". The answers from the students were brought together with appropriate codes and themes. Student opinions regarding this question are given in Table 8.

Table 8. Students’ answers regarding the question “Would you like more such writing/modeling/modeling and writing activities in science lessons, and why?"

Students’ Answers	Coding for Answers	Students	Total (N)	Percentage (%)
Yes	Entertaining	G, R, Z, Y, E, Ö	6	18,8
	Ensuring Permanency	M1, R, B3, F, Ö	5	15,6
	Ensuring Lesson Understanding	M1, R, A, Y	4	12,5
	Developing Skill	G, H, E	3	9,4
	Instructive	B3, E, M3	3	9,4
	Facilitating	G, F	2	6,3
	Reinforcing	B3, Ö	2	6,3
	Increasing Motivation	G	1	3,1
	Make Curious	G	1	3,1
	Spending Time Efficiently	R	1	3,1
	Able to be Done from Easily Accessible Materials	R	1	3,1
	Thought-provoking	H	1	3,1
No	-	-	-	-
Indecisive	Suitability for the Subject	B1	1	3,1
	-	M2	1	3,1

According to the students, poster/model/poster and model preparation activities help to think, spend time productively, develop skills, increase motivation, use time efficiently, facilitate and comprehend the subject, and make the lesson more permanent, interesting, and fun. In addition, the fact that it can be prepared from easily accessible materials, that it is instructive, and that it reinforces the subjects is seen among the reasons for expressing opinions in favor of using the activities more. Therefore, twelve students interviewed stated that such writing and modeling activities should be used more in science courses. In addition, two students were undecided about using more or fewer activities. One of these students supported his view by stating that preparing a poster is not suitable for every subject.

To determine the change in the interest of the experimental group students in the lesson, the students were asked the question “How did the poster/model/model and poster activities you prepared affect your interest in the science lesson?”. The answers from the students were brought together with appropriate codes and themes. Student opinions regarding this question are given in Table 9.

Table 9. Students’ answers regarding the question “How did the poster/model/model and poster activities you prepared affect your interest in the science lesson?”

Students' Answers	Coding for Answers	Students	Total (N)	Percentage (%)
Increased Interest	-	Z, B3, F, H, E, M3, Ö	7	46,7
	Entertaining	M1, R	2	13,3
	Ensuring Permanency	G	1	6,7
	Ensuring Lesson Understanding	R	1	6,7
No Change	-	B1, A, M2, Y	4	26,6
Reduced Interest	-	-	-	-

While ten of the experimental group students answered, "it increased" to the stated research question, four people gave the answer "there was no change". In addition, students who answered positively stated that the activities helped the subjects to be understood more easily, to be learned more permanently, and to make the lesson fun. When Table 9 is examined, it is remarkable that although seven of the interviewed students gave positive answers to the research question, none of them used expressions that supported their ideas.

To determine the change in the science course success of the experimental group students were asked the question "How did your science course success change after the poster/model/model and poster activities?" The answers from the students were brought together with appropriate codes and themes. Student opinions regarding this question are given in Table 10.

Table 10. Students' answers regarding the question "How did your science course success change after the poster/model/model and poster activities"

Students' Answers		Coding for Answers	Students	Total (N)	Percentage (%)
Increased Success	Positive	Facilitating	M1, R, Z, B3, F, M3	6	31,6
		Entertaining	B1, G	2	10,5
		Instructive	B1, E	2	10,5
		Ensuring Lesson Understanding	H, Ö	2	10,5
		Ensuring Permanency	H, M3	2	10,5
		-	A, M2	2	10,5
	Negative	Being Costly	G	1	5,3
		Confusing	G	1	5,3
No Change		-	Y	1	5,3
Reduced Success		-	-	-	-

When Table 10 is examined, it is seen that six of the students in the experimental group stated that their success increased by emphasizing the facilitating aspect of the activities. Interviewed students attributed the increase in their success to the entertaining, instructing, and permanence features of the activities. In addition, although two students stated that their success increased, they did not provide any justification for this issue. However, it was remarkable that one student said that although posters increased success, they were disadvantageous in terms of cost and confusion. One student stated that the activities were not effective in increasing the success of the science course.

Finally, the students were asked the question "If you were a teacher, would you like your students to do poster/model/model and poster activities in the lessons, and why?". The answers from the students were brought together with appropriate codes and themes. Student opinions regarding this question are given in Table 11.

Table 11. Students' answers regarding the question "If you were a teacher, would you like your students to do poster/model/model and poster activities in the lessons, and why?"

Students' Answers	Coding for Answers	Students	Total (N)	Percentage (%)
Yes	Entertaining	B1, R, M2, Z, B3, F, M3	7	21,9
	Instructive	G, M1, B3, F, M3	5	15,6
	Ensuring Lesson Understanding	G, F, H, E	4	12,5
	Facilitating	B1, Ö	2	6,3
	Make Curious	Y, H	2	6,3
	Reinforcing	B3, Ö	2	6,3
	Ensuring Permanency	B3, Ö	2	6,3
	Increasing Motivation	R	1	3,1
	Thought-provoking	R	1	3,1
	Increasing Success	A	1	3,1
	Informative	M2	1	3,1
	Relevance to Student	B3	1	3,1
	Spending Time Efficient	F	1	3,1
	Developing Skill	E	1	3,1
	Correcting Misconceptions	M3	1	3,1
No	-	-	-	-
Indecisive	-	-	-	-

When Table 11 is examined, all of the students in the experimental group interviewed stated that they would use poster/model/model and poster preparation activities when they thought of themselves as teachers. The students supported their

ideas with the aspects of entertaining, teaching, comprehending, facilitating, arousing curiosity, reinforcing, maintaining permanence, and increasing motivation and success. According to Table 11, other positive aspects of models and posters were determined to be thought-provoking, informative, suitable for students, and correcting misconceptions.

Findings Regarding the Fifth Sub-Problem

"What are the opinions of the classroom teachers about writing for learning and model-based learning activities?" is the fifth sub-problem of the study. Classroom teachers' views on writing for learning and model-based learning were tried to be revealed through the answers given to open-ended questions. The questions were arranged according to the writing for learning and model-based learning activities, and the interviews were recorded. The findings obtained from the teachers were examined under the title of each research question.

First, the teachers were asked the question "What are the reasons why traditional practices are generally used in lessons?". The answers from the teachers were brought together with appropriate codes and themes. Teachers' views on this question are given in Table 12.

Table 12. Teachers' answers regarding the question "What are the reasons why traditional practices are generally used in lessons?"

Coding for Answers	Teachers	Total (N)
Ensuring Permanency	E, Z	2
Reinforcement	E	1
Easy Implementation	S	1
Getting Results Immediately	S	1

When Table 12 is examined, it is seen that the experimental group teachers had positive views on traditional practices. Teachers supported their views with the features of traditional practices that reinforcement, easy implementation, ensuring permanence, and getting results immediately.

Afterward, the teachers were asked the question "Do you use writing /modelling/writing and modeling activities in your lessons?". The answers from the teachers were brought together with appropriate codes and themes. Teachers' views on this question are given in Table 13.

Table 13. Teachers' answers regarding the question "Do you use writing/modeling/writing and modeling activities in your lessons?"

Teachers' Answers		Coding for Answers	Teachers	Total (N)
Yes	Positive	Ensuring Permanence	E	1
		Learning by Doing-Experiencing	S	1
	Negative	Failing to Complete the Curriculum	E	1
No		Teacher Competencies	Z	1
Indecisive		-	-	-

When Table 13 is examined, one of the teachers emphasized the permanence aspect of the activities and stated that she used similar activities in the lessons. It is noteworthy that the same teacher said that the activities were not suitable for the education time despite using the activities. Similarly, another teacher emphasized the active learning aspect of the activities and stated that she used the activities in her lessons. In addition, a teacher expressed that he did not use the activities in his lessons because he did not have enough equipment.

Then, the teachers were asked the question "Do you find it useful to use the activities of writing/modeling/writing and modeling in science lessons?". The answers from the teachers were brought together with appropriate codes and themes. Teachers' views on this question are given in Table 14.

Table 14. Teachers' answers regarding the question "Do you find it useful to use the activities of writing/modeling/writing and modeling in science lessons?"

Teachers' Answers	Coding for Answers	Teachers	Total (N)
Yes	Ensuring Permanency	E, Z, S	2
	Concretization	S	1
	Entertaining	S	1
No	-	-	-
Indecisive	-	-	-

All the interviewed teachers found the use of writing for learning/modelling/writing for learning purposes and modeling activities in science lessons useful. In addition, the teachers supported their ideas by emphasizing the features of the activities to concretize, provide permanence and make the lesson fun.

Finally, the teachers were asked the question "Do you think that writing for learning/modelling/writing for learning and modeling activities motivate students in science class, and why?". The answers from the teachers were brought together with appropriate codes and themes. Teachers' views on this question are given in Table 15.

Table 15. Teachers' answers regarding the question "Do you think that writing for learning/modelling/writing for learning and modeling activities motivate students in science class, and why?"

Teachers' Answers		Coding for Answers	Teachers	Total (N)
Yes	Positive	Concretization	E, Z	2
		Providing Communication	E	1
		Learning by Doing-Experiencing	S	1
	Negative	Compatibility with the System	E	1
No	-	-	-	-
Indecisive	-	-	-	-

According to the teachers, writing for learning and modeling activities helps to concretize the subjects, develop communication skills and effective learning. Therefore, all the interviewed teachers said that such writing and modeling activities motivate students. In addition, one of the teachers thought that the practices motivated the students but stated that they were not suitable for the education system.

CONCLUSION AND DISCUSSION

While one of the experimental groups did the poster activities, the other carried out the model activities, one other carried out the poster-model activities together. In the study, it was examined whether there was a statistically significant difference between the experimental groups and the control group in terms of academic achievement and permanence. As a result of the evaluation of the post-test data, it was seen that there was a significant difference in favor of the experimental group that applied the model-based learning activity. In addition, it was determined that the permanence test averages of the experimental groups were higher than the permanence test averages of the control group. The findings showed that the academic achievement of the students who performed model-based learning activities in the fourth-grade science course was higher than the control group students. Additionally, findings were obtained showing that the students in the experimental group learned the subject of "Simple Electric Circuits" more permanent than the students in the control group. This result supports the results of some previous studies (Bozat & Yıldız, 2015; Günel et al., 2009; İnal, 2014). In addition, the quantitative results of the research are generally similar to the results of some previous studies on writing for learning and model-based learning (Burkaz, 2012; Cerit-Berber, 2008; Daşdemir, 2017; Daşdemir et al., 2015; Demirçalı, 2016; Yıldırım, 2016). On the other hand, the results obtained are not compatible with the results of some studies (Daşdemir, 2018; Karaçağıl & Avarogullari, 2017; Yıldız & Büyükkasap, 2011a; 2011b; 2011c).

Almost all the students in the experimental groups who were interviewed stated that writing for learning and model-based learning activities helped them understand the subjects better, and that they learned and reinforced the subject better while doing the activities. In addition, the students said that it became easier to understand the subjects, their self-confidence increased, their skills improved, it made them happy to help someone, they spent their time productively and their imaginations developed. Only two students expressed their negative views, stating that both poster and model activities took time, were confusing, tiring, and costly. It has been determined that students generally want to use similar activities in other units of the science course and in other lessons, but a few students think that the activities are not suitable for every subject. Almost all the students who prepared the poster and all the students who carried out the poster and model activities together stated that their interest in science increased after the activities. The majority of the experimental group students stated that there was an increase in their science course success after the poster and modeling activities. A student in the experimental group who prepared the model claimed that there was no change in his success after the implementation. In addition, all the students in the experimental groups stated that they would have their students do these activities when they thought of themselves as teachers. The fourth-grade teachers, whose opinions were taken, stated that traditional applications provided permanence, reinforced the subjects, were easy to practice and result-oriented, and they used these applications more than non-traditional applications in their classrooms. Although one teacher had a positive attitude about writing for learning and model-based learning activities, she made a negative criticism stating that the activities were time-consuming. On the other hand, another teacher explained that did not have teacher competencies about activities and that did not use such activities in the lessons. In addition, it was determined that the teachers found the activities useful but did not find them suitable for the current education system. The qualitative results of the research are generally similar to the results of some previous studies on writing for learning and model-based learning (Aktepe, 2020; Batı, 2014; Duymaz, 2011; Koçak, 2013; Zorlu, 2016). The qualitative findings obtained from the study are completely similar to the results (providing a better understanding of the subject, reinforcing the subject, helping to learn effectively and remembering the information) obtained from the study of Duymaz (2011) and Koçak (2013). According to these results, new researches can be carried out at the third grade level, in different lessons or in different units of the same lesson.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

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