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The Impact of A Modeling Technique on Teaching The Skill Of Time And Chronology

Research Article

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ABSTRACT

The social sciences are a subject area that has posed difficulties for learners and has been criticized as including too many abstract topics. Creating a learning environment that provides a fun factor has been suggested as a preferred way to engage students in the subject. With this in mind, this study aimed to determine whether a modelling process was effective for teaching the skill of "Time and Chronology" to 7th grade elementary students, applying an experimental method within the framework of a quantitative approach. A pilot study was conducted with 26 students, followed by the actual experimental stage that was carried out with 62 7th graders: 31 in the experimental group and 31 in the control group. In line with the research problem, a pre-test and post-test design was applied to collect the data, which were then analysed via the SPSS program. In light of the findings, it was determined that the students in the experimental group, who were taught with the modelling process, were more successful than the control group students, who were taught according to a teacher-centred method.

Keywords:
Modelling, Social Sciences, Science in Time, Time and Chronology, Skill

Introduction

Societies desire individuals who have superior personal and professional qualities, and education is seen as the means to achieving this aim. Education, which is the process of developing desired behaviours in individuals, is a lifelong undertaking (Erdoğan, 2016). The social sciences are an important field of education, as it intertwines with everyday life and is involved in developing learners' ability to adapt to a changing world, to gain knowledge on current topics, and to acquire related skills. The basis of the social sciences is the interaction of humans with their physical and social environment. Its educational roots in our country can be traced back to the beginnings of Turkish history (Kaymakcı, 2015; Akpınar and Kaymakcı, 2012). One of the

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most important aspects of social sciences education is the teaching of skills, or the expertise, talent and ability to perform given tasks (Çelikkaya, 2011; Mutluer, 2013). With Turkey's revised educational program, there are 28 different skills or objectives that must be taught in the context of social sciences (MEB, 2018). One of these skills is Time and Chronology. With the help of this skill, students can establish healthy relationships between past and present; explain events in terms of their causes and effects and comprehend where they are in the history of humankind. The skill of Time and Chronology allows students to explain the cause and effect relationships of events throughout the stages of history, as well as to order events and facts (Sağlam, Tınmaz and Hayal, 2015). Within the framework of the skill of Time and Chronology in the Turkish curriculum, there are several sub-skills, as set forth in Figure 1 below (Demircioğlu, 2014; Kaymakcı and Altun, 2016; Şimşek, 2016).

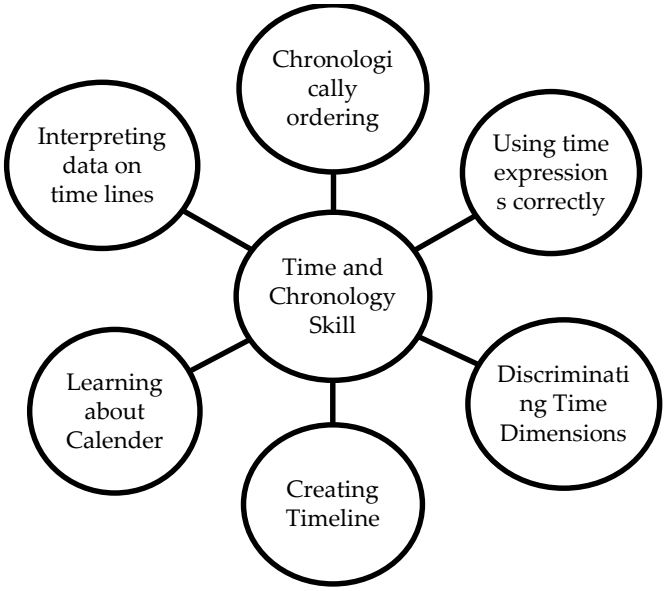

Figure 1. Sub-skills of Time and Chronology Perception Skill

Figure 1 demonstrates the sub-skills relating to Time and Chronology. For instance, the skill of Learning About Calendars encompasses the sub-skills, "performs operations related to calendar information," and "measures and calculates calendar times." Furthermore, under the skill of Discriminating Time, the sub-skills "the student can discriminate between past, future and present" and "the student can establish the effects and connections between the events happening in the present" are delineated. In terms of the Using Time Expressions Correctly skill, the sub-skills "students can use time concepts like calendar, period, milestone, time, chronology, past, future and century correctly" are indicated. On the other hand, the skill of Chronologically Ordering includes the sub-skills "students can evaluate historical events in a meaningful way and order events according to before-after and closeness- distance relationships." On the other hand, the skill of Creating Timelines and Interpreting Data on a Timeline" entails that students can indicate and interpret the events and facts on a specific timeline. Namely, with the help of timelines, students can view the events in a tangible way and picture them in their minds, rather than memorizing dates and events in history (Demircioğlu, 2014; Kaymakcı and Altun, 2016).

Apart from the many other characteristics it addresses, the field of social sciences also emphasizes the skill of developing responsibility. The approach to this issue has undergone many important changes over time. One of the most significant of these was the shift to a constructivist approach in 2005, wherein the teacher is no longer considered as an information giver, but as a guide. At the same time, the student's role also changes to one of learning by doing and living, rather than passively absorbing information. The aim of the constructivist approach is to ensure that the individual internalizes and retains what he/she has learnt. Within this change of direction in the instructional process, several different approaches are followed to make

students more active participants; in this regard, teachers have important responsibilities. Çiftçili (2009) during this process, the learning environment should be organized in such a way that students are encouraged to express their thoughts and ideas. Furthermore, in social sciences lessons, which relate to life itself, learning becomes more permanent when the targeted skills are made relevant to students' personal lives. Altunçekiç and Bozdoğan, 2007; Aksoy and Gürbüz (2013) in accordance with the constructivist approach, while education editing the learning environment utilizable 5E lesson plain. At 5E lesson plain, the student is active at every stage in learning process. İn addition they, students, benefit from previous information, Thus learns more meaningful and lasting they.

When teaching the social sciences, teachers are expected to use new methods and techniques, as opposed to traditional approaches, in order to provide a fun and engaging learning environment (Kan, 2006). One approach to making a lesson less boring for learners is to ensure that they see a connection between the topic and their own lives. For this purpose, lessons should be supported by appropriate teaching materials and equipment to make learning more effective (Yiğit, 2013).

As with other subject areas, the educational tools used in social sciences learning stimulate learners in more than one of their senses making the learning process more appealing help (Aydemir, 2012). Such tools are employed with the aim of revealing students' prior knowledge, as well as allowing them to learn complicated and abstract concepts by simplifying them and making them concrete. By using appropriate teaching materials, teachers draw their students' attention, enrich the education environment, and make new knowledge more permanent by associating the topics and concepts with their daily lives. (Çelikkaya, 2013).

One type of educational material that is effective in supporting retention is models, which simulate the processes, facts or events they represent in a simplified manner (Arslan, 2013; Güneş and Gülçiçek, 2004). As Harrison and Treagust (2000) point out, models and modelling have an important place in the constructivist approach to learning, as they ensure that events and procedures can be learnt easily, as well as simplifying complicated topics and processes. The formation of these learning agents is referred to as modelling. In this sense Koçak (2006) defined modelling as the process of making the unknown understandable and the model as the product that comes about as a result of this process.

A review of the literature on modelling produces ten different model types:

- Pedagogic and analogical models,
- Scale models,
- Mathematical models,
- Theoretical models,
- Maps,
- Diagrams and tables,
- Concept-process models,
- Simulations,
- Cognitive models,
- Figurative and symbolic models and
- Synthesis based models.

Moreover, there are five different modelling cycles; i.e., Clement (1989), Hestenes (2002), Justi and Gilbert (2002), Halloun (2004), and Nunez-Oviedo (2004). However, in examining the literature on modelling

and the usage of models, it can be observed that most of the research in this area has been carried out in the context of science and mathematics. Studies showing the effect of modeling on student success studies (Bilgin ve Geban, 2001; Coll ve Treagust, 2003; Ünal, 2005; Ünal Çoban, 2009; Sağlam Arslan ve İyibil, 2010; Harman, 2012; Çökelez, 2015; Bebek, 2016; Ayvacı, Bebek vd., 2016), studies aimed at determining the mental development of students with mental modeling (Nunez Ovideo, 2004; Sözcü, 2015) and the studies done with modeling are descript and content analysis studies are available. On the other hand, in the field of social sciences, the only study found was performed by Sözcü (2015). The aim of this study was to determine the change in mental models of students' scientific value, which in the 2014-2015 academic year, 311 7th grade students were employed. In this study, the data collection tool was used twice before teaching and after teaching the value. Draws pictures or cartoons about scientific value and metaphor they produce. As a result of the research; it was observed that the students' non-scientific mental models fell.

As such, it can be seen that modelling, although actively used in other fields, is not given the necessary importance in the social sciences. Whereas, thanks to modellig student will be able to learn by embodying abstract concepts and associating them with own life. The more the student information becomes concretized, the more permanent it is. The modeling process provides students with the opportunity to reveal what is in their mind, thus revealing incorrect or incomplete information in the student's mind. Another contribution of this process to the student is that it makes the student very effective and active both mentally and physically during the course process, and this feature also coincides with the constructivist approach. Constructivist approach to teaching and modeling appropriate teaching technique an effective way with the acquisition of these skills will be used in will benefit. The teaching made using models will help the student to make sense of abstract and complex events and processes. In this way, the student will take a more active role in the process and will have the opportunity to practice own life.

What makes this work important is the use of modeling technique for effective teaching of time and chronology skills. On account to time and chronology skills are abstract, it is difficult to learn. However abstract issues will become concrete thanks to modeling. The student will be active in the course and will have the opportunity to learn by living. When the literature is reviewed, the use of the modeling process in the field of social studies is not common. Thanks to this study, space in the field will be filled and will lead to other studies. In another respect, this study provides a different technique for teachers in skills acquisition. In this way, teachers can use teaching methods effectively

With this in mind, the current study, which aims to determine the role of modelling in teaching the skill of Time and Chronology, is believed to greatly contribute to the literature.

The aim of this study is to determine the role of a modelling technique in teaching the skill of Time and Chronology.

Within this framework, the study aimed to answer the following questions:

1. Is there a significant difference between experimental and control group students in terms of pre-test post-test scores?

2. Is there a significant difference between the pre-test and post-test results of the experimental and control groups?

Method

In order to determine the role of modelling in teaching the skill of Time and Chronology according to the aim of this study, a quantitative approach was adopted through use of a quasi-experimental method. Given the aim of quantitative studies in terms of explaining and revealing the relationships of prediction, generalization and causality (Yıldırım and Şimşek, 2016), one of the quasi-experimental models, the pre-test,

post-test non-equal control group model, is considered as the most appropriate framework for educational studies in which there are difficulties in the objective selection of the participants. According to this model, students are first subjected to a pre-test, then the experiment is performed on one of the groups. At the end of the experiment, both groups are subjected to a post-test (Tanrıöğen, 2009).

Study Group

The study group consisted of both an experimental and a control group who were each subjected to a pre-test and a post-test. In order to accelerate the study in terms of timing, appropriate situation sampling was applied, wherein the researcher chooses an easy and available situation in order to expedite a study (Karasar, 2016).

To determine the sample group and carry out the study in the desired manner, the researcher conducted pre-interviews about the experiment with the principals of elementary schools in the Trabzon city centre, as well as social sciences teachers working in those schools. Both the principals and the teachers were informed about the aim and framework of the study. Following this process, the researcher determined the school to be used in the pilot phase, as well as the school to be included in the actual experiment. The pilot phase 2017-2018 study fall semester and actual experiment 2017- 2018 in the spring semester done.

The resulting study group consisted of 62 7th grade students; 31 in the experimental group and 31 of them in the control group. During the preparation of the achievement test, pre-pilot and pilot tests were administered to ensure the validity and reliability of the instrument at the highest level. The pre-pilot test was conducted with 26 individuals, and the pilot test was conducted with 18. Finally, 62 students participated in the actual experiment.

Data Collection Instruments

First, the researcher examined the literature on modelling and found that it is not commonly used in social sciences education, and therefore, the research in this area is limited. For this reason, the researcher believed that an investigation of the effects of modelling on the acquisition of social sciences objectives was needed. Second, the class level and topic on which the experiment would be performed was determined. In this respect, the objective of Time and Chronology was targeted in accordance with the experiences of previous studies. For this reason, the 7th grade class level was selected for the purpose of the investigation, with a focus on the unit "Science through History". This unit was selected due to the timing and because it was appropriate for teaching the skill of Time and Chronology. Third, suitable data collection instruments and teaching materials were developed in order to apply the modelling technique.

In this study, which examined the effects of modelling on teaching the skill of "Time and Chronology" in the unit "Science through Time," a series of 5E lesson plans that were conducive to modelling were prepared, and relevant teaching materials were developed in accordance with the aims determined for each teaching phase. In preparing the lesson plans and teaching materials (consisting of worksheets, concept maps, concept caricatures, conceptual change texts, visuals, maps, semantic analysis tables, etc.), the researcher was assisted by modelling experts at the university, as well as a social sciences expert. In order to determine the appropriateness of the materials to the students' ability level, social sciences teachers were consulted throughout the process, along with teacher guide books.

The data collection instruments and teaching materials were presented to social sciences teachers and academics for pre-assessment. A pilot test was then performed after making improvements on the basis of the data gathered in the pre-assessment. Before the pilot test phase, the course instructor was informed about the activities and the procedure. Within the 12 lesson hours reserved for the unit (over a 4-week period), the social sciences teacher carried out the lesson plan prepared by the researcher, who conducted in-class observations.

An observation form was completed, and the issues were noted. Afterward, once the lesson plans and activities were revised after the pilot test phase, the actual experiment was initiated. Prior to beginning the experiment, the social sciences teacher who would conduct the procedure was informed about the process in detail. Before the experimental phase was carried out over a 4-week period (12 lesson hours), both the experimental and the control group were subjected to an achievement test. The lesson phase was carried out following the pre-test. The social sciences teacher who conducted the experiment applied the modelling lesson plan and activities for the experimental group while conducting the lessons according to the current curriculum for the control group. During the experimental phase, the experimental and control groups were observed and recorded by the researcher over the 4-week period. At the end of this process, both the experimental and control groups were subjected to an achievement test and data was gathered.

Prior to preparing the achievement test, information about the skills covered in the 7th grade unit "Science Through History" and the skill of understanding Time and Chronology skill was mastered. Before the test was prepared, headings were presented, and the duration reserved for the skills and how they were presented in the student and teacher books were determined. In order to prepare the test, the researcher solicited the opinions of social sciences teachers and reviewed the existing studies that had applied achievement tests (Baştemur Kaya, 2013; Kısa, 2007; Taşkın, 2017; Yıldız, 2011; Yılmaz, 2013; Kofoğlu, 2013). The test was prepared accordingly, and after developing the test items, the researcher requested the opinions of expert faculty on their suitability. In line with their recommendations, the number of questions was increased, and the test was then presented to the social sciences teachers for their assessment of its appropriateness for 7th grade students. In the first phase, there were 33 questions included on the achievement test. However, after the pilot application, two of the questions that were determined to be indistinct were removed, and the others were revised. For the pilot study, 31 questions were used; and afterward, the number of items was determined as 30.

In order to determine the reliability and validity of the test, a pre-pilot test was implemented with a group of 26 7th grade students to evaluate the items. Following this evaluation, some of the questions were revised, and some were removed. After the revisions, a pilot test was conducted with another group of 18 people, and each question was re-evaluated. Moreover, the items that presented problems in the item difficulty and distinctiveness indexes were revised, and test items were again applied.

After the item analysis and distinctiveness indexes were calculated, the answer sheets were examined by the researcher, and the incorrect items and those that were left blank were graded as 0 points, while correct answers were graded as 1 point. The students' raw scores were then calculated and ordered from the top score to the lowest. After the pre-pilot test, the lowest 27% and highest 27% scoring students were placed into a lower and a top group respectively (7 students in each). After the pilot test, the lowest and highest 27% were again determined, with 5 in the lower and 5 in the top group.

Table 1. Item Analysis Chart of the Pilot Study Achievement Test According to Number of Students in the Lower and Top Groups

Question Number.	Du*	Da*	p*	d*
1	4	2	0,6	0,4
2	5	3	0,8	0,4
3	4	2	0,6	0,4
4	5	3	0,7	0,4
5	5	3	0,8	0,4
6	3	1	0,4	0,4
7	4	3	0,7	0,2
8	5	2	0,7	0,6

9	5	1	0,6	0,8
10	3	1	0,4	0,4
11	3	1	0,6	0,6
12	3	0	0,3	0,6
13	5	2	0,7	0,6
14	5	2	0,7	0,6
15**				
16	5	2	0,7	0,6
17	5	2	0,7	0,6
18	5	0	0,5	1
19	5	1	0,6	0,8
20	4	1	0,5	0,6
21	3	0	0,3	0,6
22	3	1	0,4	0,4
23	5	0	0,5	1
24	4	1	0,5	0,6
25	4	1	0,5	0,6
26	3	0	0,3	0,6
27	4	2	0,6	0,4
28**				
29**				
30	3	1	0,4	0,4
31	3	0	0,3	0,6

When Table 1 is examined, it can be seen that the distinctiveness index of the 27 items in the test was 0,40 and higher, and 1 item was valued at 0,20-29. After 2 items were removed and the other items were revised in the pre-pilot phase, in order to ensure that the test was valid and reliable, the 7 items of which the distinctiveness index was 0,20-29 were selected to be removed from the test that was then applied during the pilot phase. In general, when item distinctiveness analyses are examined, items of 0.30 and higher are more distinctive, while values between 0.20 and 0.30 need to be improved, even though they can be used in the test. Items for which the value is lower than 0.20 should not be placed in the test, since their distinctiveness is low (Büyüköztürk, 2017). The item distinctiveness being high also increases the validity level of the test (Çepni and Akbulut, 2013).

Table 2. Science through Time Academic Achievement Test Statistical Table

Number of Questions	30
Cronbach alpha	0,733
Spearman-Brown	0, 888
KR- 20	0,863

When Table 2 is examined, it can be seen that there are items ranked as easy, medium and difficult. The Cronbach Alpha reliability co-efficient of the Science Through Time achievement test was found to be 0,733, and the Spearman-Brown (split-half test reliability) reliability was 0,888. This shows that the final instrument was highly reliable.

The extent to which a test evaluates the desired features is as important as its reliability. In this sense, content validity is an indicator of whether the test items evaluate the desired behaviours (Büyüköztürk, 2017). In order to test the content validity, expert opinions were solicited via interviews.

Analysis of the data

In this study, 62 students, 31 in the experimental and 31 in the control group, were subjected to a pre-test and a post-test. The resulting data were analysed via SPSS 20. First, in order to decide on the test to be carried out in SPSS, a normality test was performed, as reported in Table 2.

Table 3. Normality Test Analysis of Experimental and Control Groups

Kolmogorov-Smirnov					**Shapiro-Wilk**		
Group		**Statistic**	**df**	**p**	**Statistic**	**df**	**p**
Experiment	**Pre-test**	,104	31	,200	,976	31	,688
	Post-test	,122			,969		,054
Control	**Pre-test**	,086			,933		487
	Post-test	,110			,965		402

When Table 3 is examined, it can be seen that the test results indicate a normal distribution, as the Kolmogorov-Smirnov and Shapiro-Wilk test values are p>0.05. Therefore, in order to compare the achievement scores of experimental and control groups, one of the parametric tests, the unpaired t-test, was employed.

Findings

Table 4. Findings on the Comparison of the Pre-Test Achievement Scores of Experimental and Control Group Students

Test	**Groups**	**n**	**$\bar{X}$**	**sd**	**df**	**Sig**	**t**	**p**
Pre-test	Experiment	31	43,84	15,887	60	,690	-181	,242
	Control	31	48,45	14,848				

When Table 4 is examined, it can be observed that there is no significant difference at between the experimental and control group students' pre-test achievement score average [t(60)=-0,181, p>.05]. This finding can be interpreted as that experimental and control group students are equal to each other and there is no significant difference that can hinder the study to be conducted. Table 4 indicates whether there is a significant difference between students' pre-test and post-test scores after the experiment.

Table 5. Control Group Pre-Test Post Test Scores

Test	**n**	**$\bar{X}$**	**sd**
Pre-test	31	48,45	14,848
Post-test	31	52,42	14.703

When Table 5 is examined, it can be observed that their pre-test and post-test results of the control group. While the pre-test results were 48.45, the final test results 52.42.

Table 6. Experimental Group Pre-Test Post Test Scores

Test	**n**	**$\bar{X}$**	**sd**
Pre-test	31	43,84	15,887
Post-test	31	74,23	16.697

When Table 6 is examined, it can be observed that their pre-test and post-test results of the experimental group. While the pre-test results were 43,84 the final test results 74,23.

Table 7. Experimental and Control Group Pre-Test Post Test Scores

Group	**n**	**Test**	**$\bar{X}$**	**sd**
Experiment	31	Pre-test	43,84	15,887
		Post-test	74,23	16.697
Control	31	Pre-test	48,45	14,848
		Post-test	52,42	14.703

As Table 7 illustrates, there was a pre-test and post-test results of the experimental and control group. While the experimental group pre-test results were 43,84 the final test results 74,23. Also while the control group pre-test results were 48, 45 the final test results 52,42.

Table 8. Independent Samples T Test Evaluation of the Experimental and Control Group Pre- Test Scores

Group	n	$\bar{X}$	sd	df	Sig	P
Experiment	31	43,84	15,887	60	,690	-181
Control	31	48,45	14,848		,242	

As Table 8 illustrates, there was a post-test results of the experimental and control group. While the experimental group pre-test results were 43,84 the while the control group pre-test results were 48, 45.

Table 9. Independent Samples T Test Evaluation of the Experimental and Control Group Post Test Scores

Group	n	$\bar{X}$	sd	df	t	P
Experiment	31	74,23	16.697	60	-1,181	0,000
Control	31	52,42	14.703			

As Table 8 illustrates, there was a significant difference between the experimental and control groups in terms of their achievement score averages on the α=.05 level [t(60)=-1,181, p<.05]. The reason for this difference was that the achievement scores of the students in the experimental group (=74.23) was higher than those of the control group.

Conclusion, Discussion and Recommendations

When the effects of modelling on teaching the skill of Time and Chronology were examined, it was concluded that, according to the pre-test that was performed before the experiment, there was no significant difference between the achievement levels of the experimental and the control group students.

Control and test group pre-test Independent t test results observed that there is no significant difference at between the experimental and control group students' pre-test achievement score average [t(60)=-0,181, p>.05]. The achievement test results were determined by examining whether there was a statistically significant difference in terms of the experimental and control groups. While the experimental group pre-test results were 43,84 the final test results 74,23, also the control group pre-test results were 48, 45 the final test results 52,42.

When the data were analysed at the end of the teaching process, the t-test results were observed in order to determine if there was statistically significant difference; a significant difference was found in favour of the experimental group. There was a significant difference between the experimental and control groups in terms of their achievement score averages on the α=.05 level [t(60)=-1,181, p<.05]. The reason for this difference was that the achievement scores of the students in the experimental group (=74.23) was higher than those of the control group.

This suggests that modelling-based teaching leads to greater student success than teacher-centred instruction. When the post-test results of the experimental and control group students were compared, it was revealed that the test scores of the students whose lessons were conducted through modelling were improved to a greater extent. When the post-test scores were examined, it came to light that the students in the experimental group mastered the topics in the unit "Science Through Time more effectively. In addition, they comprehended the skills regarding the Time and Chronology topic to a greater degree. When the post-test

scores of the control group students were examined, it was noted that they had improved in comparison to the pre-test scores, but this improvement was limited. When the control group students' post-test results were examined, it was likewise revealed that they had not fully mastered the topics in the "Science Through Time" unit and the skills of Time and Chronology.

These results align with numerous studies in the literature that suggest modelling-based education is more effective than traditional teaching. Example Malone (2006), Mansyur and Darsikin (2016) revealed in physics class with modeling teaching more effective according to traditional teaching. Similarly studyed performed by Wang and Barrow (2011), which characteristics and levels of sophistication: An analysis of chemistry students' ability to think with mental models, they demonstrated the ability of mental modeling. Also some studies mathematics and science showed the effect of modeling on success, Ünal Çoban (2009), Türker (2011) and Zorlu (2016) observed that modeling is more effective. Sözcü (2015) worked in social studies and he aim determine students' scientific value mental change of models. At study differently he used metaphors. As a results unscientific mental models seriously fall.

In this sense, modelling-based education, which is held to be appropriate for the constructivist approach, is student-centred and provides an active and creative learning opportunity. Differing from traditional approaches in that it puts the student at the centre of the process, the important aspect of a constructivist approach is that the individual is the one who creates the information, rather than receiving it passively. With the help of models, students can reflect their inner thoughts, knowledge and dreams to the outer world. Thus, it has been observed that modelling, which is defined by students as being creative, and embodying and reinforcing knowledge, has a great impact on successful learning. On the contrary, traditional approaches such as memorizing information may be viewed as meaningless, because a student should internalize, interpret and establish cause and effect relationships with other information, rather than simply memorizing facts (Bahçeci and Bilgin, 2017).

As in the teaching process with modeling, the student should be activated and the student should gain knowledge and skills through the activities. Social studies has a complex and abstract information system, this is far from permanent learning. When we look at the data obtained, it is observed that learning through the Model process saves the student from overwhelming knowledge and makes the information more permanent. According to the findings, the following suggestions can be made:

- The teacher should regularly prepare a lesson plan prior to conducting a lesson. In this manner, information loss can be prevented, and lesson process can be experienced as more organized.
- Students', pre-service teachers', teachers' and academicians' views on models and modelling can be revealed.
- This study was conducted with 7th grade students only. Differences between students of other grade levels may be observed through future studies.
- This study was mainly performed according to cognitive models. Additional studies using other model types may provide additional contributions to the literature.

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