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## IMPLEMENTATION OF 3D DESIGN-SUPPORTED ACTIVITIES IN SOCIAL STUDIES TEACHING

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### Abstract

It is known that during the teaching of social studies course, students' reading the relevant pages of the textbook at home before coming to class and teachers' lecturing on the topic during the lesson is not enough to achieve a good level of learning and reduces students' interest in and desire for the course. Reflecting on this situation, this study was planned to handle the subjects of history and geography, which contain a lot of abstract concepts and have intense content, in the social studies course. During the teaching of these subjects, the effect of 3D design-supported activities on the lesson and students was determined by taking the opinions of students and teachers. 12 Secondary school students and 2 teachers participated in the research. In the study, it was concluded that the 3D design-supported activities contributed to students, e.g. they were more interested in the lesson, they learned with fun, and the activities helped to reinforce the information they learned and to embody the past. In addition to these results, the theoretical knowledge gained during the course turned into 3D design objects. This encouraged students to use their creativity and imagination. Teachers concluded that 3D activities helped students understand and become interested in social studies topics, and improve their digital literacy. However, it was observed that some students had problems with technical details, had difficulty understanding how to use the tools and commands, and were distracted.

**Keywords:** Social Studies; three-dimensional design (3D); history topics; geography topics; science and art center

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## **1. Introduction**

Human needs, which change over time, have brought along some necessary innovations and arrangements in almost every field. The effects of these innovations and changes can be seen in areas, such as technology, science, art, education, and health. The goal of education is to raise the type of individuals that countries need and have universal values and skills. While teaching processes are planned, an understanding that emphasizes the effective utilization of educational technologies to achieve desired teaching goals has been adopted. Obtaining information and transferring and spreading the obtained information to individuals has been facilitated and accelerated thanks to technology (Gripenberg, 2006). Therefore, information technologies have become an important part of daily life. The use of current technologies by adapting them to education helps increase the level of education. The use of technology in teaching not only allows students to learn more easily, faster, and more effectively and permanently but also enables teachers to enjoy their educational activities (Ozan, 2009). In addition, instructional technology makes a great contribution to the realization of individual learning and to individuals taking responsibility for learning. As in every field, the use of technological tools in social studies course is important. This course blends various social sciences, such as history, geography, economy, and politics. Due to this feature, the content of the course includes too many abstract topics and concepts. Making the teaching of the social studies course, which includes such intense topics and concepts, fun and concrete will be beneficial for students. In particular, this can help students learn subjects such as history and geography more concretely and engagingly.

Technology has become an important tool to increase the quality of teaching-learning activities, raise students' learning motivation and success, and enable teachers to teach their subjects more effectively (Garrison & Vaughan, 2008; Khaddage et al., 2018; Means et al., 2013). However, the presence of teachers who do not have enough knowledge, skills, and experience with the use of technology limits the use of the potential of educational technologies (Ertmer & Ottenbreit-Leftwich, 2010; Kim & Khera, 2016 cited in Ozdamli & Asiksoy, 2016; Law et al., 2008).

The shortcomings of teachers in using technology have been the topic of many studies. In particular, teachers' inability to use technological tools for educational purposes may cause the effect of technology to decrease in education and negatively affect students' learning experiences (Yuan & Kim, 2014). However, the use of technology in lessons such as social studies, where history and geography subjects are covered intensely, can help students better understand and learn the subjects effectively (Wang et al., 2019). Therefore, effective use of technology in social studies lessons can increase students' success (Bruce, 1994).

The main objective of this research was to determine the opinions of students and teachers about the use of 3D design activities in social studies course. Accordingly, the problem of the research was determined as follows:

What are the opinions of teachers and students about activities performed with 3D technology in the teaching of social studies course?

It was aimed to determine the difficulties encountered by students during the application and to get their opinions about the application to solve this basic problem. Another aim was to investigate the observations and opinions of teachers participating in the research on 3D applications.

This research is significant as it is an example of the use of technology-based 3D design, which is not very common in social studies teaching in Turkey. It is also very important that such activities, which are applied mainly in the teaching of science and engineering fields, have been used in the teaching of social sciences topics such as history and geography. This research can offer ideas for teachers to use 3D design activities frequently in social studies course or to improve such activities.

### *1.1. 3D Design and educational use*

Since the social studies course includes the concrete and abstract concepts of social sciences, teachers need technological tools and material to make the course fun and comprehensive. In parallel with the developments in digital technologies, technological tools, such as computers, video cameras, cameras, scanners, voice recorders, projectors, smart boards, flash disks, mobile phones, and 3D printers, which can address different sensory organs simultaneously, have been preferred to be used in teaching and learning since the 2000s.

3D software and printers, which are seen as the production technology of the future, have started to be used and become widespread in many areas in recent years. While there are new developments about 3D printers every day, there are limited studies on how this technology can be used in education. Recent advances in 3D printing technology have produced low-cost systems that can convert 3D and digital elevation models into physical models. 3D software and printers can help create new material and tools to be used in the teaching of geography and history topics in social studies course, which will have an important place in increasing students' interest in the course. 3D design software has become available for higher education and secondary and primary school students (Eisenberg, 2013). Various 3D software-related studies and projects have been carried out in different fields, such as engineering education, science education, robotics education, special education, anatomy education, medical education, earth science education, design education, STEM education, geography education, and social studies education.

Micallef (2015) stated that as a part of the learning process, 3D drawing and printing could help embody abstract concepts by transforming them into physical objects in the classroom, which would create a significant impact in educational environments. Peels (2017) stated that 3D design software was generally used in education to make STEM activities fun and to attract more attention to lessons by embodying abstract concepts. Studies on 3D design and its educational use in social studies education have increased in recent years with the spread of 3D software and printers in many areas (Maloy, Kommers, Malinowski & LaRoche, 2017; Ningsih, Riyanto & Suyanto, 2019; Shibata, Ishihara, Sato & Ikejiri, 2017).

## **2. Method**

### *2.1. The model of the study*

This study was carried out to determine the opinions of students and teachers about the use of technology-supported 3D applications in the teaching of social studies course. This is a survey model study as it observes the experiences of students in the teaching process 3D applications were observed in the teaching process and the situation was reflected as it was. A case study design, one of the qualitative research methods, was used in the study. A case study is a methodological approach that involves an in-depth examination of a limited system using multiple data about how it operates and works (Chmiliar, 2010). According to Creswell (2007), a case study is a qualitative research approach in which the researcher examines one or more limited cases over time using data collection tools (observations, interviews, audio-visuals, documents, or reports) that includes multiple sources, and events and themes depending on these events are defined.

### *2.2. Study group*

Niksar science and art center students and teachers participated in this research. The study group consists of 12 students from the 5th, 6th and 7th grades, 1 teacher who is an expert in the field of design-based education, and 1 social studies teacher. The information of the study group is as follows: 1 female and 3 male from the 5th grade, 3 female and 1 male from the 6th grade, 3 female and 1 male from the 7th grade. All of the teachers are male and have more than 15 years of professional experience. Students and teachers participated in the study on a voluntary basis.

### *2.3. Data collection tools*

A semi-structured interview form was used to determine the opinions of students and teachers about the technology-based, 3D-applied social studies activities. It consists of preparing an interview form that includes questions that researchers plan to ask (Smith, 2003). Semi-structured interviews allow the researcher to ask sub-questions and get in-depth information according to the flow of the conversation (Yalçiner, 2006). Separate interview

forms were prepared for students and teachers by a history instructor (academic), who was an expert in the field, and a social studies teacher. These research questions were created to determine whether the 3D design activities performed in social studies course attracted students' attention, whether students had difficulty doing these activities, and whether the 3D design-supported activities had an effect on the teaching of social studies topics. There were three separately for students and teachers on the semi-structured interview forms. Data collection process

The application included the units of the social studies course on history and geography, which consisted of abstract and complex subjects and which students had difficulty understanding. The activities that were designed in the study, the units that the activities were based on, and levels were as follows: "Introduction to Civilizations" activity in the 5th-grade Culture and Heritage unit, the "Kırkkızlar Cupola" activity in the 6th-grade Culture and Heritage unit, and the "We Are Demolishing the Walls" activity in the 7th-grade Culture and Heritage unit. Also, the "Geographical Regions of Turkey" and the "Layers of the Earth" activities from the 7th grade were designed as geography topics. These applied activities were carried out on the Fusion 360 software. This software is used for 3D modeling and students can use and learn it easily. Before the activities were initiated, the Fusion 360 software was introduced to students and the basic 3D design drawing tools and commands were taught (for three class hours). After all students learned how to use the software, it was put into practice. In history activities, students designed the tools and historical artifacts of past civilizations in accordance with the units. They also made 3D designs of geographical regions and layers of the Earth in geography activities (for six class hours). Students created these designs using their own creativity and imagination. Combining the knowledge gained in the course with the 3D design software, students made 3D models. The models were produced using 3D printers and they turned into real objects. The data collection process was followed regularly by the researcher, and any problem was immediately intervened. In this process, all necessary precautions were taken to make the students feel comfortable and give appropriate answers.



Figure 1. 3D digital model of oxcart



Figure 2. 3D digital model of Türkiye



Figure 3. 3D model of designed wind direction indicator



Figure 4. 3D model of designed Cupola

### 2.5 Data analysis

The semi-structured interview form, one of the qualitative data collection tools used in the study, was subjected to content analysis. Content analysis is performed to bring together similar data in the form of concepts and themes and analyze them in a way that the reader can understand (Yıldırım & Şimşek, 2003). For this purpose, the data collected were coded and conceptualized, and then themes were determined according to these concepts.

The first finding of this research was about students’ evaluation of the software used for the creation of 3D design-supported social studies activities. For this purpose, at the end of this six-hour, three-week period, students were asked, “*Have you had any difficulties using the 3D design software in the social studies course? If you have, can you tell us about which phases you have had difficulty with?*” The findings from student answers were as follows:

Table 1: Students' views on the use of the 3D design software

Stages	Experienced difficulty	No difficulty
Introduction to Fusion 360 software	3	-
Learning to use the tools/commands	3	-
All stages	-	6

As seen in Table 1, three students had difficulty understanding the “Introduction to Fusion 360 software” stage and three students had difficulty “learning to use the tools and commands.” It was determined that six of the students did not have any difficulties using the 3D design software at all. Looking at this table, it can be said that most of the students participating in the research were able to use the 3D design software without any difficulty. Some of the answers given by the students were as follows:

“I had a hard time learning at first, but then I learned it very easily.” (S5)

“I had some difficulty learning new tools and commands.” (S7)

“I have never had any difficulties.” (S6)

As seen in Table 1 and from student answers, some students had difficulty understanding the basics of the software at first but it was learned easily afterward. This indicated the complexity of the first applications. This difficulty disappeared as students started learning to use the software. This reflects the difficulties associated with the language and symbolic processing load in the learning process of the software. In light of these findings, it is thought that the difficulties encountered in the learning process were related to factors such as cognitive load and the complexity of the application.

The second finding of the study included the opinions of the students about the 3D design-supported social studies activity. All students were asked two questions to obtain this basic finding. The first of these questions was “In what way were you affected by doing 3D design activities in social studies class?” The second question was “What do you think about the contribution of the 3D design-supported activity to the teaching of social studies subjects?” The answers given by the students to the first question were tabulated using content analysis as follows:

Table 2: The impact of 3D design activities on students

Theme	Codes	Frequency (f)
Learning	Finding a solution, learning to design	5
Emotions	Having fun, being happy, feeling like an engineer, being an innovator	4
Interest	Interesting	3

As seen in Table 2, the 3D design applications of the students in the social studies course affected them in terms of learning, emotions, and interests. Five of the students stated that these design activities had the most impact on their learning. Four of the students were affected emotionally and three found the activities interesting. Some of the answers given by the students to this question were as follows:

“It was interesting and fun. We made, for example, a wheel, oxcart, and cupola.” (S1)

“I felt happy and like an innovator and engineer because I always love such things.” (S8)

“It was interesting and fun. It was nice to make things like an oxcart, wheel, and cupola. We produced solutions and learned to design.” (S11)

These findings showed that the 3D design activities in the social studies course had a positive effect on participants. Students stated that they enjoyed designing objects such as

wheels and ziggurats and that they felt happy and innovative and like an engineer while doing these activities.

The following question was asked to collect the final data from students: “What do you think of the contribution of 3D design-supported activities to the teaching of social studies subjects?” The content analyses of students’ answers to this question are given in the table below.

Table 3: Contribution of 3D design-supported activities to the teaching of social studies subjects

Theme	Codes	Frequency (f)
Contribution	Contribution to learning, contribution to the World	5
Having fun	Learning with fun	3
Learning	Teaching 3D design	3
Reinforcement	Reinforcing what has been learned during the class	2

Table 3 presents students' answers to the question “What do you think of the contribution of the 3D design-supported activity to the teaching of social studies subjects?” As seen in the table, the themes and frequencies obtained from the codes related to 3D design activities were as follows: "contribution, 5; having fun, 3; learning, 3; reinforcement, 2." Student responses to this question were as follows:

“I think it makes a big contribution. It teaches 3D design. It gives children a chance to contribute to the world.” (S2)

“We both have fun and learn with 3D design.” (S4)

“It contributes a lot. I have reinforced what I learned in social studies classes.” (S12).

It is seen that most of the participants believed that 3D design-supported activities contributed to the teaching of social studies subjects. Some participants stated that they both had fun and learned. These results show that 3D design-supported activities attract children's attention to social studies subjects and make the learning process more fun. In addition, some participants stated that 3D design reinforced what they had learned. These results may give some clues that 3D design-supported activities can be used as an effective tool in the learning process and reinforce what has been learned.

Teachers in the study were first asked, "What are your views on the appropriateness of the study for students’ level?" The answers given by the two teachers who participated in the research as observers in each lesson throughout the process were as follows:

“The study was prepared in accordance with the level of our students. Especially, 3D activities attracted students’ attention and motivated them. However, some of our students had some difficulty understanding the tools.” (T1)



“I think the study was appropriate for students’ level in general. My students showed a great interest in 3D activities and coding and can't wait to apply what they've learned. However, some of them had difficulties at the beginning, so I realized that they needed more guidance.” (T2)

The answers given by the two teachers showed that they thought the study was suitable for students’ level. Students were interested and enthusiastic, and 3D activities motivated them. However, it was stated that some students had difficulty understanding the tools or had problems at the beginning. While teachers’ responses emphasized the suitability of the study for students’ level, they also pointed out that more orientation toward the learning needs of the students was necessary.

The second question asked to the teachers was “What are your views on the contribution of the study to technology-based social studies teaching?”

The answers given by the teachers to the second question were as follows:

“I think the study has a great contribution to technology-based social studies teaching. With the help of technology, our students were able to study important structures, tools, and technologies that were used in history. I think such activities will help our students to better understand social studies subjects.” (T1)

“This study can make a huge contribution to technology-based social studies teaching. Considering especially students' interest in technology, I think our students will be more interested in social studies subjects thanks to these activities. In addition, the digital literacy of our students will increase along with their coding skills.” (T2)

As understood from these two teachers’ answers, it is thought that the study will contribute to technology-based social studies teaching. Teacher 1 emphasized that students could take a closer look at history and examine artifacts and objects thanks to 3D applications. Teacher 2 associated 3D applications with technology literacy and stated that this could make students get interested in the course. The two teachers looked at the situation from different perspectives. 3D activities attract students' attention and make social studies subjects more interesting.

As a final question, the teachers were asked, "What difficulties have your students had during the study?" Teachers’ answers were as follows:

“Some of the students had technical difficulties. In particular, some had problems downloading and installing software on their computers. Therefore, it is important to provide more support for our students on how these technical issues can be resolved.” (T1)

“During the study, some of our students had difficulty coding and needed more guidance. Also, some students were distracted during 3D activities and required more guidance and management. The study should be designed and directed appropriately according to students’ level to minimize these problems.” (T2)

Teachers pointed out technical difficulties encountered in the learning phase of the 3D design software such as coding, drawing, etc. Teacher 1 stated that students had problems with downloading and installing the software.

Teacher 2 stated that some of the students had difficulties coding and needed more guidance. It was also stated that students' attention was distracted and that they needed more guidance. In this case, it can be said that teachers should design activities according to students' level. This can help students focus more on the activity and better understand topics.

### **3. Discussion and Conclusion**

After presenting the results, you are in a position to evaluate and interpret their implications, especially with respect to your original hypotheses. Here you will examine, interpret, and qualify the results and draw inferences and conclusions from them. Emphasize any theoretical or practical consequences of the results. (When the discussion is relatively brief and straightforward, some authors prefer to combine it with the Results section, creating a section called Results and Discussion.)

Open the Discussion section with a clear statement of the support or nonsupport for your original hypotheses, distinguished by primary and secondary hypotheses. If hypotheses were not supported, offer post hoc explanations. Similarities and differences between your results and the work of others should be used to contextualize, confirm, and clarify your conclusions. Do not simply reformulate and repeat points already made; each new statement should contribute to your interpretation and to the reader's understanding of the problem.

Your interpretation of the results should take into account (a) sources of potential bias and other threats to internal validity, (b) the imprecision of measures, (c) the overall number of tests or overlap among tests, (d) the effect sizes observed, and (e) other limitations or weaknesses of the study. If an intervention is involved, discuss whether it was successful and the mechanism by which it was intended to work (causal pathways) and/or alternative mechanisms. Also, discuss barriers to implementing the intervention or manipulation as well as the fidelity with which the intervention or manipulation was implemented in the study, that is, any differences between the manipulation as planned and as implemented.

Acknowledge the limitations of your In this study, the opinions of students and teachers about 3D design applications used in social studies course were obtained. The opinions of the students, who were at the center of the application, and the teachers who observed this application, were examined separately. Before the 3D design-supported application was initiated, it was concluded that some students had difficulty understanding and using this software. They had difficulty understanding the coding, drawing, and some commands on the software. In addition, it was observed that some technical problems were experienced in parallel with these difficulties. Teachers need to have a good plan and strategy to overcome these problems. They should be able to guide students well in such situations.

According to teachers' observations, some students had difficulty doing this application, and they had difficulty understanding and applying it. From this point of view, we see that students and teachers agreed on this issue. This result of our research was similar to that of the study by Maloy (2017). According to Maloy (2017), teachers and students thought that the 3D modeling software was difficult to use. It was understood that 3D design-supported applications affected students in terms of learning, emotions, and attractiveness. Conducting this application taught students how to make designs and find solutions. Also, it was seen that students were affected emotionally as they felt like an engineer and the application made them happy and have fun.

It was concluded that 3D design-supported applications contributed to the teaching of social studies course by allowing students to learn with fun and reinforce what they learned during classes. According to the students, this practice not only helped them learn better but also allowed them to contribute to the world. It was concluded that students learned with fun in social studies course, which is a complex field and often boring. This result of the study is similar to the results of some studies in the literature. The 3D applications used in the social studies course not only made a contribution to students but also made the teaching process of the course more effective, enjoyable, and interesting (Maloy, 2017; Shibata, Ishihara, Sato & Ikejiri, 2017; Ningish, Riyanto & Suyanto, 2019).

According to the teachers who participated in the application as observers, 3D design activities contributed to the teaching of the social studies course. They stated that some students had difficulty doing this activity, but that most of them could do it easily. According to teachers, the software used was suitable for students' level, and these activities helped embody the subjects that were difficult to understand and use technology effectively. They emphasized that it was beneficial for students to create models, especially in the teaching of history subjects. This result of the research is consistent with the result of the study by Karaduman (2017) showing that 3D printers could be easily used as material in the 2017 Social Studies Course Curriculum. Similarly, another research result showed that abstract concepts could be concretized by transforming them into physical objects in the classroom by using 3D drawing and printing as part of the learning process (Micallef, 2015).

Students liked 3D design-supported activities, which were extraordinary applications in the social studies course. Considering their positive contributions to both students and the course, that is, to the teaching process, it can be expected that students may want to use such applications, especially in the teaching of subjects such as history and geography.

## Declaration of Conflicting Interests and Ethics

The authors of this article declare no conflict of interest of interest and considered all the ethical issues.

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