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Physics Teachers' Opinions on Algodoo Training

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ABSTRACT The purpose of this research is to reveal the feelings and thoughts of physics teachers towards Algodoo training within the scope of the 4005 TUBITAK project named Innovative and Technology Supported Applications in Physics Education. This study was carried out with phenomenological research within the context of the qualitative research approach. The study group of the research consisted of 22 physics teachers trained in the 4005 TUBITAK project and volunteered to participate in the research. Data were obtained from semi-structured interviews. The data were carried out following the descriptive analysis method with the help of the NVivo 9 program. As a result of descriptive analysis, four categories emerged. These are the installation and application of the Algodoo program, physics teaching activities, and apps similar to Algodoo and Algodoo training. Based on the findings obtained from the research, it was concluded that most of the teachers were very interested in using Algodoo in their lessons, could benefit from Algodoo in their lessons, and could prepare simple physics simulations. Based on the results, Suggestions such as disseminating Algodoo training with in-service training for teaching physics subjects with interactive applications were presented to those interested in the subject.

Keywords Algodoo training, physics teachers, teachers' opinions

1. INTRODUCTION

The technological and physical infrastructure of schools is developing daily with devices such as interactive smart boards and tablets in schools today. Thanks to the effective and widespread use of technology, the improvement of teaching are ensured. With the development of technology, it is possible to comprehend difficult subjects to learn more easily thanks to the programs prepared with computer and mobile support. Especially simulation programs are of great importance in physics courses. The volume of simulation applications used in learning abstract subjects within the context of physics courses is increasing daily. When the literature is examined, it is possible to come across many studies on teaching physics subjects with simulation. For example, electromagnetism (Batuyong & Antonio, 2018), Archimedes principle (Çelik, Sarı & Harwanto, 2015), kinetic friction coefficient (Çoramık & Ürek, 2021), velocity and acceleration (Kabigting, 2021), atom and molecule (Moore, Chamberlain, Parson & Perkins, 2014), optics (Özdemir & Çoramık, 2021), physics laboratory (Taibu, Matara & Shekoyan, 2021) and electrodynamics (Yunzal & Casinillo, 2020) conducted simulation-supported instruction. From the results of these studies, it is seen that simulation-assisted physics teaching has a positive effect on students' learning of physics concepts.

As a result of the research carried out in the literature, the Algodoo program, which includes simulation applications of physics subjects, attracts particular attention. Algodoo is a digital virtual environment with 2D simulations developed for physics topics. It allows students and teachers to easily create simulated "scenes" and explore physics through a user-friendly and visually appealing interface (Euler & Gregorcic, 2019; Gregorcic & Bodin, 2017). Algodoo is an app where students can move freely to learn physics subjects and concepts (Euler, Prytz & Gregorcic, 2020). The Algodoo program can be easily accessed free of charge with a web browser (URL-1, 2021). It is possible to install this program on computers and smart boards. Thanks to the Algodoo simulation program, it is possible to implement experiments and activities belonging to the physics course, which are difficult to implement in the laboratory environment without the need for internet access. Algodoo can be used on Newtonian

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mechanics, simple machines, density, optics, and many other subjects (Özdemir & Çoramık, 2021).

For the last two years, due to the global epidemic Covid-19, it has been ensured that instead of face-to-face courses are conducted with online education. In online education, applications that can attract students' attention to the lesson have started to be used by teachers. Teachers must use the abstract topics and concepts in the physics course in online courses through simulation software. Algodoo simulation program is one of the software that can overcome this deficiency. Physics teachers' mastery of the Algodoo program is important in facilitating the explanation and evaluation processes of some physics subjects and concepts in face-to-face and online lessons. With this research in which the experiences of the participating physics teachers about the Algodoo simulation program in the 4005 TUBİTAK (The Scientific and Technological Research Council of Türkiye) project named "Innovative and Technology Supported Applications in Physics Education" are shared; It will be clarified how physics teachers use the Algodoo program, where there are difficulties in using the program, what should be considered when using the program, and the place of the program in physics teaching.

1.1. Purpose of the Research

This research aims to reveal the physics teachers' opinions on Algodoo training presented in the 4005 TUBITAK project named "Innovative and Technology Supported Applications in Physics Education". For this purpose, it sought to answer the following questions:

1. What are the opinions of physics teachers about the installation and implementation of the Algodoo program?
2. What are the physics teachers' opinions on the physics teaching activities of the Algodoo program?
3. What are the physics teachers' opinions on applications similar to the Algodoo program?
4. What are the opinions of physics teachers about Algodoo training presented to them within the scope of the research?

2. METHOD

2.1. Research Method

This research was carried out with the phenomenology method, one of the qualitative research approaches. In the phenomenology design, it is tried to determine the perspectives of individuals about a phenomenon and the meanings they attribute to these phenomena. The study's primary source is the individuals who have experienced and reflected on the phenomenon under study (Creswell, 2013). In this context, since high school physics teachers are seen as individuals who share the Algodoo application and reflect it in their lessons, the pattern of this study has been determined as phenomenology.

2.2. Participants of the Research

The research participants consisted of 22 physics teachers trained within the context of the 4005 TUBITAK project named "Innovative and Technology Supported Applications in Physics Education" and volunteered to participate in the research. Demographic information of physics teachers who received Algodoo training in the related 4005 TUBITAK project and participated in this study is given in Table 1

Table 1 Demographic characteristics of the participants

	n (%)
Sex	
Female	14 (63.6)
Male	8 (36.4)
Experience (y)	
0-5	- (0)
6-10	3 (13.6)
11-15	4 (18.2)
16-20	3 (13.6)
> 20	12 (54.5)
Level of Education	
Bachelor's	8 (36.4)
Master's	8 (36.4)
Doctoral	6 (27.3)
Working school	
Science and Art Center	12 (54.5)
Science High School	6 (27.3)
Anatolian High School	3 (13.6)
Private high school	1 (4.5)
Previously received Algodoo training	
No	15 (68.2)
Yes	7 (31.8)

2.3. Data Collection Tool

The researchers created a semi-structured interview form to reveal the thoughts of the physics teachers participating in the study about the Algodoo program. In the preparation of the interview form, the opinions of two lecturers who are experts in physics education and three physics teachers were taken. In line with the feedback, the 10-item interview form was finalized (Annex-1).

2.4. Implementation Process

In the project named "Innovative and Technology Supported Applications in Physics Education" with the code 4005 TÜBİTAK 121B338, 30 physics teachers working in different school types were trained by researchers on the use of Algodoo. Algodoo training took a total of 8 lesson hours over two days. In training, the installation of the Algodoo program on computers, the program's interface, and menu bars are explained first. Later, activities were carried out on simple machines used in physics teaching, density in liquids, separation of white light into colors, and uniform circular motion with Algodoo. Participating teachers were provided with these activities. In addition, free practices were provided for a total of two lesson hours, one lesson hour individually and one lesson hour with the group. In each activity, instant

feedback was given to the teachers. At the end of the activities, the opinions of 22 volunteer teachers about the Algodoo training process were taken. Semi-structured interviews with each teacher lasted an average of 25-35 minutes. The implementation schedule during the training is presented in Table 2.

Table 2 Algodoo training calendar

Education	Duration (min)	Apps
First day		
1	40	Algodoo program introduction and use of menu bars
2	40	Drawing simple shapes with Algodoo
3	40	Forming the shapes of simple machines and understanding the working principles
4	40	Doing activities on density in liquids
Second day		
5	40	Making the activity of separating white light into colors with a light prism
6	40	Performing uniform circular motion activity
7	40	Doing self-study (under the guidance of researchers)
8	40	Working with the group (under the guidance of researchers)

Below are some images from the implementation phase (photos 1-4). These photographs show some of the applications during the Algodoo training conducted by the researchers.

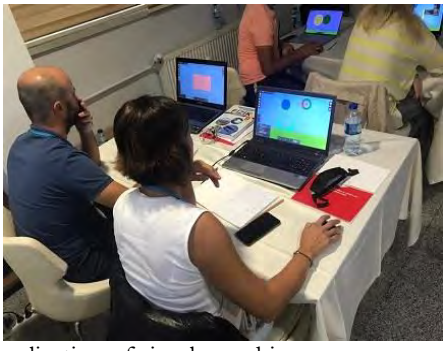

Photo 1 Application of simple machines

Photo 2 Application of shape drawing

Photo 3 Application of density in liquids

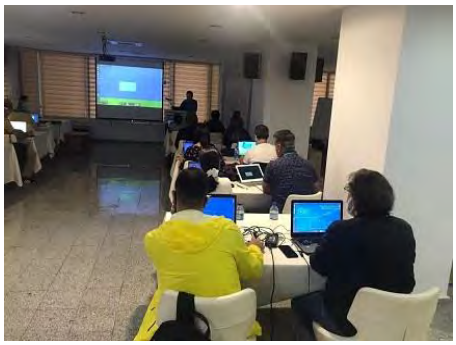

Photo 4 Application of light prism

2.5. Data analysis

NVivo 9.0 program was used for data analysis in the research. The "descriptive analysis" method was used to analyze the data. In the descriptive analysis method, categories are determined by the sub-problems of the research. Findings are organized and interpreted according to these categories. The descriptive analysis method summarizes the existing situations, and sample quotations are included (Özmen & Karamustafaoğlu, 2019). According to this analysis, the data were collected under four categories. These:

Installation and application of the Algodoo program
- Physics teaching activities
- Apps similar to Algodoo
- Algodoo training

For the reliability of the data analysis, the inter-rater reliability value was used. For this purpose, two researchers who conducted this research independently coded the data in the interview form. Then, the researchers compared the data they coded. Out of these coded data, incompatible ones were excluded from the study, and compatible data were included. The formula reliability = Consensus / (Agreement + Disagreement) x 100 was used to determine the percentage of agreement in the data (Aydın-Günbatar, 2019).

The compliance percentage in the category of installation and implementation of the Algodoo program was 0.82, the compliance percentage in the physics teaching activities category was 0.85, the compliance percentage in the category of applications similar to Algodoo was 0.90, and the compliance percentage in the Algodoo training

category was 0.92. The general agreement percentage was found to be 0.87. It is recommended that the percentage of agreement between coders be at least 80% (Aydın-Günbatar, 2019). Afterward, the findings were interpreted and discussed in light of the relevant literature. The researchers reached a consensus in coding the interview form data and creating the themes. Modeling was used to help readers better understand the data.

3. FINDINGS

This section presents the codes created from the teachers' opinions about the Algodoo training carried out and the models belonging to the categories.

The teachers' opinions about the installation and implementation of the Algodoo program are presented in Figure 1.

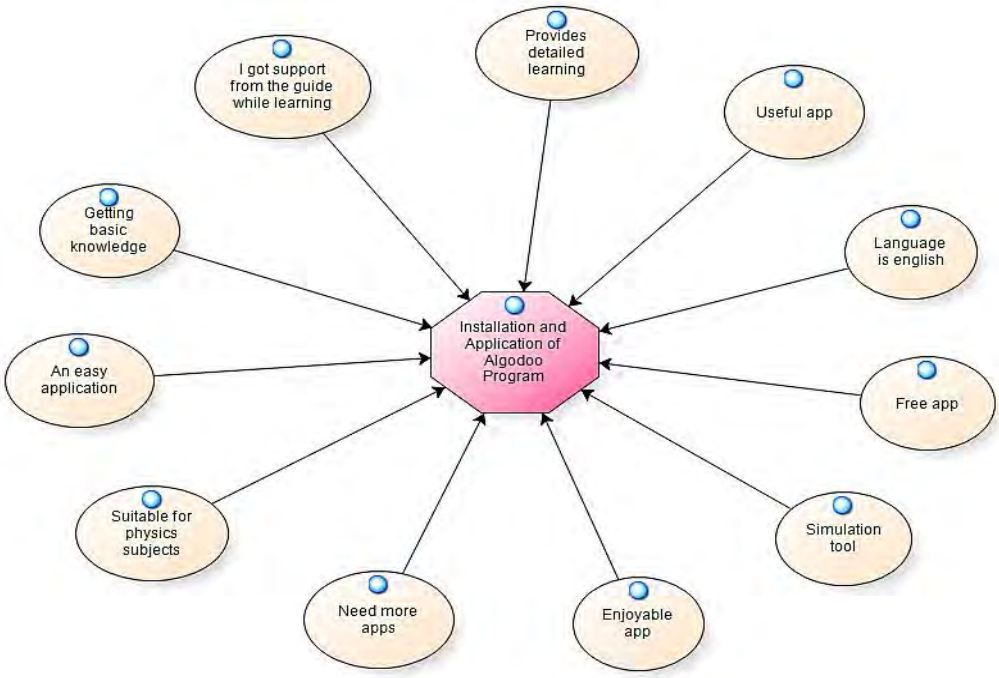

Figure 1 Teachers' opinions on the category of Installation and implementation of the Algodoo program

Most teachers stated that the Algodoo program was easy to install, suitable for physics subjects, and that the program was free of charge and would be useful for physics teachers.

Examples of one-to-one statements taken from teachers' opinions are given below.

"…I installed the Algodoo program easily. I had no difficulty… (T2)"

"…We were able to learn the examples given by our experts during the lesson in a pleasant way by trying them on our computer simultaneously. Our teacher helped us by waiting where we got stuck… (T9)"

"…An easy app for physics lessons. Animating subject and question models that the student has difficulty in understanding (such as a frictionless environment) as a simulation will provide great convenience at no cost… (T10)"

The opinions of teachers about physics teaching activities are given in Figure 2.

Examining the teacher opinions in Figure 2, the majority of the teachers stated that the Algodoo program would be effective in eliminating misconceptions, that it could be used to embody abstract concepts in physics courses, and that it was suitable for some physics subjects.

Examples of one-to-one statements taken from teachers' opinions are given below.

"…Algodoo is an app I want to include in my lessons. It has a special place among the web tools/programs I have used. We saw the basic concepts during the training we received, but I need more information to apply them in class. At first glance, I think it will be very useful for me in mechanical units. In addition, I can benefit from Algodoo while working on topics such as force, motion, and pressure (T7)."

"…Physics is an experimental science. However, we do our lessons theoretically due to the structure of the curriculum and the lack of materials. Most of us skip similar example questions without spending enough time on concepts. In this respect, Algodoo will save us time and compensate for the lack of materials… (T8)"

"…I think the Algodoo simulation program is suitable for physics experiments… (T19)"

Teachers' opinions about applications similar to Algodoo are given in Figure 3.

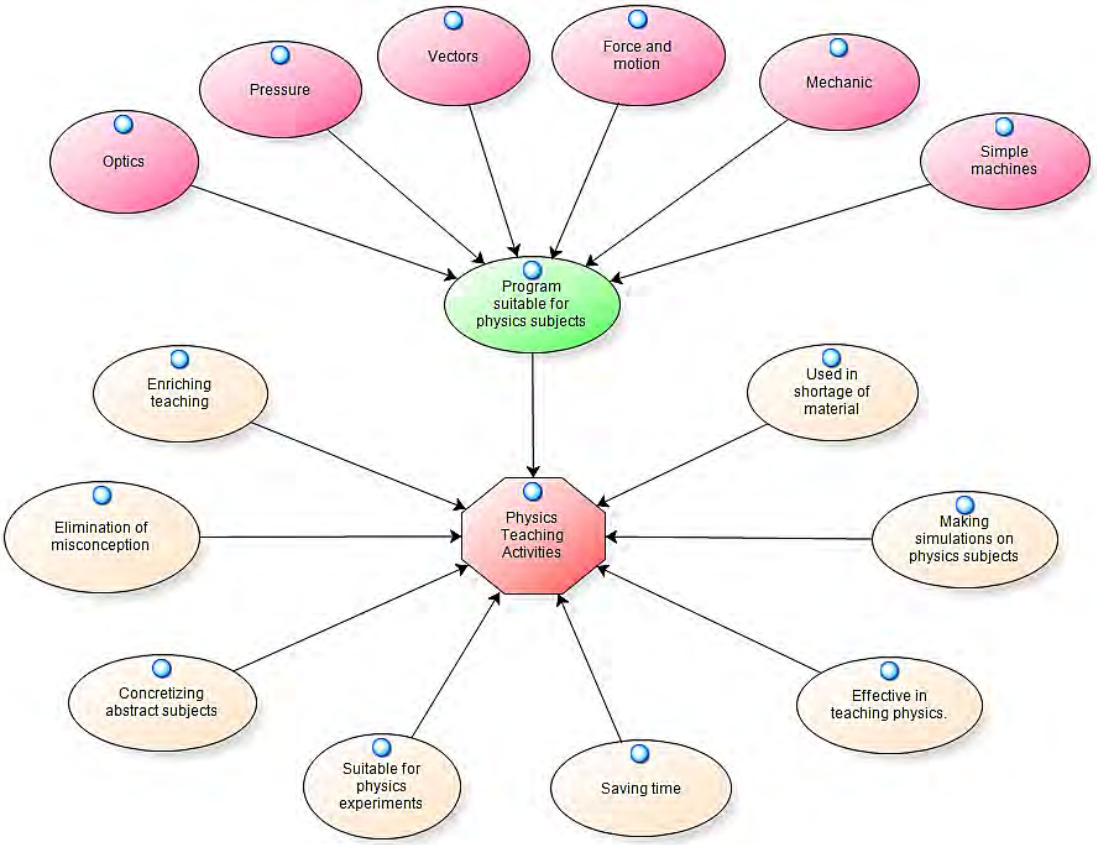

Figure 2 Teachers' opinions on the category of physics teaching activities

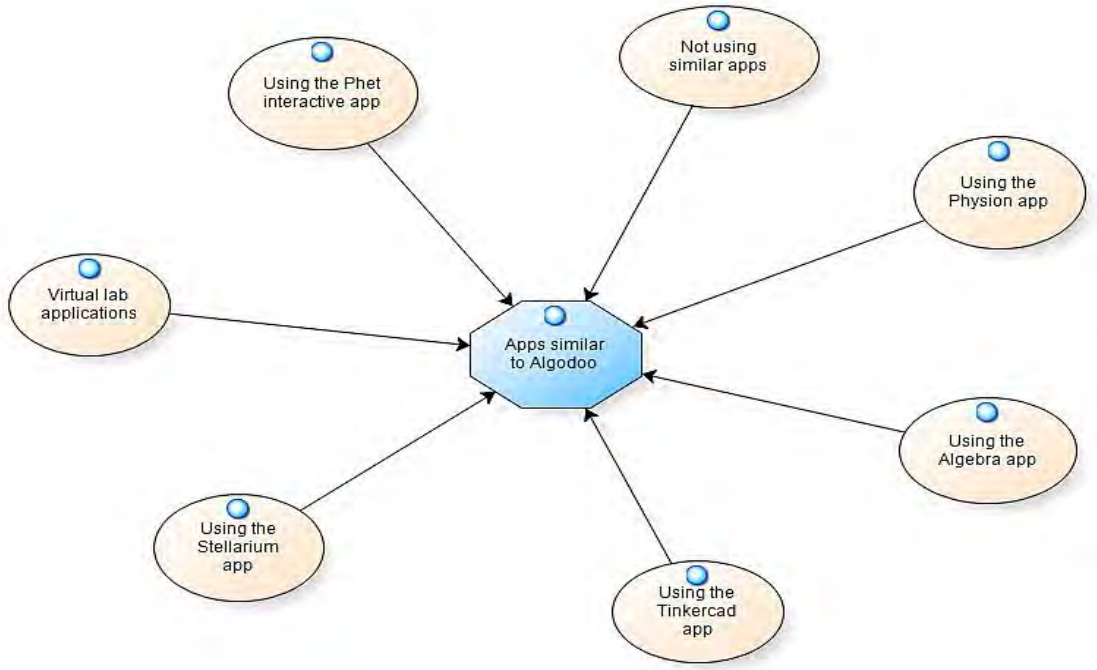

Figure 3 Teachers' opinions on the category of applications similar to Algodoo

An analysis of the teachers' opinions in Figure 3 reveals that more than half of the participant teachers stated that they used other simulation programs similar to Algodoo.

Examples of one-to-one statements taken from teachers' opinions are given below.

"…I use the PhET interactive app a lot. A Simulation program similar to Algodoo. A practical application… (T11)"

"…I used Algebra. A handy practical application for vector drawing and operations… (T13)"

"…I have not used any app similar to Algodoo until now… (T15)"

The opinions of teachers about Algodoo training are given in Figure 4

Regarding the installation and implementation category of the Algodoo program, it was understood that the teachers thought the installation was easy, enjoyable, suitable for physics subjects, and a useful simulation tool. Çelik, Sarı & Harwanto (2015) stated in their research on Archimedes' principle that pre-service physics teachers did not have difficulty creating simulations with Algodoo, that the program was suitable for physics subjects, and increased motivation. However, the fact that the Algodoo

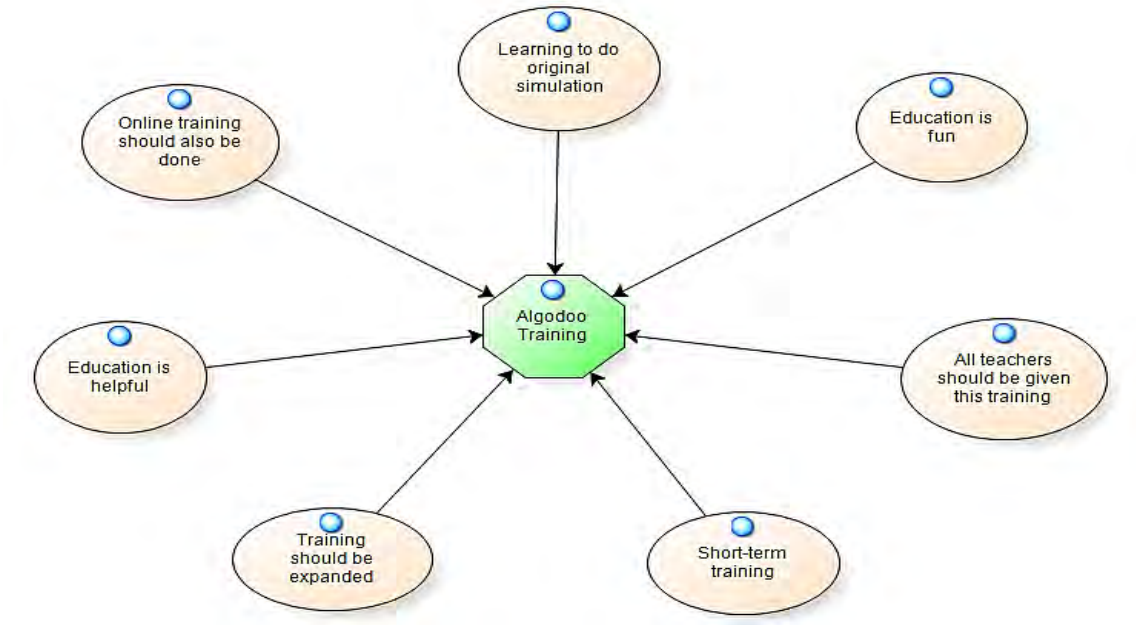

Figure 4 Teachers' opinions on the category of Algodoo training

Regarding the teacher's opinions about the Algodoo training, the majority of the teachers stated that the training was useful and that this training should be made widespread.

Examples of one-to-one statements taken from teachers' opinions are given below.

"…The Algodoo training was beneficial. Our instructors were well-versed in their subjects. I think the training was fun… (T3)"

"…I think education is beneficial. I used to use ready-made simulations all the time, but now we prepare them ourselves with our students. It gave a more original and ownership feeling… (T5)"

"…I think that the time given in terms of implementation in training should be a little longer. I also think that the training should be expanded… (T21)"

4. DISCUSSION

In this section, first, literature-supported discussions on the findings obtained from physics teachers' views about Algodoo training carried out within the scope of the 4005 TUBITAK project. Then the results based on the discussions are presented.

application software language was in English was expressed as a problem in the teaching process (Akdağ & Güneş, 2018). In this study, it was also understood that since the software language of the Algodoo application was English, there were some problems understanding the process for non-native speakers.

It has been determined that the teachers have thoughts about the Algodoo application related to the physics teaching activities, such as saving time in teaching, not requiring experimental materials, eliminating misconceptions, and concretizing abstract subjects. Accordingly, it can be said that teachers' use of the Algodoo application can be effective in teaching physics. Furthermore, when the literature is examined, it is stated that the Algodoo application is effective in teaching physics subjects and concepts (Çoban, 2021; Dinçer & Güçlü, 2013; Gregorcic, 2015; Hırça & Bayrak, 2013). Therefore, physics lessons prepared for the Algodoo application can clear students' misconceptions about physics subjects and embody abstract subjects. For instance, the Algodoo application can be used to eliminate misconceptions in the teaching of force and motion (Özer & Canbazoğlu Bilici, 2021; Akdağ & Güneş, 2018) and to embody abstract

topics in physics experiments (Kirmizigül, 2021; Taibu, Mataka & Shekoyan, 2021; Turan-Güntepe & Dönmez-Usta, 2022).

When the teachers' opinions about applications similar to Algodoo were examined, it was seen that some teachers (f:8, 36%) did not use any application in their classes. In contrast, some (f:14, 64%) used mobile and computer-supported interactive applications such as PhET, Stellarium, Algebra, Tinkercad, and Physician. It is understood from the relevant literature that effective physics teaching is made by making use of various interactive applications (Jimoyiannis & Komis, 2001; Karamustafaoğlu, 2012; Solvang & Haglund, 2021; Walsh, 2017). In addition, Özdemir & Çoramik (2021), in their research on optics, state that other applications such as Algodoo and PhET for physics lessons can be more effective by using them together.

About Algodoo training, it was determined that the teachers had the views that they learned to simulate in the education process, that the education is fun, that it should continue as online education, that the education period should be longer, and that education should be expanded. In this context, it has been understood that the Algodoo training carried out within the scope of the 4005 TUBITAK project is seen as useful training for the participating physics teachers.

Half of the physics teachers with more than twenty years of professional experience (f:6, 50%) and the majority of the teachers with less than twenty years of professional experience (f:8, 80%) stated that they used Algodoo or similar simulation programs in their lessons. In the literature, it is reported that teachers use simulation programs in the first years of their profession (Solvang & Haglund, 2021). It was found that almost all of the teachers working at the Science and Art Center (f:11, 91%) used simulation programs in their lessons or in preparing projects. In contrast, a minority of the teachers working at other schools (f:3, 30%) used simulations in their teaching activities. The fact that most of the teachers working in Science and Art Centers use Algodoo or similar simulation programs may be because the school type they work in uses technology within the scope of the project-oriented teaching process (Kabadayı & Tanrıseven, 2022).

5. CONCLUSION

In conclusion, this research showed that most teachers who volunteered for this research among the Algodoo training participants liked Algodoo and were very enthusiastic about using it in their lessons. Because the physics teachers who participated in the research mostly expressed that they want such an education to continue. As a result of the interviews with the teachers, it was understood that Algodoo training contributed to the teachers' pedagogical knowledge. Although the English language of the Algodoo program makes it difficult to use, it has been concluded that teachers can benefit from Algodoo in their lessons and prepare simple physics simulations. It was concluded that teachers need more time and more applications with the program to use the Algodoo program more effectively in their lessons.

According to the results of this research, it has been suggested that Algodoo training should be made widespread with in-service courses for the teaching of physics subjects and concepts, the Turkish language should be added to the language options of the Algodoo program, the course hours of the Algodoo trainings to be organized would be longer, and the physics teacher training programs should be included in education such as Algodoo.

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APPENDIX

Interview form

1. How was your access to the Algodoo program and the installation process on your computer? Were you able to access the program easily? Did you have trouble installing the program?
2. Did you learn to use the Algodoo application? Please explain.
3. How did you find the Algodoo application? Please explain.
4. What are the positive and negative aspects of the Algodoo application? Please explain.
5. Do you also make use of the Algodoo application in the teaching activities you conduct in your lessons? How? Please explain.
6. Which subjects and concepts do you use Algodoo application in your lessons? Please explain.
7. Is the Algodoo application effective in learning physics subjects? Please explain.
8. Did you use applications similar to Algodoo while conducting your lessons? If you have used them, can you give information about their names and contents?
9. Do you think the Algodoo training you received was beneficial? Please explain.
10. What are your suggestions for this training to be more beneficial and for the Algodoo application to be used more effectively in teaching?