Infographics and Their Applications in the Hybrid Learning Process

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Abstract: With the effective use of technological tools and equipment in all areas of life, the effective use of technological applications that will support the solution of daily life problems has become inevitable in order for science literacy to occur. The main purpose of this research is to determine the effect of infographic applications on the development of students' technological competencies and science literacy in the hybrid education process in high school physics courses. The study was carried out with 173 students in Turkey in the fall semester of the 2020-2021 academic years, for three weeks at school where the researcher taught. Quantitative and qualitative methods were used together within the scope of action research. Quantitative findings were evaluated with t-test and qualitative findings were evaluated with content analysis. In the hybrid education process, as a result of the infographic applications in the physics lesson, the technological competencies for educational purposes have developed in the students. As a result of students' effective use of infographic content in online and face-to-face educational applications, they have achieved advanced development in the dimensions of researching and questioning information, revealing the relationship between technological changes and science, and cognitive assimilation of information.

Key words: Physics Teaching, Hybrid Education, Infographics, Science Literacy

1. Introduction

With the increase in the effective use of advanced technological tools and equipment in social life, the basic needs of society have changed, and different problems have begun to be faced (Cloete, 2017). Considering that education plays an active role in the career planning process of all members of the society, the necessity of using technology effectively and innovatively in the education process comes to the fore (Burbules et al., 2020). Technology plays an important role in providing needs and solving problems in individual and social life. With the world community facing extraordinary health problems such as the pandemic, there have been significant disruptions in the equal and effective delivery of education to all members of society (Batubara, 2021). Online, face-to-face and hybrid education applications were applied in this process and studies were carried out to develop effective methods for each application. With the experience of these three types of applications in learning environments, trends from traditional face-to-face education to hybrid education have begun (Akkaş Baysal & Ocak, 2021).

Hybrid learning can be expressed as a learning environment where the boundaries between face-to-face and online education are eliminated with the help of technological tools and interactive learning is provided (Hwang, 2018). In hybrid learning, students who learn both face-to-face and online courses actively participate in the learning process (Bennett et al., 2020). In order to be able to teach the subjects more effectively, teachers have to develop and implement activities that will involve both groups in the process, instead of keeping only face-to-face participants active in the classroom activities they offer (Mumford & Dikilitaş, 2020). In hybrid learning applications where alternative learning environments are offered, students are given the freedom to choose the learning environment that suits those (Ma'Ruf et al., 2020). Ensuring student satisfaction within the scope of freedom of learning environment contributes significantly to the learning process and outcomes (Kurniawan et al., 2018).

Infographics provide the opportunity to present concepts and information that can be explained in a long time with verbal expressions concisely with the help of visual applications (Ru & Ming, 2014). If

infographic applications are developed and presented by students, they contribute to the learning process in many ways. These contributions can be listed as saving time by shortening the process of concepts and educational information, providing ease of comprehension and remembering by appealing to the five senses, enabling knowledge to be learned in cooperation, and learning and transferring self-knowledge in a short time (Kaya-Hamza & Beheshti-Fezile, 2017; Ozdamli & Ozdal, 2018). In order to avoid application and presentation problems in infographics, teachers who provide educational practice and students who take an active role in infographic design should follow some basic dynamics well. Infographics should be basic and plain, the images in the content should be compatible with the information, the images should be interesting, the information articles should be short and descriptive (Alford, 2019; Mubarok & Asri, 2020). If the infographics are prepared and presented by the students, effective teacher guidance is needed so that the educational information is researched in depth and the visuals are compatible with the concept and academic information (Akbarov, & Aydogan, 2018; Gebre, 2018).

The use of infographics in hybrid education provides multiple advantages by combining both the advantages of hybrid education and the advantages of technology-supported interactive infographic applications (Odabaşı et al., 2020). Students or student groups presenting the infographic material are followed live by the students who follow the course face-to-face or online, and the information is questioned simultaneously. In this case, easy and fast information presentation is provided, communication and interaction between the learner and the instructor are provided quickly, learning is permanence and the opportunity to go down to the anthropology of knowledge is provided (Gallagher et al., 2017). For students who do not have equal conditions in terms of cost and access to technology, preferring to participate in face-to-face or online courses eliminates the negativities in online education (Davidson, 2014). In the event of negativities such as pandemic diseases and disasters, the inability of all members of the society to access education face-to-face may occur. In order to ensure equality of opportunity between groups that can continue education face-to-face and those that can continue online, technological opportunities and technological competencies of individuals should be moved to higher levels (Code et al., 2020).

Advanced technological opportunities should be used effectively in the process in order to teach the subjects of physics, chemistry, and biology, where the effects of technological development and change are felt most, to students in a qualified way (Kurbanova & Yarovikov, 2021). In order for science literacy to occur in schools, first of all, technological opportunities and the interaction between students and teachers should be at an advanced level (Vrellis et al., 2020). When scientifically literate persons encounter problems in daily life, they use their scientific process skills effectively in the stages of solution development. As a result of the effective use of technology in science lessons, students interpret the relationship between science-technology-society-environment in daily life, develop a positive attitude towards science and increase their scientific-technical psychomotor skills in the process (Afifah & Ardianti, 2021). In studies, it has been revealed that as a result of the use of technology-supported infographics in lessons for teaching purposes, it provides positive contributions to students' academic, technological, and course attitudes (Alrwele, 2017). In addition, as a result of the applications of hybrid education, it is revealed that there is a significant improvement in students' success and attitude compared to online education applications (Shea et al., 2016).

Due to the suspension of education all over the world during the Covid-19 epidemic, education applications were continued as online, face-to-face, and hybrid. There was a need for learning activities where students who attend classes face-to-face and online can follow the lessons with equal opportunities and interact. Although there are studies on satisfaction, success and attitude in hybrid learning environments in the literature, there are no technology-supported teaching practices developed and presented by students in interaction (Bawaneh, 2021; Kuo et al., 2012; Park et al., 2019). In the hybrid learning environment, activities that can effectively establish the relationship between science and daily life by keeping all students in learning practices are needed in all countries of the world. In this ongoing process, application experiences that can be continued to be applied after the pandemic have also emerged. One of these applications is the hybrid education application. Since infographic applications have not been included in the scope of hybrid education in the researches carried out so far,

there is a need for hybrid education-based infographic studies within the scope of the physics course, where the effects of science and technology are the most.

This study attempted to determine the effect of the infographic applications on the development of students' technological competencies and science literacy in the hybrid education process in physics courses in high schools. With this purpose of the study, answers to the following questions were sought:

> 1. What is the effect of infographics on the development of students' technological competencies in hybrid education applications?
> 2. What are the effects of infographics on students' science literacy in hybrid education applications?

2. Method

2. 1. Research Design

Action research was used to improve the effectiveness of the research process. In the case of confronting the problems, a process in which solutions were developed under the guidance of the researcher teacher was followed. In line with the principles of action research, there was no generalization anxiety by making use of qualitative and quantitative findings. It was aimed to increase the quality of education by applying the obtained results and educational experiences as case studies in other groups with similar characteristics. Due to the fact that there was a researcher and student group in the problem experienced due to the Covid-19 epidemic, which deeply affects the societies and suddenly emerged, action research was preferred because quick decisions should be taken and local solutions should be developed in the educational process.

In the hybrid education process, the applications were carried out on the Canva platform. The free version and the fact that it is a platform that all students can easily access in their mother tongue contributed positively to the educational process. The Canva infographic platform has been preferred because its educational effectiveness is supported by many researches. In the 9th-grade physics curriculum, activities were prepared according to the six acquisitions in the "introduction to physics science" unit. For three weeks, infographic applications were made by the students on the subjects of "importance of physics science" and "application areas of physics".

2. 2. Research Participants

The research was conducted with 173 students (112 girls, 61 boys) in total at Araklı Mehmet Akif Ersoy Anatolian High School in Trabzon province in Turkey in the fall semester of the 2020-2021 academic year. 73 of the students were academically moderate (academic grade point average is between 50-70), 63 were at a good level (academic average is between 70-85), 37 were at a very good level (academic average was between 85-100). The research group was 9th-grade students and was between the ages of 14-16. At the beginning of the research, the participants were informed about the basic ethical procedures and the practices were started. Written permission was obtained from the school administration before the study. Students participated voluntarily and were allowed to leave whenever they wished. The groups were formed to be academically homogeneous. External influences that could affect students' views were minimized (teacher's verbal and mimic effect, other students' effects, family effect). Written notes were taken during the interview process. Name and personal information confidentiality were guaranteed. The data were processed by comparing the audio recordings with the written recordings. The raw data was confirmed by having the students read it.

2. 3. Data Collection Tools

In this study, three measurement tools were used: "Science Literacy Rubric Form", "Interview Form" and "Technology Attitude Scale". The course scores, grade point averages and personal information of the students were obtained from the school information system with the permission of the school administration. The questionnaire items were created within the framework of education-technology relation and education-daily life relation themes (Tınmaz, 2004). The Scale consists of twenty-eight 5-

point Likert-type items (strongly agree, I agree, I am not sure, I disagree, I strongly disagree). Cronbach's alpha reliability value of the scale was found to be 0.91 and this value shows that the scale is reliable. 148 of the questionnaires were applied face-to-face and 25 of them were applied online and delivered to the researcher via social media. In the questionnaires applied before and after the three-week infographic applications, the missing or incorrect ones were checked and corrected by the students.

In order to evaluate the infographic applications of the students during the research process, the science literacy rubric form was used. The rubric form was prepared by the researcher and two physics teachers by examining the literature. These target achievements were scored as excellent (5), very good (4), good (3), fair (2), and poor (1). Students' presentations were evaluated over this rubric for three weeks. The reliability coefficient of the rubric measurement tool was calculated as 0.71, taking into account Cohen's kappa ranging (Cohen, 1960). According to Landis and Koch (1977), this value shows that the measurement tool is reliable.

In order to clearly reveal the effects of infographic applications on students' science literacy, interviews were used in the natural environment of the researcher and the students. In order to determine whether the infographic applications have an effect on the science literacy of the students, four interview questions were created with two physics teachers. Each interview lasted an average of 14 minutes. Since the students were studying at the boarding school, the interviews were conducted after the lesson, student volunteerism, and in accordance with the permission of the school administration. Voice recording was made and then the coded data were shown to each student, and their consent was obtained and used. In order to ensure credibility, transferability, reliability and confirmability in the qualitative findings within the scope of the research, some precautions were taken by the researcher teacher. These; the researcher teacher shared the same environment with the students for a long time and stayed at the boarding school one day a week with the students all day long. In the infographic applications, a physics teacher and an Information technology teacher were used as expert opinions for the questions and problems of the students. Data credibility, audio recordings, and descriptions of the process were used for the consistency of the measurements.

2.4. Instrument and Procedures

Mills (2003) action research processes were adapted to this study. Considering the academic and technological readiness levels of the students, infographic application examples were presented and they were asked to develop activities at these levels. The infographic development and application process in hybrid education in this research is shown in Table 1.

Table 1. *Action Research Process of Infographic Applications in Hybrid Learning Process (Mills, 2003)*

Stage	Studies carried out
Understanding content	Comprehension of theoretical information about infographic Introducing the Canva infographic program
Deciding on an area of focus	Getting information about the subject to be presented Researching the theoretical and academic knowledge of the subject
Data collection	Researching the information to be presented on the subject of "the importance of physics science" Researching the information to be presented on the subject of "Application areas of physics"
Data processing	Entering data into Infographic Editing the infographic page layout
Sharing and presenting	Making a presentation in a hybrid learning environment. Scoring in the hybrid learning environment

During the design and implementation process of the infographics, the implementation suggestions of Lamb and Johnson (2014) were taken into consideration. These recommendations are; the information is simple and understandable, the visuals and their contents create integrity, the content that can be presented quickly, the use of interesting visuals and the use of design principles. In the infographic development process, decorations and excessive coloring that would keep the message in the background were avoided (Hagen & Golombisky, 2010). In the hybrid environment, infographics were

applied in five different classes for three weeks, for a total of thirty lesson hours. Due to the pandemic conditions, the students in the classrooms participated in the classes, half of them online and the other half face-to-face. Some of the applications developed by the student groups in the three-week Canva infographic applications are shown in Figure 1.

Figure 1. *Some Examples of Students' Infographic Applications*

2. 5. Data Analysis

The skewness and kurtosis values were used to determine whether the data had a normal distribution. The values were determined as .94 and 1.73 in the "technology-education" subcategory, -.20 and -1.25 in the "technology-daily life" subcategory, and -.58 and 1.55 in the "technology proficiency" category. According to Darren and Mallery (2010), if the skewness and kurtosis values are in the range of ± 2, it satisfies the normality condition. In this case, the survey data used will show a normal distribution.

The paired-sample-t-test data were analyzed in SPSS 22.00. The student assessment data obtained to evaluate science literacy within the scope of qualitative data were interpreted by content analysis. The data obtained from the rubrics and interview forms for the evaluation of the students' infographic presentations were coded with similar content and presented in a systematic, unbiased, and easy-to-understand manner.

3. Findings

3.1. Effect of Infographics on the Development of Students' Technological Competencies

In this process, in which the effect of using infographics on students' technological competencies in hybrid education applications was investigated, t-test results are shown in Table 2, depending on the relationship between students' pre-test and post-test scores.

Table 2. *Technological Competence Paired Sample t-test Data*

Measurement	Factors	N	df	t	$\overline{X}$	p	SD
Education-Technology	Pre-test	173	172	8.80	3.52	.001	1.01
	Post-test	173			4.19		
Daily life-Technology	Pre-test	173	172	27.03	2.62	.001	0.48
	Post-test	173			3.61		
Technological proficiency	Pre-test	173	172	14.57	3.17	.001	0.72
	Post-test	173			3.97		

The data obtained after the infographic supported teaching practices of the students studying in high schools in the hybrid learning environment under the guidance of the researcher teacher are as in Table

2. According to the research findings, after the infographic applications, there was a significant increase in the perceptions of the students in the education-technology category compared to the pre-application, t(8.80), p < .01. While the average of the students' education-technology scores before the application was $\overline{X}$ = 3.52, it increased to $\overline{X}$ = 4.19 after the application. This finding showed that the application of infographics in hybrid learning environments had a significant effect on students' attitudes towards using technology for educational purposes. In addition, after the infographic applications, it was observed that there was a significant increase in the students' perceptions in the category of application competencies of technology in daily life compared to the pre-application t(27.03), p < .01. While the average of the students' daily life-technology scores was $\overline{X}$ = 2.62 before the application, it increased to $\overline{X}$ = 3.61 after the application. This finding showed that the application of infographics in hybrid learning environments had a significant effect on students' attitudes towards using technology in daily life. According to the research findings, it was observed that there was a significant increase in students' perceptions in the technology competence category after the infographic applications compared to the pre-application, t(14.57), p < .01. While the average of the students' education-technology scores before the application was $\overline{X}$ = 3.17, it increased to $\overline{X}$ = 3.97 after the application. This finding showed that the application of infographics in hybrid learning environments had significantly affected students' technology competencies.

3.2. Effect of Infographics on Students' Science Literacy

In this process, in which the effect of the use of infographics on students' science literacy in hybrid education applications was investigated, the data of the students' infographic presentations, which were evaluated and processed into the rubric form, are shown in Table 3.

Table 3. *Science Literacy Rubric Evaluation Data in the Process of Infographic Applications*

Measurement	Codes	Factors	N	$\overline{X}$
Basic science concepts related to science	BSC	Mechanics, Thermodynamics, Electromagnetism, Optics, Nuclear Physics, Fundamental and derived quantities, Research Centers	54	4.7
Scientific knowledge	SK	Scientific knowledge, Scientists	54	4.5
Basic law and theory knowledge of science	BLT	Method, Theory	54	3.9
Using science process skills	SP	observing, measuring, sorting/classifying, inferring, predicting, experimenting, and communicating	54	4.6
Science-Technology-Society-Environment	STSE	Technology, daily life, examples from the environment	54	4.9
Scientific, Technical and psychomotor skills	STPS	Science-Technical, Psychomotor	54	4.0
Attitude towards science	AS	Volunteering, Willingness for new knowledge	54	4.5
Total			54	4.4

Science literacy levels of students were measured with the help of rubrics in infographic-supported applications. When the average scores of 54 groups, each consisting of three students, as a result of the infographic supported course presentations were evaluated, respectively; STSE ($\overline{X}$ = 4.9), BSC ($\overline{X}$ = 4.7), SP ($\overline{X}$ = 4.6), SK ($\overline{X}$ = 4.5), AS ($\overline{X}$ = 4.5), STPS ($\overline{X}$ = 4.0), BLT ($\overline{X}$ = 3.9) were obtained. A total of 26 codes were used in the rubric, in which science literacy was evaluated in seven categories.

Effective use of technology (*f = 47*) and associating infographic content with daily life (*f = 44*) came to the fore in the formation of STSE scores of student groups. While the student groups were making presentations on the subfields of physics, it was observed that they demonstrated the relationships between the contents of daily life technologies and physics at a high level. Some of the examples

presented regarding mechanics were expressed by rockets, the movement of planets, atomic movements, the movement of wheels in vehicles, high-speed trains, falling leaves, soccer balls, and the movement of a cat. While examples of mechanics were presented, the relationship between technological tools and mechanics was also expressed. The first week in the formation of the BSC scores of the student groups; infographics that reflect the contents of mechanics ($f=32$), optics ($f=27$), thermodynamics ($f = 23$), electromagnetism ($f = 19$), and nuclear physics ($f = 13$) at a high level came to the fore. In the second week's presentations, adequate applications were presented as Fundamental quantities ($f = 42$) and derived quantities ($f = 40$). In the third week presentations, applications were presented as scalar quantities ($f = 37$) and vector quantities ($f = 38$). In the formation of SP scores of student groups, communicating ($f = 34$), inferring ($f = 25$), sorting/classifying ($f = 21$), predicting ($f = 19$), observing ($f = 14$), measuring ($f = 11$) and experimenting ($f = 13$) codes came to the fore. Scientific knowledge ($f = 38$) and scientists ($f = 33$) codes came to the fore in the formation of SD scores of student groups. Volunteering ($f = 39$) and willingness to new information ($f = 32$) codes came to the fore in the formation of AS scores of student groups. Science ($f = 28$), technique ($f = 22$) and psychomotor ($f = 19$) codes came to the fore in the formation of STPS scores of student groups. Method and theory ($f = 15$) codes came to the fore in the formation of BLT scores of student groups.

Considering that the topics in the physics lesson are intertwined with daily life, the inclusion of technology and daily life applications in the course of the physics lesson by associating them with physics subjects made a positive contribution to the science literacy of the students. Including technology-supported student-centered infographic applications under the guidance of teachers in the hybrid education process ensured the active participation of disadvantaged students in the lessons voluntarily, and as a result, contributed positively to their attitudes and achievements.

Table 4. *Classification of Interview Findings According to Answers*

Measurement	Positive (f)	Negative(f)	Neutral (f)
The effect of explaining basic science concepts related to science	24	-	1
The effect on the perception of science-technology-society-environment	20	1	4
The effect of attitude towards science	12	-	13
The effect on the adequacy of using scientific process skills	19	2	4
Total (%)	75	3	22

As a result of the questions asked to the participant students, when the effects of infographic applications within the scope of science literacy in hybrid education are listed; "the effect of explaining the basic science concepts related to science" ($f = 24$), "the effect of the perception of science-technology-society-environment" ($f = 20$), "the effect of using scientific process skills" ($f=19$) and "the effect of attitude towards science" ($f = 17$) categories were obtained. In the category of negativity, answers were given in two areas. These were expressed as "The effect on the ability to use scientific process skills" ($f = 2$) and "The effect on the perception of science-technology-society-environment" ($f = 1$). The indecision categories of the infographic that supported the teaching process are "Attitude towards science" ($f = 13$), "Science-technology-society-environment perception" ($f = 4$), "Adequacy in using scientific process skills" ($f = 4$), and "Basic science concepts" ($f = 1$). 17 codes belonging to the categories were used and the total number of reported opinions was 100.

The participant students were asked, "How has the effect of infographic supported applications to explain the basic concepts of physics in hybrid education?", positive codes in the category of "the effect of explaining basic science concepts related to science" within the scope of science literacy; understanding basic physics subjects ($f = 11$), proficiency in explaining with examples ($f = 8$), scientific knowledge-based teaching ($f = 3$), and learning research process ($f = 2$). Positive codes in the category of effect on explaining basic science concepts related to science within the scope of science literacy; were grouped as "understanding basic physics subjects" ($f = 11$), "explaining with examples" ($f = 8$), "scientific knowledge-based teaching" ($f = 3$) and "research by learning" ($f = 2$). The code in the neutral category was grouped as the shortness of the process ($f = 1$). As an example of the answers given in the

"positive" category, S11: "*Physics topics that we previously knew to be complex have been simplified with pictures and short explanations*", S47: "*Preliminary information for the topics we will teach in class with the help of infographics and the need for pictures to explain this information caused us to do more research and learn more information*". As an example of the answers in the "neutral" category, S105 was as follows: "*I was already interested in physics lessons and physics subjects, the use of infographics did not change my views*".

The students were asked, how has your experience in the infographic application and presentation process affected your perception of science-technology-social life-environment?" Positive codes in the category of effect on science-technology-society-environmental perception; "effect on science attitude" ($f = 10$), "effect against technology" ($f = 8$), "effect of students on solving the problems they experience in their environment" ($f = 6$), and "influence on explaining social and technological changes" ($f = 7$) grouped as. The negative code was found to be "impact density of technology" ($f = 1$). The category of indecision was coded as "shortness of the process" ($f = 4$). As an example of the answers given in the positive category, S23: "*It helped me to see that physics topics and technology are intertwined, and that physics exists in many areas of daily life*", S36: "*The infographic design process was very useful for me to associate many changes that occur in our lives with the changes in technology with the physics course*". As an example of the answers given in the category of neutral, S76: "*The contents of the physics course are everywhere in our lives, there has been no change in my ideas in such a short time*". As an example of the answers in the "Negative" category, S16 was as follows: "*The technology development process occurs in a very wide area; such short-term effects did not contribute positively to my ideas*".

As a response to the question: "How did scientific knowledge, scientists who develop knowledge and the process of knowledge creation contribute to you in the process of infographic applications? The following results were obtained by classifying and coding student opinions. Positive codes in the category of effect on attitude towards science; "understanding scientists" ($f = 8$), "understanding the nature of science" ($f = 2$), and "understanding the nature of scientific research" ($f = 2$). The codes in the category of neutral are grouped as short process ($f = 7$) and undefinable process ($f = 6$). As an example of the answers given in a positive category, S6: "*As the opinions of the related scientists were asked while I was making presentations to my fellow students with the help of infographics, it was necessary to gather information about the scientists*", S29: "*It was very useful to make an infographic presentation in the hybrid education process, we had to make a presentation by reaching the first starting point of the information by doing more research*". As an example of the answers in the neutral category, S105 was as follows: *"There was no change in my attitude towards scientific knowledge and scientists during the three-week implementation period".*

As a response to the question: Which and how did you benefit from the activities of observation, classification, inference, estimation, and communication during the infographic application and presentation process? The following results were obtained by classifying and coding student opinions. Positive codes in the category of effect on the adequacy of using scientific process skills; are grouped as "classification" ($f = 7$), "inferring" ($f = 6$), "predicting" ($f = 3$), "communicating" ($f = 2$), and "observing" ($f = 1$). "Interaction" ($f = 2$) was found as a negative code. In the neutral category, coding was done as "communication" ($f = 4$). As an example of the answers given in a positive category, S15: "*It was very important to classify information, make inferences for new information and present it effectively in the classroom while researching and presenting physics subjects with infographics*", S42: "*All of my friends who follow the online and face-to-face classes asked questions, some of the online communication providers asked their questions in written form, a good communication opportunity was created*". As an example of the answers in the neutral category, S52 was as follows: "*I believe that the communication is not clear and distinct because there are problems about whether the online participants are listening or not*". As an example of the answers in the category of negativity, S16 was as follows: "*I have witnessed that the interaction of online students and face-to-face students is not sufficient*".

4. Discussion

As a result of infographic applications in hybrid education environments, ideal learning environments for students are those where they interact face-to-face and closely with their teachers. The hybrid education model emerges as the ideal application that can be applied in cases where education is necessarily suspension, such as infectious diseases and disasters, or when some of the students are away from face-to-face education. In hybrid education applications, groups that attend classes online may be at a disadvantage compared to groups that attend face-to-face. Interactive infographic designs in hybrid education are important applications that equalize opportunities between students who attend face-to-face and online courses. In the process of hybrid education applications, infographic applications encourage student groups to use technology effectively for educational purposes. The effective use of technological content in the teaching process makes a positive contribution to students' perceptions of technological competence. When the infographic content is prepared and presented by identifying with daily life problems and daily life technology content, it makes a positive contribution to students' perceptions of technology application competencies in daily life. When infographic applications are provided under the control of teachers in a planned and controlled manner within the scope of hybrid education, students begin to develop a significant positive attitude in terms of the necessity and effect of technology in education. In the research of Umugiraneza et al., (2018), the positive development in success and attitudes of students in the case of using technology for teaching purposes under the guidance of teachers coincides with the results of this research. In addition, the positive contribution of Alrwele (2017)'s use of infographics in education in students' attitudes towards technology and academic content of courses supports the results of this research. The results of this research are consistent with the fact that the use of technological infographics in science lessons by Kuzukıran (2020) contributes positively to students' attitudes towards daily life technological tools and equipment in their future lives and towards STEM.

Presenting technology-supported infographic applications in student groups under the guidance of teachers within the scope of hybrid education contributes to learning by questioning in which areas and how technology is used in the content of science lessons. In the process of teaching science subjects and concepts, the use of technological content in the environment in which students live in the course contents and questioning the working systematics of technological tools positively affect attitudes towards subjects and concepts. Positive attitudes towards science concepts are effective in questioning and learning the working mechanisms of technological contents related to science subjects. This process contributes to the better learning of basic science concepts and their positive development in science and technology attitudes. In the research of Yeh et al., (2019), it is seen that teaching the subjects by making use of the technologies in the environment of students in teaching basic science concepts contributes positively to students' attitudes towards science concepts and the relationship between science and technology. These results are in agreement with the results of the research.

In hybrid learning classes where face-to-face education cannot be fully provided and some of the students attend online classes, providing the priority of presentation to the online participants in the applications in order to ensure the active participation of the students who participate in the online lessons, carries the students' problem-solving competencies, research and communication skills to higher levels. In such practices, instead of just researching the course contents and concepts, students use advanced technological opportunities to provide classroom control by presenting in hybrid environments, and they have to keep the attention of other student groups constantly dynamic by ensuring that the concepts and topics that are researched and presented are interesting. These efforts and wishes of the students in the process contribute significantly to the development of science literacy. In the research of Tati et al., (2017), the positive effects of designing boat models and the effective use of technology in lessons, and the application of STEM learning on energy STEM and science literacy of students are in line with the results of this study.

Researching and presenting the infographic applications in groups in the hybrid education process contributes to the higher levels of communication between students who participate online and students who participate face-to-face. Responsibility sharing plays an important role in increasing the success levels of the groups. As a result of responsibility sharing, information is voluntarily researched and new information is accessed more effectively. Combining the information obtained by each individual in the

groups with the interactions of the group members online or face-to-face, classifying them, and making them ready for presentation contributes to science literacy by improving the scientific process skills of the students in the process. Interaction of students in applications with technological content overlaps with the research of Silalahi and Hutauruk (2020), which will provide process gains in students. The studies of Park et al., (2019) on the fact that student success and attitudes will develop positively as a result of providing online and face-to-face interaction together coincide with this study.

5. Conclusions and Implications

This study reveals that infographic applications in hybrid learning environments had a positive effect on students' use of technology for education and training and the development of science literacy. Considering that infographics are an effective learning tool in online and face-to-face education environments, it is seen that infographics are a viable learning tool in teaching physics course topics in hybrid learning environments. It is thought that infographic applications that will be developed on physics topics under the guidance of action researchers can be used in both in-school and out-of-school learning environments at the high school level. In this study, infographic applications were developed by students for online and face-to-face learning environments at the high school level. It is recommended that such practices, which are carried out under the guidance of teachers, in order to raise students' awareness in providing science literacy, should be carried out together with other science disciplines (physics, chemistry, biology) that play a key role in providing science literacy.

Despite an improvement in the technological competencies and science literacy behaviors of the students who developed the infographic after the applications, it was determined that their attitudes towards science had little effect. According to another result of the study, students showed improvement after the application in the categories of education-technology, daily life-technology, and technological proficiency. However, it was revealed that the scientific-technical-psychomotor characteristics of the students were underdeveloped. Other researchers working in the field of science education can examine the effects of current practices in different situations such as simulation-assisted, individual learning, and problem-based learning.

According to another result obtained from the research, since students who develop infographics as a group expect participation from other students in the group, basic science concepts related to science, scientific knowledge, scientific attitude towards science, science-technology-society-environment, scientific-technical-psychomotor skills they have gained many competencies such as and using science process skills. The fact that there are restrictions in learning environments due to Covid-19 both in Turkey and around the world and therefore the loss of life and property has increased, has revealed the need for the implementation of alternative and interactive applications. It is recommended to evaluate different approaches, models, and applications in infographic applications comparatively according to different learning environments, and to disseminate high-impact practical training. It is recommended that evaluate different approaches, models, and applications in infographic applications comparatively according to different learning environments, and to disseminate high-impact practical training.

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