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## The Effect of STEAM Applications on Lesson Outcomes and Attitudes in Secondary School Visual Arts Lesson

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### Abstract

STEAM is a concept that is made up of the initials of the words science, technology, engineering, arts and mathematics. The aim of this study is to determine the effect of STEAM-based teaching activities on students' lesson achievements and attitudes in secondary school Visual Arts lessons. The study was carried out in a private secondary school in Mersin. The study, which was carried out with 24 students in the experimental and 24 control groups for 5 weeks, was designed according to the experimental model with the control group, which is one of the quantitative research methods. In the study, Secondary School Visual Arts Lesson Acquisition Test and Attitude Scale towards Visual Arts Lesson were used as data collection tools. According to the research findings, there were significant differences in favor of the experimental group in the posttest achievement and attitude scores of the experimental group, in which activities based on the STEAM teaching approach, and the control group, in which traditional teaching was applied.

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### Introduction

According to the literature, artistic production has been in three stages, from past to present, 'traditional', 'mechanical' and 'digital'. With the industrial revolution, mechanization has developed and traditional art production has been replaced by reproduction. Technological possibilities that started with the camera have brought digital production to large masses through the computer. Researches and styles have changed with the different techniques that technology has added to the forms of art (Öztürk & Öztürk, 2022; Özdemir, 2022; Türkmenoğlu, 2014). In the second half of the 20th century, technological elements became widespread in different disciplines such as Pop Art, Op Art, Action Painting, Kinetic Art, Performance Art and Happening. The use of the internet in a wide area and the easy access of everyone to technology have created new art forms that can be followed and made in the digital environment (Ceran, 2022; Valuable and Türker, 2016). With the importance of computer software and technology, art has also been directly affected by these developments. Technology, as a tool in the creation of art, has also become an indispensable element for the art educator. Raising creative individuals, thinking fluently, finding original solutions to problems is one of the aims of national education. While determining the national education framework, it should be determined in the light of art and technological developments (Akdeniz et al., 2016; Kaleli, 2020; Kara, 2021; Karayağmurlar, 2002; Kibici, 2022; Kibici & Sarıkaya, 2021; Shettar et al., 2021). According to Sarıkaya (2022), Yılmaz and Bilici (2016), art

education can be made enjoyable, fun and effective by integrating technology into art education. In this way, the field of art can be made more interesting and the desire to learn can increase in the student. When it comes to the evaluation stage, it saves time and results can be reached faster and without errors.

The developments in the 21st century have brought about information to change rapidly and the need for information to increase more than ever before, and pave the way for countries to change and develop their educational needs and goals (Aslan, 2011). In order to improve the skills of students in the 21st century life, it is necessary to use engineering education accurately and effectively, especially on the basis of innovation and production (Alan, 2019; Gözümlü et al., 2005; Rodriguez et al., 2020). The subject of learning by producing has been the main priority of many education systems. In the information society, it is seen as a necessity to increase mental processes and production skills rather than labor and muscle power. There is a need for students who can use technology, think, question, research and invent in accordance with the requirements of the age. Individuals' ability to think creatively, innovatively, creatively and critically in order to solve a problem when faced with a problem is a requirement of the developments in technology in the 21st century and the skills necessary to apply this technology (Sünbül, Gündüz & Yılmaz, 2002). This requires individuals to have access to in-depth knowledge in the fields of science, technology, engineering and mathematics and to be ready to use this knowledge in their daily lives. Based on this idea, in recent years, especially the United States of America, Japan, Korea, China and many European Union countries have started to apply STEM education, which includes a solid science and mathematics foundation, in many lessons and subject areas at pre-school, primary and secondary education levels in order to create an innovative society. Kier & Khalil, 2018; Williams & Young, 2021; Wu, Cheng & Koszalka, 2021). Bybee (2013) stated that although STEM education is an innovative approach, it supports the training of productive individuals who can use science and technology properly. Based on all these definitions, it can be said that STEM education plays an important role in the development of 21st century skills.

The concept of STEM is among the important concepts that emerged as a result of the rapid progress of science and technology in the 21st century. Developments in science and technology have required people of our age to have new and different skills. These skills, also known as 21st century skills, are expressed by P21 (Partnership for 21st Century Learning) as creativity and innovation, critical thinking and problem solving, communication and collaboration, media literacy, information literacy and technology literacy (P21, 2015). STEM covers the fields of Science, Technology, Engineering and Mathematics. STEAM, on the other hand, adds art to these areas. In fact, art has many different meanings, tasks and applications in STEAM education. Incorporating the humanities as well as the arts, it seeks to answer the question: How do we identify the challenges we want to overcome? The concept/product that emerged as a result of educational inquiries; It has been seen as a necessity brought by 21st century skills and professions. The concept of STEM should be taken seriously in terms of providing four different discipline skills in an integrated way and creating a society with developed skills in the disciplines in question. Recently, with the addition of the art field to the STEM concept, the concept has expanded and gained widespread use as STEAM (Razi & Zhou, 2022; Wu, Cheng & Koszalka, 2021). STEAM is positioned above the level desired to be reached with STEM. Within the discipline of art, there are contents such as aesthetics, handcraft skills, free design process (Yakman, 2008).

The basis of STEAM education is the use of different disciplines together, the preparation of projects and the realization of these projects by turning them into production. At the same time, STEAM education provides an environment for students to turn their projects into products on the axis of art, design and creativity. The most important difference of STEAM education is that it makes art and design an integral part of the education model (Erdoğan, 2020; Houghton et al., 2022). STEAM education has a framework for lesson plans that show how standards can be adapted, compared, and easily reinforced in unique and engaging ways. According to Yakman (2008), STEAM connects all its subjects to each other in an interdisciplinary manner and also to the whole spectrum of the rapidly changing business and professional world. It is a lifelong career and a way of being ready for life that can adapt to the rapidly changing global world we live in. Moving to the STEAM perspective means learning in an educational context; it not only has a framework that shows where topics overlap, but also provides a vibrant and adaptive learning framework for ever-changing personal and unpredictable global development (Houghton et al., 2022; Morales et al., 2021).

Art is a manifestation of creativity necessary for 21st century skills. It has been proven by experimental research that art develops many skills such as thinking, observation, verbal and written expression, and the inclusion of art in STEAM has also revealed in the researches the acquisition of skills such as better questioning ability, higher concentration and finding more effective solutions to problems. STEM education is generally based on logic and use of the left hemisphere of the brain. However, many studies have proven that areas where the right hemisphere of the brain is used, such as art, support and strengthen creativity. Considering that the basis of STEM education is the desire to reach the power of innovation, adding the term "art" makes this desire reasonable. In a STEAM-based education, students can have the opportunity to discover their potential by using their brains at full capacity. In addition, since the field of art is completely thinking-based, unlike memorization, it will reduce students' memorization habits and positively affect success in other fields (Poyraz, 2018).

By leading the development of divergent thinking, art supports the creative thinking that underlies the breakthrough innovations and inventions of scientists and engineers (Fox and Schirmacher, 2018). For this reason, Leonardo da Vinci and Michelangelo Buonarroti, better known as painters and sculptors, have made many innovations in history (e.g. flying machines, catapults, suspension bridges) as inventors, engineers and scientists at the same time (Laurenza, 2018). ; Sousa and Pilecki, 2013). With this in mind, in recent years, researchers in the field of education have focused on the planning and implementation of educational processes in which art is included in STEM acronym and its contributions to both students and educators (Liao, 2019; Madden et al., 2013; Moomaw & Davis, 2010; Perkins & Stoycheva; 2016; Quigley and Herro, 2016).

Many educators argue that the arts should also be included in the integration of Science, Technology, Engineering and Mathematics, and that creativity supported through art is very important for generating new ideas in STEM disciplines (DeJarnette, 2018; Jamil et al., 2018; Madden et al., 2013; Wynn & Harris, 2012). Moreover, in addition to content such as mathematics, science and history, art is among the necessary subject areas for all students in the 21st century. The STEAM approach, which emerged from this point of view, can be defined as “instilling principles, concepts and techniques in the field of art and design into STEM teaching and learning” (National Art Education Association, 2014). It should be emphasized that; STEAM means much more than the

integration of art into STEM. The nature of STEAM reflects a more creative, real-world-oriented and problem-and/or project-based view of education (Henriksen et al. 2019).

The most important reason for the integration of art into STEM is the development of competencies related to aesthetics, innovation and imagination (Liao, 2019). In fact, art and STEM are different from each other in some ways. For example, while the disciplines that make up STEM are objective; art contains subjective expressions. Similarly, while STEM is analytical, analytical and more about logic; Art is emotional, instinctive and unique. On the other hand, the main goal of both is to make discoveries and both require creative thinking. In fact, skills such as making use of the sense of curiosity, which are considered as scientific tools, observing correctly, perceiving an object with multiple dimensions, spatial thinking and working effectively with others, are also at the center of art. In addition, not only artists but also scientists use creative thinking in their work (Sousa & Pilecki, 2013). Art and STEM education should be considered as the basic components of education that cannot be compared with each other, but complement each other (Jamil, Linder, & Stegelin, 2018; Ünal, 2022; Sousa & Pilecki, 2013). It is possible to give different examples of using art and STEM disciplines together. For example, physics, light, basic chemistry and trigonometry are the main learning areas of photography. Computer graphics or games; mathematical thinking, geometry, software and programming require artistic skills. As can be understood from these examples, this is why art and STEM disciplines are used together and art is included in engineering. Also, art makes STEM disciplines stronger, more attractive. In other words, it helps students to look at the world from a different perspective as visually literate (Mercin, 2019).

When the researches on the subject are examined, it is seen that many studies in the international arena (Cook, Bush & Cox, 2017; Kang, 2019; Liao, 2016; Moon, 2018; Pilkinton, 2018; Rolling, 2016; Sochacka) on STEAM education and STEAM teacher education in arts education (Guyotte & Walther, 2016; Stohlmann, Moore, Roehring, 2012; Tenoglia, 2017; Yakman, 2010). These studies draw attention to the fact that the lessons given with the STEAM education approach provide a more meaningful art education to the students in the field of visual arts, as in every discipline. In addition, it is seen that the education given with the STEAM approach creates an increase in the attitudes of the individuals towards the disciplines of Science, Technology, Engineering, Art and Mathematics that make up STEAM. Although there are few studies on STEAM education in Turkey, both in the field of art and in other fields, some educators (Ata-Aktürk, 2021; Azkın, 2019; Benek & Akçay, 2018; Erdoğan, 2020; Gülhan & Şahin, 2018; Helvacı, 2019; Kahya, 2019; Mercin, 2019) contributed to the promotion of this approach in art education with their publications such as book chapters, thesis and articles. In addition to the fact that STEAM studies are only studied by researchers in the field of science and mathematics, it is seen that the framework of applications that can serve as an example for the integration of these disciplines has not been clearly determined. The lack of sufficient number of studies to illuminate these points about the STEAM approach is considered as an important problem. For this reason, in this study, the effect of STEAM applications in secondary school visual arts education lesson on students' attitudes and achievements compared to traditional teaching was examined. For this purpose, answers to the following questions were sought in the study:

1. Is there a significant difference between the pretest-posttest lesson attitudes of the control groups in which the STEAM model-based applications are carried out in the 1st Secondary School 6th Grade Visual Arts Education lessons and the control groups in which the traditional teaching is applied?

2. Is there a significant difference between the posttest lesson attitudes of the experimental group in which the STEAM model-based applications were carried out and the control group in which the traditional teaching was applied in the Secondary School 6th Grade Visual Arts Education lessons?
3. Is there a significant difference between the pretest-posttest lesson acquisitions in the experimental group in which STEAM model-based applications are carried out in the 6th Grade Visual Arts Education lessons and in the control groups in which traditional teaching is applied?
4. Is there a significant difference between the posttest lesson achievements of the experimental group, in which the applications based on the STEAM model were carried out, and the control group, in which the traditional teaching was applied, in the 6th Grade Visual Arts Education lessons?

## Method

In this study, it was tried to determine the effect of STEAM-focused painting teaching in the sixth grade Visual Sub-Learning Area, which is included in the Secondary School Visual Arts Curriculum, on the students' visual arts lesson achievements, their attitudes towards the lesson and their interest in STEM professions. The study was carried out in an experimental design. Patterns in which cause-effect relationships between variables are determined are experimental designs. In this study, quasi-experimental design was used in the data collection process. Quasi-experimental designs may be preferred when real experimental designs require but some control cannot be achieved. In this respect, quasi-experimental design is frequently preferred in the field of social sciences (Büyüköztürk vd., 2008). This study was conducted on secondary school students. Considering that making an unbiased assignment in the process of forming the study groups may cause some problems, a quasi-experimental design was preferred in this study. The symbolic representation of the pattern is given in Table 1.

Table 1. Experimental Design Applied in the Study

<b>Groups</b>	<b>Pretest</b>	<b>Experimental Process</b>	<b>Posttest</b>
G1	T1 <sub>12</sub>	STEAM-based Visual Arts Teaching	T2 <sub>12</sub>
C	T1 <sub>12</sub>	Traditional Visual Arts Teaching	T2 <sub>12</sub>

In the study, the Experimental group, in which G1 STEAM training was applied; C represents the control group in which traditional teaching was applied. Visual Arts lesson achievement and attitude scales were applied as a pre-test to both groups before the experimental procedure (T1). The same scales were applied to the groups as a posttest at the end of the experimental process (T2).

Pretests applied to the subjects according to the table above:

- T1<sub>1</sub> → Visual Arts Lesson Achievement Test (Pretest)
- T1<sub>2</sub> → Attitude Scale towards Visual Arts Lesson (Pretest)

In the study, the following experimental applications were carried out in the experimental and control groups: Daily and activity plans were prepared to be used in the research based on the secondary school 6th grade Visual Arts lesson curriculum. In this context, a 5-week activity was planned in the 'Visual Communication and Formation' learning area of the lesson. Within the scope of this learning area, "Using different materials and

techniques while creating visual art work", "Ideas and experiences in visual art work; written, oral, rhythmic, drama etc. Experimental and control group sessions were held on the topics of "reflecting their ideas on visual art work in line with the chosen theme and subject" and "Using perspective in visual art work". Meanwhile, STEAM-based activities in the experimental group and traditional teaching practice in the control group were carried out. In the activities carried out in the experimental group, the students colored the visuals they created using their imaginations with the materials they cut in geometrical shapes, and turned them into reliefs and different pictures. In addition, within the scope of science activity, they associated their subjects with elements and stimuli from nature. Students made designs for visual communication and presentation individually and as a group in the engineering aspect of STEAM. Students who used the disciplines of design and mathematics in the visual arts lesson performed a fun presentation activity at the last stage. After the experimental procedures of the study, Visual Arts Lesson Achievement Test and attitude scale were applied to both groups as a post-test.

The study group of the research consisted of sixth grade students in a private secondary school in Erdemli, Mersin, continuing their education. In the study, two groups were selected, one being the experimental group and the other being the control group. In the experimental group, 13 girls, 11 boys, 24 students. In the control group, there were 24 students, 12 girls and 12 boys. Necessary permissions were obtained from the families and school administration in order to carry out the research. Before the experimental procedures of the research, the equivalence of the test scores of the students in the experimental and control groups was checked with the Mann Whitney U test and the results are presented in Table 2 and Table 3.

When Table 2 is examined, it is seen that the pretest visual arts lesson achievement scores of the students in the experimental and control groups are compared. As a result of the Mann Whitney U test, it is seen that the pretest achievement scores of the students in the experimental and control groups did not differ statistically significantly [ $z=-0.435$ ;  $p>0.05$ ). Before the experimental procedures of the research, it was understood that the secondary school students in the experimental and control groups had equivalent visual arts lesson achievements.

Table 2. Comparison of Pre-test Visual Arts Lesson Achievement Scores of Students in Experimental and Control Groups

Group		N	Mean Rank	Sum of Ranks	Mann Whitney U/Z	p
Acquisition	Experimental	24	23.63	567.00	-0.436	0.663
	Control	24	25.38	609.00		
	Total		48			

When Table 3 is examined, it is seen that the pretest attitude scores of the students in the experimental and control groups are compared. As a result of the Mann Whitney U test, it is observed that the pretest scores of the experimental and control group students did not differ significantly from a statistical point of view [ $z=-1.342$ ;  $p>0.05$ ). Prior to the experimental operations of the research, it was understood that the secondary school students in the experimental and control groups had the same level of visual arts lesson attitudes.

Table 3. Comparison of Pre-test Visual Arts Lesson Attitude Scores of Students in the Experimental and Control Groups

		Mean	Sum of	Mann		
		Rank	Ranks	Whitney U/Z	p	
Attitude	Group	N				
	Experimental	24	27.21	653.00	-1.342	0.179
	Control	24	21.79	523.00		
	Total	48				

**Data Collection Tools**

The Visual Arts Lesson Attitude Scale (which was developed by Demirel (2011) to determine the attitudes of secondary school students towards the Visual Arts lesson was used. The scale consists of 24-item attitudes towards the Visual Arts lesson. The scale is in the form of a 5-point Likert. The answers given by the participants to the scale items are scored as “I strongly disagree, 2 Disagree, 3 Undecided, 4 Agree, 5 Completely Agree”. The highest score that can be obtained from this scale is 120. A high score from the scale indicates that the student's attitude towards visual arts lesson is high, if the score decreases, the attitude towards the visual arts lesson The Cronbach Alpha Coefficient of the scale was determined as .84. As a result of the analysis performed in this research sample, the scale was found to have a Cronbach Alpha Confidence Coefficient of .86.

*Secondary School Visual Arts Lesson Acquisition Scale*

Secondary School 6th Grade Visual Arts Lesson outcome scales developed by Yanal (2019) were used to determine the extent to which secondary school students achieved their Visual Arts Lesson achievements. In the scale there are expressions representing the achievements of the sixth grade Visual Arts Lesson. There are 21 items in the outcome scale prepared for the sixth grade. In order to ensure the validity of the scale, the achievements in the Visual Arts Lesson curriculum were taken into account and expert opinion was sought. A 5-point rating system was used to score the outcome scale. Visual Arts Lesson Achievement scale was designed as an observation form. The Visual Arts Lesson teacher gives points between 1 and 5 for each student according to the level of realization of the achievements in the scales by the students. A general score between 1 and 5 is obtained by dividing the scores obtained from the scale by the number of items. Scores of 5 and close to 5 indicate that the achievements of the Visual Arts Lesson have been realized to a large extent. In this study, the Cronbach alpha reliability coefficient, which was used to demonstrate the reliability of the scale, was found to be .92 for the overall scale.

**Data Analysis Techniques**

SPSS-23 was used in the analysis of quantitative data within the scope of the study. Shapiro Wilk is recommended when the number of observations is less than 30, and Kolmogorov-Smirnov is recommended when it is 30 or more (Ak, 2008). Since the sample size of the study was 48, Kolmogorov Smirnov test was used to test the normality of the data. In the study, it was decided whether the data showed normal distribution or not, using the



Kolmogorov Smirnov test, Descriptive Statistics values and Histogram graphics. In this context, since the research data did not meet the normal distribution assumptions, the Wilcoxon Sign test was used to look at the significant difference between the pretest and posttest scores of the Design Based STEM activities in the experimental group, the Wilcoxon Sign test to look at the significant difference between the pretest and posttest scores of the traditional teaching activities in the control group, Mann Whitney U test was used to compare the posttest scores of the groups.

## Findings

When Table 4 is examined, it is seen that the posttest-pretest attitude scores of the students in the experimental groups are compared. As a result of the Wilcoxon signed-rank test, it is seen that the pretest and posttest attitude scores of the experimental group students differ statistically [ $z=-4.115$ ;  $p<0.05$ ). After the procedures performed in the experimental group, there was a significant increase in the attitudes of the students towards the visual arts lesson.

Table 4. Comparison of Pretest-Posttest Attitude Scores of the Students in the Experimental Group

Experimental Group		N	Mean Rank	Sum of Ranks	Wilcoxon Z	p
Attitude Post-test—Pre-Test	Negative Ranks	0	0.00	0.00	-4.115 <sup>c</sup>	0.000
	Positive Ranks	22	11.50	253.00		
	Ties	2 <sup>d</sup>				
	Total	24				

When Table 5 is examined, it is seen that the posttest-pretest attitude scores of the students in the control groups to whom traditional teaching was applied were compared. As a result of the Wilcoxon signed-rank test, it is seen that the pretest and posttest attitude scores of the control group students differ statistically [ $z=-4.112$ ;  $p<0.05$ ). After the teaching practices carried out in the control group, significant increases were observed in the attitudes of the students towards the visual arts lesson.

Table 5. Comparison of the Pretest-Posttest Attitude Scores of the Students in the Control Group

Control Group		N	Mean Rank	Sum of Ranks	Wilcoxon Z	p
Attitude Post-test—Pre-Test	Negative Ranks	0	0.00	0.00	-4.112	0.000
	Positive Ranks	22	11.50	253.00		
	Ties	2				
	Total	24				

The results of the Mann Whitney U test, in which the posttest scores of the experimental and control groups from the attitude scale towards the visual arts lesson were compared, are given in Table 6. As a result of the statistical processes, a significant difference was found between the posttest attitude scores of the experimental and control

groups ( $Z=-4.796$ ;  $p>0.05$ ). Accordingly, the students in the experimental group who were taught STEM-focused visual arts had higher attitudes than the control groups taught with the traditional method.

Table 6. Comparison of Posttest Visual Arts Attitude Scores of Students in Experimental and Control Groups

	Group	N	Mean		Mann	
			Rank	Sum of Ranks	Whitney U/Z	p
Post-Test	Experimental	24	34.17	820.00	-4.796	0.000
	Control	24	14.83	356.00		
	Total	48				

When Table 7 is examined, it is seen that the posttest-pretest visual arts lesson achievement scores of the students in the experimental groups are compared. As a result of the Wilcoxon signed-rank test, it is seen that the pretest and posttest achievement scores of the experimental group students differ statistically [ $z=-4.287$ ;  $p<0.05$ ]. After the procedures carried out in the experimental group, there was a significant increase in the gains of the students in the visual arts lesson.

Table 7. Comparison of Pretest-Posttest Visual Arts Lesson Achievement Scores of the Students in the Experimental Group

Experimental Group		N	Mean Rank	Sum of Ranks	Wilcoxon	
					Z	p
Acquisition	Negative Ranks	0 <sup>e</sup>	0.00	0.00	-4.287	0.000
Post-test—Pre-Test	Positive Ranks	24 <sup>f</sup>	12.50	300.00		
	Ties	0 <sup>g</sup>				
	Total	24				

When Table 8 is examined, it is seen that the posttest-pretest visual arts course achievement scores of the students in the control groups are compared. As a result of the Wilcoxon signed-rank test, it is seen that the pretest and posttest achievement scores of the control group students did not differ statistically [ $z=-1.795$ ;  $p>0.05$ ]. After the traditional teaching practices carried out in the control group, no significant increase was observed in the visual arts course achievements of the students.

Table 8. Comparison of Pretest-Posttest Visual Arts Lesson Achievement Scores of the Students in the Control Group

Control Group		N	Mean Rank	Sum of Ranks	Wilcoxon	
					Z	p
ACQUISITION	Negative Ranks	9 <sup>e</sup>	8.78	79.00	-1.795	0.073
Post-test—Pre-Test	Positive Ranks	14 <sup>f</sup>	14.07	197.00		
	Ties	1 <sup>g</sup>				
	Total	24				

The results of the Mann Whitney U test, in which the posttest scores of the experimental and control groups from the visual arts lesson outcome test were compared, are given in Table 9. As a result of the statistical processes, a significant difference was found between the posttest achievement scores of the experimental and control groups ( $Z=-5.026$ ;  $p<0.05$ ). Accordingly, students in the experimental group taught with STEM-oriented visual arts achieved a higher level of attainment compared to the control groups taught with the traditional method.

Table 9. Comparison of Posttest Visual Arts Lesson Achievement Scores of Students in Experimental and Control Groups

		Mean		Mann Whitney		
		N	Rank	Sum of Ranks	U/Z	p
Port-test	Experimental	24	34.63	831.00	5.026	0.000
	Control	24	14.38	345.00		
	Total	48				

## Discussion and Conclusion

In the discussion part of this study, which was carried out in order to determine the effects of the activities carried out based on the STEAM approach, in accordance with the secondary school Visual Arts curriculum, on the achievement of the lesson achievements of the 6th grade students and their attitudes towards the lesson; The sub-problems were associated with the findings obtained from the data collection tools, compared with other studies on the subject, and the extent to which the solution of the sub-problems of the research was achieved was examined. Examining the findings in the study, it was found that the students in the experimental group, who were applied STEAM, developed significantly higher attitudes towards the visual arts lesson compared to their peers in the control group, which was applied traditional teaching. These findings are in Darling-Hammond & Bransford (2005), Henriksen (2014), Kim et al. (2014), Kong & Ji (2014), Nadelson, Seifert, Moll & Coats (2012), and Uğraş (2018). According to Darling-Hammond & Bransford (2005), integrating science-technology-engineering-mathematics and art education into the curriculum of STEM-based activities in the teaching process provided more participation in the learning processes of the students, affective learning products, and meaningful and permanent learning experiences. According to Henkriksen (2014), incorporating art into the STEAM approach reduces students' anxiety about the lesson and increases their motivation and attitudes in a positive way, even though it is difficult and time-consuming in classrooms. With the inclusion of an interdisciplinary approach in art, in-class participation also increases. In addition, students have the opportunity to see the connection between Science, Mathematics, Technology and Engineering disciplines and Art. In STEAM applications, the students' creation of a product by making small designs motivates the students towards the lesson. When students produce a product at the end of the applications, they see that their current knowledge works and they are motivated to learn more.

Another finding of this research is about the effect of the activities based on the STEAM approach on the achievements of the 6th grade students in the visual arts lesson. According to the research findings, it was seen that the students in the experimental group, who were applied with STEAM, achieved significantly higher visual

arts lesson gains compared to their peers in the control group, which was applied traditional teaching. These findings are similar to those of the research conducted by Bae (2011), Cook, Bush & Cox (2017), Kang (2019), Kim (2015), Liao (2016), and Mishra (2011). Educational activities with the STEAM approach contribute to the teaching of that discipline in many ways, regardless of which component it is based on. The STEAM approach used in teaching science subjects enables students to learn the lesson content better and to increase their perceptions about STEAM subjects (Kim, 2015). While STEAM trainings are effective in increasing secondary school students' attitudes towards technology, they also increase students' attitudes towards using technology in lessons and developing creative activities (Bae, 2011). In general, the transdisciplinary nature of STEAM teaching is compatible with the nonlinear problem-solving and open-ended nature of creative thinking (Mishra et al., 2016), encouraging students to create a space to use their imaginations (Eisner, 2002). All these situations indicate that STEAM contributes to meaningful and effective learning in the visual arts lesson, where creativity and imagination are important. On the other hand, art and engineering education includes activities based on problem solving. This method gives students the ability to think at a high level. Considering that art is always a form of mass communication, students can create more original, functional and aesthetically balanced objects with STEAM applications (Bequette & Bequette, 2011).

As a result, STEAM education, which provides the integration of all knowledge and skills in science-technology-engineering-mathematics and art disciplines, should be popularized in schools and out-of-school learning environments, considering that it positively changes the attitudes of students towards the Visual Arts lesson and increases their achievements. In this way, it can be said that the interest and motivation of the students will increase with the inclusion of art among these fields that can be seen independently of each other, while the decreasing interest in both visual arts and science and mathematics is increased. In order for this method to be effective in schools, necessary equipment and resources on STEM/STEAM should be provided in Visual Arts workshops, and teachers should be trained on this subject. The research is a quantitative study. It is important to evaluate similar studies to be carried out in the future in a holistic way and to gain a different perspective.

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