The Effect of the Art-themed Activities on Mathematics Achievement and Student Views

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Abstract

This study was aimed to examine the effect of teaching with art-themed activities on students' mathematics achievement and to examine students' attitudes on the teaching process. The research was carried out with a total of 52 fifth grade students studying in Istanbul (Turkey). The research has a hybrid design in which qualitative data are used to support quantitative data. In the study carried out with the quasi-experimental research method, the experimental group was taught with art-themed mathematics activities, while the control group was taught with the activities in the Ministry of Education textbook. As a result of research, it was found that teaching mathematics with art-themed activities was more effective in increasing math achievement than teaching with the Ministry of Education textbook. Students considered teaching as fun in general through art-themed activities and expressed that they learned better by having fun. Findings are discussed with a reference to relevant and recent literature.

Keywords

art-themed activity, attitudes towards mathematics, mathematics achievement, mathematics education, quasi-experimental method

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Introduction

Mathematics is seen as a difficult lesson to learn for students. When the TIMSS data of 2015 and the last 10 years of the PISA exam are examined, it is observed that Turkish students' math scores have lagged behind in the country rankings and their level of math literacy has gradually decreased (Taş et al., 2016; Yıldırım et al., 2016). Many personal, social, and environmental factors influence students' mathematics success. One of them is that the students don't like mathematics and therefore mathematics course. As interest in mathematics increases, students' mathematics success also increases (Yıldırım et al., 2016). In the current curriculum, activities are used to increase students' interest in the course (Milli Eğitim Bakanlığı [MEB], 2018). However, the functioning and activities in textbooks may not provide sufficient motivation for the student and may not attract the attention of the students. In order to achieve effective teaching, it is important to enrich the teaching process with remarkable activities aimed at developing skills (Nolan, 2009).

Art is an important context for students to develop their mathematical skills as well as spatial understanding and proportional thinking skills associated with artistic skills. There is a reciprocal relationship between mathematical learning and artistic learning (Edens & Potter, 2007). Kim (2018) states that combining art with different disciplines can improve students' creativity.

Music-integrated teaching can help students learn at many levels and broaden participants' intellectual horizons (Overland, 2013). Johnson and Eason (2016) examined the impact of participation in music programs on students' attendance and academic achievement. As a result of the study, the amount of music participation was found to have a significant impact on both students' participation and academic achievement. Such activities have positive effects on the development of students' multiple mathematical abilities (modeling, strategy development and implementation) (An et al., 2013); on their academic achievement, attitude, and knowledge persistence (Topçu & Bulut, 2016; Yağışan et al., 2014). Teachers who engage in music-integrated mathematics in their classrooms say that this teaching will help students to understand concepts more deeply (Still & Bobis, 2005) and enable them to see mathematics from different angles (An et al., 2016). The inclusion of art in the curriculum also encourages students to transfer what they have learned from art to non-art areas (Catterall, 2005).

For teachers and teacher candidates in designing math activities integrated with music, it appears that the activities are based mainly on four areas of music content (An & Tillman, 2014): (i) listening and singing, (ii) composition and performance, (iii), musical notes, and (iv) the design of musical instruments. Another area that comes to mind when we talk about music is dance. Music and dance are two inseparable areas. Dance can therefore be used in music integrated teaching. What mathematics and dance have in common include concepts such as direction, model, combinations, sequence, symmetry, transformation, communication, and problem solving (Rosenfeld, 2013).

There is a close relationship between mathematics and visual arts (Kaplan et al., 2015). For example, with the help of Islamic patterns, teachers can teach symmetry, rotation, reflection, simple mathematical shapes and their relationships at all levels from kindergarten to university level. It is even possible to switch to group theory with the help of Islamic

patterns (Abas, 2004). From an academic point of view, there is a significant difference in attitude and mathematics achievement of the students who receive mathematics education supported by visual arts course compared to the students who receive traditional education (Ozder, 2008).

Drama based instruction students' academic achievements (Cakır, 2012), self-motivation, self-sufficiency and self-concept (Campbell, 2013) increases, and helps you learn mathematical concepts better (Masoum et al., 2013). Students who experience the use of drama in geometry teaching find it the method fun and useful. Drama-based teaching increases the attractiveness of the course and offers students the opportunity to learn together, show what they have learned and increase their confidence in each other (Günhan & Özen, 2010).

Regardless of the grade level, most students regard mathematics as a difficult and boring course. Therefore, the low level of internal motivation of the students causes the course to be inefficient and reduces success (Bozkurt & Bircan, 2015). It is important to transform the formal and abstract structure of mathematics into fun with the help of activities, as making the lesson fun increases the students' interest and motivation. Activities included in Mathematics textbooks are prepared in accordance with the current curriculum (MEB, 2018). But it's noteworthy that there aren't enough art-themed events in textbooks. It is therefore thought that the work will contribute to the world of education and fill the current gap. In this context, the aim of the research is to examine the effects of mathematics teaching enriched with art-themed activities on student mathematics achievement and to determine the students' views on the teaching process. Accordingly, the sub-questions of the study are as follows: 1. What is the scope of the impact of teaching with art-themed math activities on math achievement? and 2. What are students' views on teaching with art-themed math activities?

Methodology

Research design

The present study was designed in accordance with the quasi-experimental research model. There are two groups in the study, the experimental group and the control group. While the experiment group was taught mathematics with art-themed activities, the control group was taught with the activities in the textbook of the Ministry of Education.

The work consists of two parts. Quantitative method was used to determine the impact of art-themed activities on students' math achievement. In order to support the findings obtained from quantitative data, qualitative methods were used to determine student views through journals. Therefore, hybrid design was used, with more emphasis on quantitative division and supported by qualitative data. While the quantitative data obtained from the research are the students' mathematics achievement, the qualitative data are the opinions obtained from the student journals.

Participants

For the study, fifth grade students studying at a secondary school in Istanbul(Turkey) in the 2017-2018 academic year were selected as sample. A total of 52 students (26 experimental groups and 26 control groups) were included in the sample. The universe of research covers all fifth-graders. Since both groups were trained for three weeks, accessibility was taken into account in school selection. Therefore, the easily accessible state sampling technique was used. With this method the researchers gained speed and practicality in the application process (Yıldırım & Şimşek, 2018).

Data collection tools

In the scope of the study, "Mathematics achievement exams" and semi-structured student journals were used to collect data. For the application, 5th grade "Geometry and Measurement" learning area and "Basic Geometric Concepts and Drawings" sub-learning area were chosen as the subject topics. The ability of the subject to be integrated into more than one art field has been the focus of attention when choosing the subject. Three experts, one of whom is an measurement and evaluation specialist and two of whom are experts in mathematics education, were consulted to determine the parallelism, degree of difficulty and suitability of the achievement exams. The final version of the tests was given according to the opinions received.

During the application, reflective journals were used to take notes and learn the feelings, thoughts and views of the students instantly. Semi-structured journal forms were prepared taking into account the presence of students who do not want to write or talk about their experiences in general. It was also thought that the space left in journals for students would give students the power to think about things they found useful and unhelpful. A framework has been drawn specifically to comments and emotions with questions added to their daily forms. This, in turn, helped students communicate with the researcher. Thus, unnecessary information to be added to the students' journals was prevented and the data became more functional. Examples of expressions in the journals are as follows:

1. Course passed fun / boring. Because……
2. I have understood the subject in the course very less / less / very good. Because……
3. The most interesting part of the course …….. Because……
4. This course is different from the previous mathematics courses. Because……

Data collection and analysis

Within the scope of the research, 11 art (painting, music and drama) themed activity plans were designed by the researchers in accordance with the MEB (2018) curriculum, covering the objectives in the "Basic Geometric Concepts and Drawings" sub-learning area. It has been prepared by considering contemporary approaches such as reflective thinking. According to Gardner (1991), multiple intelligences include Linguistic intelligence, Logical-Mathematical intelligence, Musical intelligence, Spatial intelligence, Bodily-Kinesthetic intelligence, Interpersonal intelligence, Intrinsic intelligence (Smith, 2002). But later existential intelligence was also added to the theory. In the activities created within the scope of the application, different branches of art were included and it was aimed to ensure the participation of students with different types of intelligence (Appendix 1). With multi-intelligence activities, students become aware of their abilities and take their own learning responsibilities (Sünbül, 2014). For detailed information about the activities, see the thesis of author Yıldızhan (2019).

The activities included activities requiring group work. Group work not only draws attention to the lessons of the students with social intelligence type, but also provides the opportunity for cooperative learning. With cooperative learning, students are not only responsible for their own success but also for the success and learning of the team (Sünbül, 2014). To this end, the students become aware of their responsibilities and perform their duties.

The activities prepared within the scope of the research were applied to the experimental group for three weeks. In the control group, the lesson was taught based on the activities in the Ministry of Education textbook. During this period, one of the two researchers took part in the class and observed the process. The points found to be remarkable about the process were noted by the researcher and presented in the study findings. Also, pre-test and post-test were applied to both groups to determine the success levels of students before and after the teaching process. Students were asked to fill in their journals at the end of each lesson in order to learn their views and feelings about the course process. While the data obtained from the pre-test and post-tests were analyzed with the SPSS 21 program, the student journals were analyzed with the help of the NVivo program.

Approval

The present study was carried out as a master's thesis at Marmara University. At the time of the study, all stages of the study are carried out under the control of the university and ethics committee approval is not required. Application permission was obtained from the Ministry of Education in order to apply to the students. Also, since the students were under the age of 18, consent was obtained from the parents of the students for their children to participate in the study. In order to document this, the parents signed a petition declaring that the students voluntarily participated in the study.

Findings

The effect of teaching with art-themed mathematics activities on math achievement

The findings of this study are presented on the basis of research questions. The first research question focuses on the impact of arts-themed activities on students' math achievement. In order to test this question, it was first determined whether the scores of the control and experimental groups were normal distributions. Since the number of students in the groups was less than 30, the Shapiro-Wilk normality test was performed and the results of the analysis were given in Table 1.

Table 1. *The results of the Shapiro-Wilk tests*

			Parameters			
	Groups	**N**	$\bar{x}$	Ss	**z**	**p**
Pre-Test Scores	Experimental group	26	,3397	,17308	,918	,040*
	Control Group	26	,3974	,18304	,887	,008*
Post-Test Scores	Experimental group	26	,5833	,27988	,922	,049*
	Control Group	26	,4679	,26675	,884	,007*

*p<0,05

It was found that preliminary test scores and post test scores from the experimental and control groups did not show normal distribution (p<0,05) (Table 1). Therefore, the data from the groups were analyzed using nonparametric statistical tests. In order to determine the mathematics achievement of the selected experimental and control groups before the application, the pre-test scores of the groups were compared using the Mann Whitney-U test, one of the non-parametric tests.

Table 2. *Mann Whitney-U test results for pretest*

	Group	**N**	**S.O**	**S.T.**	**U**	**z**	**P**
Pre-Test Scores	Experimental group	26	23,77	618,00	267,000	-1,355	,17
	Control Group	26	29,23	760,00			
	Total	52					

As a result of the analysis (Table 2), there was no significant difference between the math achievement preliminary test scores of the experimental group and the control group (p>0,05). This information was an indication that the initial levels of the groups were equal and therefore the study would provide reliable results. Or in other words, the result of the post test can be entirely attributed to the effect of the experimental design prepared for the study, since the groups were equal before the study began. Pre- and post- test scores of the two groups were analyzed with the Wilcoxon sign test to determine the impact of

mathematics teaching with art-themed activities and mathematics teaching based on textbooks prepared according to the Ministry of Education curriculum on success.

Table 3. *Wilcoxon marked ranks test results*

	Group	Rank	N	S.O.	S.T.	z	p
Post-Test Score – Pre-Test Score	**Experimental Group**	Negative Rank	4	8,75	35,00	-3,484	,00*
		Positive Rank	21	13,81	290,00		
		Equal	1				
		Total	26				
	Control Group	Negative Rank	9	10,72	96,50	-,995	,32**
		Positive Rank	13	12,04	156,50		
		Equal	4				
		Total	26				

*p<0,05

As a result of the analyses (Table 3), there was a significant difference between the achievement scores of the students who were taught mathematics through art-themed activities at the end of the course and at the beginning of the course (p <0,05). There was an increase in the success of about 80% (21 people) of the students. In the course taught according to the textbooks prepared according to the Ministry of Education curriculum, there was no significant difference between the post-teaching and pre-teaching success scores of the students (p>0,05). It was observed that only 50% (13 people) of the students increased their success. Considering that the scores of the students in the two groups are similar before starting the lesson, it is understood that arts-themed activities and mathematics teaching affect student achievement more positively. To test whether this effect was significant, the Mann Whitney-U test was performed on the post-intervention (post-test) scores of the experiment and control group.

Table 4. *Mann Whitney-U test results for posttests*

	Group	N	S.O	S.T.	U	z	p
Post-Test Scores	Experimental group	26	29,63	770,50			
	Control Group	26	23,37	607,50	256,500	-1,516	,13
	Total	52					

As a result of the analysis (Table 4), there was no significant difference between the post test scores of the experimental group and the post test scores of the control group (p>0,05). The post test scores of the students in the experimental group were higher than those in the control group. However, this difference was not statistically significant at the p <0,05 significance level.

Student views on art-themed math activities

Data from the semi-structured math journals of the students in the experimental group were analyzed to reveal the students' views on this intervention (teaching with

art-based activities). Students were given a journal form at the end of each course and analyzed. The total number in the analysis of qualitative data varies because the journal forms of students who did not attend classes are missing.

The findings obtained from the journals are classified as main title and justification appropriate to the title (Table 5). The titles in the students 'reflective math journals were "the state of being fun", "understanding of the lesson", "an interesting chapter" and "differences with other math lessons". It has been observed that there is a constant emphasis on the entertainment factor in the diaries of students. It was understood that students found the activities fun and therefore did not consider math as a boring and difficult lesson. It is also seen that they find this lesson much more understandable and interesting because they have fun. The reason why they describe this course as a different course than other mathematics courses is that it is also enjoyable.

Table 5. *Titles and justifications revealed in the journals*

The state of being fun	Understanding of the lesson	As an interesting part	Difference with other mathematics courses
To be fun	**Enjoyable**	**Activities**	**Enjoyable**
Activities	Beautiful	The subject itself	**Activities**
New teacher	expression	**Enjoyable**	Teacher
Easy and straightforward	**Activities**	Teacher	No difference
topics	New teacher	Writing	Not enjoyable
Not writing	Noise	Everything	Educational games
Learning New Things		Nothing	The subject itself
Old Topics			Learn without writing
			The importance of mathematics

When student opinions about the course being fun or boring were examined, 95,08% of students found the course enjoyable (Table 6). The codes obtained from student reasons were to be fun (40,98%), lesson with activity (31,15%), new teachers (13,11%), unanswered (6,56%), easy and clear topics (3,28%), not writing (1,64%), learning new things (1,64%) and old topics (1,64%).

Table 6. *Student views on how the course should be fun*

Being fun	n	%	Reasons	n	%
Enjoyable	58	95,08	**To be fun**	25	40,98
Boring	3	4,92	**Lesson with activity**	19	31,15
Total	61	100,0	**New teacher**	8	13,11
			Unanswered	4	6,56
			Easy and clear topics	2	3,28
			Not Writing	1	1,64
			Learning new things	1	1,64
			Old topics	1	1,64
			Total	61	100

Sample sentences taken from 26 student journals who find the lesson enjoyable:

> Student3: *"The lesson was a lot of **fun**. Because we both **laugh** and understand much better and faster in the lesson."*
> Student12: *"We did very good things. The lesson was **fun**. We learned new things. It makes me so **happy**."*
> Student24: *"The lesson was **fun**. Because we had **fun**, we did activities. And we learned from the activity."*

When the student opinion on the teaching level of the course was examined, 88,52% of the students stated that they understood the course very well (Table 7). The codes obtained from student reasons were to have fun (32,79%), good lecture (22,95%), activities (11,47%), new teacher (3,18%), did not listen (1,64%) , very good understanding (1,64%) and noise in the classroom (1,64%). 24,59% of the students did not provide any reason.

Table 7. *Students' opinions about the teaching level of the course*

For Understanding the course	n	%	Reasons	n	%
Very Good Understood	54	88,52	To be fun	20	32,79
Little Understood	3	4,92	Not Responded	15	24,59
Very little Understood	3	4,92	Good Lecture	14	22,95
Unanswered	1	1,64	Activities	7	11,47
Total	61	100,0	New Teacher	2	3,28
			I did not listen	1	1,64
			Very Good Understanding	1	1,64
			Noise in the Classroom	1	1,64
			Total	61	100,0

Sample sentences taken from 26 student journals that express their understanding of the courses very well;

> Student7: *"I understood the subject **very well**. Because we work in class while **having fun**."*
> Student10: *"I understood the lesson **very well**. Because when **I play with fun**, I understand better."*
> Student18: *"I understood the lesson **very well**. Because I learned **by having fun**."*
> Student20: *"It went **very well**. Because **it piqued my interest**."*

When student opinions about the interesting part of the course were examined, 65,57% of the students stated that the sections about the activities were interesting (Table 8). The themes that emerged from the explanations of students about the reasons for finding them interesting were activities (65,57%), the subject itself (13,11%), having fun (8,20%), teachers (3,28%), writing (1,64%), everything (1,64%) and nothing (1,64%). 4,92% of the students did not respond.

Table 8. *Students' views on the section that attracted the most attention in the course*

Reasons	n	%
Activities	40	65,57
The subject itself	8	13,11
Enjoyable	5	8,20
Teacher	2	3,28
Writing	1	1,64
Everything	1	1,64
Nothing	1	1,64
Unanswered	3	4,92
Total	61	100,0

Sample sentences taken from 26 student journals who find the course interesting;

> Student4: *"The most interesting part of the lesson is the **vibration of the guitar** and **seeing the fluctuating sound up close**."*
> Student11: *"The part that caught my attention in class was **the symmetry in the last castle we built**."*
> Student14: *"**Activity**, **drama** and **entertainment**. It's beautiful and I like it very much."*
> Student22: *"The part I was most interested in in the course was **finding the upright sections in the film**."*

When students' opinions on the difference of the course from previous mathematics courses are examined, the reasons the students present in their journals are as follows: enjoyable (31,1%), activities (28,9%), teacher (17,8%), no difference (9,0%), not enjoyable (4,4%), educational games (2,2%), the subject itself (2,2%), learning without writing (2,2%), the importance of mathematics (2,2%).

Table 9. *Students' views on comparing art-themed teaching*

Reasons	n	%
Enjoyable	14	31,1
Activities	13	28,9
Teacher	8	17,8
No difference	4	9,0
Not enjoyable	2	4,4
Educational games	1	2,2
The subject itself	1	2,2
Learning without writing	1	2,2
The importance of mathematics	1	2,2
Total	45	100,0

Sample sentences taken from 26 student journals;

> Student8: *"It was different from previous math classes. Because we did a lot of **activities** and it became a **very fun** course. I had **a lot of fun** and learned a lot by doing **activities** like this."*

Student17: *"It was different from previous math classes. Because we had normal education in the normal lesson, but in this lesson we **learn by having fun**."*
Student19: *"This course was different from previous mathematics courses. Because in this we **play games**, we learn by writing."*
Student23: "*This course was different from previous mathematics courses. Because we did **activities** and taught lessons **in a fun way**."*

Data from researcher observations that support research findings

In this section, situations observed by the researcher are covered during activities with 5th grade students. It has been observed that the activities used in the process offer students the opportunity to create creative thinking and creative work. In the drawing activities, the students painted their drawings the way they wanted to and took the event to a different dimension with what they added to their drawings. At the events with music, some of the students turned the song into rap music as an alternative to the melody presented. And that's how they sang. In this way, Original and creative thinking students were offered the opportunity to present their work to the class and the students were supported. The drawings made by two students at the drawing event during the teaching process are given below:

Figure 1. *Drawing of (a) student13* *(b) student21*

The drawing made by Student13 is exactly the same as the form expected to be created within the activity. To add something from himself/herself to the event, the student simply wrote the name of the football team she supports and tried to color him/her drawing using the team's colors. It is noteworthy that Student21 added a lot of detail to the drawing. The student added clothes and shoes to the human figure. When he/she made these additions, he/she thought of everything down to the smallest detail. Laces on shoes, zippers on pants, buttons on shirts and suspenders are among the details that the student added to the drawing. The student not only added dress details to the shape, but also saw and added the folds of his ear missing. The student who finished the drawing showed the teacher his/her picture and explained all the details one by one:

> Student21: *"Teacher, this person was a firefighter. There was a fire in the house next door. The orange lines on the roof of the house indicate the fire. The firefighter also went to the scene of the fire and tried to put out the fire by spraying water. The firefighter's left hand is a firefighter's hose. He/she was fighting the fire by spraying water with it."*

Also, it is noteworthy that the shape in the painting gives an aesthetic state by incorporating arrows showing the starting points placed by the teacher into the student's story. The student21 explained this to his teacher as follows:

> Student21: *"Teacher, I did not leave the arrows you drew blank. I wrote The Fireman's name on the first arrow. I drew the water towards the arrow to interpret the second arrow as if it was pointing at the point where the firefighter was spraying water."*

Given these and similar examples encountered during the teaching process, it is seen that teaching with art-themed activities supports the development of creativity towards the interests of the students. This finding is also supported by the phrase "I think this lesson is useful for me because it improves my painting skills and math." in a student's journal. Therefore, it is understood that the imagination and its products that occur simultaneously while students are doing math during teaching with art-themed activities are important to encourage and support teaching. It has been observed that students use many skills such as spatial and proportional thinking as well as creative thinking when dealing with art-themed math activities. Spatial and proportional thinking is part of mathematical thinking as well as being associated with artistic skills. Math activities enriched with art allow students who are not yet in 5th grade to use these skills without realizing its findings respond to the purpose of the study, and are presented systematically. Findings are supported with sufficient and relevant quotations, examples, tables and diagrams.

Discussion

The aim of this study is to determine the effectiveness of teaching with art-themed activities. For this reason, while lessons were taught according to art-themed activities in one class, teaching was carried out in another class by adhering to the textbooks prepared according to the Ministry of Education curriculum. As a result of the research, more than half of the students increased their mathematics achievement as a result of teaching with artistic activities. Therefore, there was a significant difference in the success of these students. As a result of the education carried out in accordance with the Ministry of Education textbook, only half of the students were able to increase their mathematics achievement. Therefore, no significant difference was observed in the achievements of these students. In light of this information, it can be said that the increase in student achievement is due to well-chosen, created and organized rich content activities.

When the comparison was made between the groups, unexpectedly, there was no significant difference between the post-test achievements of the group that was taught with art-themed activities and the group that was taught by adhering to the Ministry of Education textbook. All these results are interpreted as both methods are effective in increasing student success, but the course prepared with art-themed activities is more effective in increasing

success. This positive but not significant result suggests that more research is needed to enrich mathematics with art-themed activities. Since research is limited to 3 weeks of education, teaching for a longer period may be the solution. Deeper enrichment activities rooted in more understanding oriented could be another solution. However, the study also revealed some interesting results.

Students who were educated with art themed activities evaluated the process as "fun" in general. They stated in their journals that they found the lesson fun because they played games and did activities throughout the process. They stated that they understood the subject very well because they had fun and did activities in the lesson. The sections that attracted the most attention of the students in the course were not related to the subject content but related to the activities carried out. The fact that the course is fun and the activities are accompanied by activities has made the course different from the previous mathematics courses in the eyes of the students. The findings of Atasay and Erdoğan (2017), Özder (2008), Özsoy (2003) and Özsoy (2007) support the students' views.

As a result of the research, it has been shown that mathematics teaching with art-themed activities is more effective in increasing success than teaching based on Ministry of Education textbook. The results of this study show that teaching mathematics with songs (Halperin, 2011; Topçu & Bulut, 2016); drama-based mathematics teaching (Duatepe & Ubuz, 2007; Inoa, Weltsek & Tabone, 20140 and visual arts supported mathematics teaching (Katipoğlu, 2016; Özder, 2008) is consistent with the results of many studies showing that it increases student achievement. Furthermore, as a result of the researcher's observations, it was observed that art-themed activities supported students' creativity. This conclusion is supported by statements from Kim (2018).

Conclusion and Recommendations/Implications

Under this heading, suggestions were made to researchers, educators and book authors who wanted to study the subject based on the results of the research. The present study is limited to 5th grade students. Researchers who want to work on teaching mathematics with art-themed activities can conduct similar studies at different grade levels. In the present study, student journals were used to shed light on the process. Researchers who will carry out similar studies can videotape the teaching process to examine student views and analyze the process in detail. In the research, it was observed that artistic activities supported the creativity of students. By investigating this situation, researchers can examine the effect of teaching enriched with artistic activities on students' creativity levels. Also, new studies can be designed to show the relationship between artistic activities and enriched teaching and multiple intelligences.

As a result of the research, it is seen that art-themed activities not only increase the mathematics achievement of the students, but also affect the affective characteristics of the mathematics lesson positively. Therefore, it may be suggested to our teachers to use activities in which art and mathematics are intertwined in their classrooms, or where a work of art emerges as a result of an extracurricular activity. Workshops can be organized so that our teachers can design effective, useful and creative art-themed activities related to mathematics teaching. Also, it is recommended that mathematics teachers collaborate and exchange ideas

with art lesson (painting, music, physical...) teachers during the design, planning and implementation stages of mathematics lessons with art-themed mathematics activities.
Finally, suggestions can be made to textbook authors in line with the findings obtained from the research. It is recommended that the activities in the mathematics textbook be organized as artistic activities that will increase the interest and motivation of the students.

Disclosure statement

No potential conflict of interest was reported by the authors.

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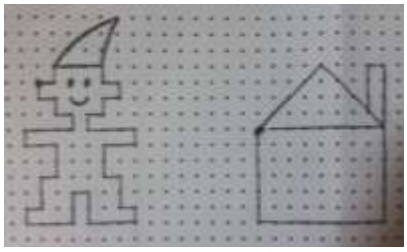
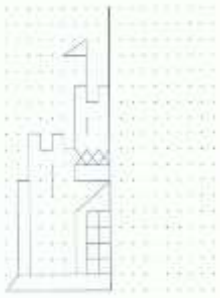
Biographical Notes

BERNA YILDIZHAN completed her bachelor's degree in Elementary Mathematics Teaching Program of Marmara University in 2016 and her master's degree in Elementary Mathematics Teaching Department of the same university in 2019. She started her doctoral education at Necmettin Erbakan University, Department of Mathematics Education in 2019. At the same time, she started working as a research assistant at the Department of Mathematics Education of Necmettin Erbakan University. Areas of interest; use of art in mathematics education, geometric patterns in Islamic art, eye tracking and visuospatial ability.

ÖZLEM ÇEZIKTÜRK With a PhD from University at Albany, SUNY in USA of mathematics education, she has been teaching as assistant professor at Marmara University, since 2015. She has been thesis advisor for Berna Yıldızhan and this manuscript is froım her thesis. Her research interests are; mathematics and art, technology in mathematics education, and mathematics thinking

Appendix

Activity Example	Acquisition
Students are asked to say whatever comes to their mind about the word "parallelism" and a discussion environment is created. By exchanging ideas, what is meant to be "parallel" with each other is discussed. Later, the students are shown the animation "The Pink Outs**" in The Pink Panther. Students are asked to show everything they see parallel to each other throughout the animation. When students say that they find a parallel, the animation is stopped and the class and these objects are discussed in parallel. After finding parallel objects, they are asked to show the objects perpendicular to each other in the same way. Video link: https://www.youtube.com/watch?v=1q2hu-mDtKs Example of parallel objects existing in animation:  	***Constructs the line segments parallel to a line segment, interprets whether the drawn segment segments are parallel.***
A dotted paper is distributed to each student. Then, with the commands given by the teacher, the pictures with certain start and end points are tried to be completed. At the end of the lesson, those who complete the picture raise their pictures with their hands and the whole class is allowed to see. Students who reveal the picture correctly are applauded by the class.  Example of the commands given by the teacher:	***Express the position of one point relative to another point using direction and unit.***

• Join the starting point with 3 units below. • Then advance your drawing to the right point by 2 units. • Merge 7 points above with your current point. ... .. **NOTE:** Yann Tiersen's work "Comptine d` autre ete" is played to students during this activity. At the end of the lesson, the video, which is a fun way of playing music, is watched and the lesson ends. Video link: https://www.youtube.com/watch?v=3_52q0djIrA	
The next picture is distributed to students. Students are asked to complete the picture by drawing the same pieces to the right pieces they see on the left. They are expected to form the symmetry of the picture seen in a sense.  NOTE: The song "J'y Suis Jamais Alle" by Yann Tiersen, who plays in the other event during the event, is played to the students. At the end of the course, it is tried to guess what the instrument in the fund is. When it is understood that the sound in the background belongs to a violin, a discussion environment is created in the classroom on how the sound can be heard from the violin. As a result of the discussion, the next picture is reflected on the board and the following information about the violin is given. Violin is a stringed instrument played with the help of bow. There are 4 strings on the violin. Although it is a small and light musical instrument, it is formed by combining an average of 84 separate pieces. Its body is symmetrical with respect to the middle axis. In addition, it is the instrument bone whose voice is most similar to the human voice compared to other instruments.	***Draws lines of equal length on a line segment.***

Notes

* This study is derived from Author XXX's thesis.

** Copyright: The cartoon is produced by David H. De PATIE and Friz FRELENG.