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Examining student achievement and experiences in the teaching of the topic matter and ındustry art based on activities[1]

Madde ve endüstri konusunun sanatsal etkinliklere dayalı öğretiminde öğrenci başarısı ve deneyimlerinin incelenmesi

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[1]It is derived from the Master's thesis with the same title.

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Abstract

The aim of this study is to examine the effects of teaching the eight-grade science topic "Matter and Industry" using educational songs and visual arts activities, in addition to the methods in the curriculum, on academic achievement and to explore student experiences. A sequential explanatory mixed-methods research design was used in this study. Study group consists of twenty-six eighth-grade students from a public middle school in Seydişehir, Konya, during the 2023-2024 academic year. In the quantitative part of the research, a quasi-experimental design with experimental and control groups was used. Data were collected through an achievement test, and the analysis was conducted using IBM SPSS Statistics 22. It was found that there was no statistically significant difference in the achievement scores of the experimental and control groups, but the academic average increases of both groups were the same. This result reveals that teaching science through art is as effective as standard curriculum methods in terms of students' academic achievement. In the qualitative part, a phenomenology design was used. Data were collected using semi-structured interview forms and student diaries, and content analysis was used to interpret the findings using the MAXQUDA programme. According to the findings, it was observed that science teaching integrated with artistic activities had a positive impact on students' cognitive, affective, psychomotor, and entrepreneurial skills. It is recommended that further research be conducted on the effects of incorporating artistic activities into science education, particularly regarding imagination, creativity skills, and knowledge retention.

Keywords: Science, Matter and Industry, Educational Songs, Visual Arts

Öz

Bu araştırmanın amacı; ortaokul 8. Sınıf fen bilimleri dersi "Madde ve Endüstri" konusunun öğretim programındaki yöntemlerin yanında eğitici şarkı ve görsel sanat etkinlikleri ile öğretiminin akademik başarı üzerindeki etkilerini incelemek ve öğrenci deneyimlerini ortaya çıkarmaktır. Çalışmada karma yöntem araştırmalarından, açıklayıcı sıralı karma yöntemler araştırma deseni kullanılmıştır. Araştırmanın çalışma grubunu 2023-2024 eğitim öğretim yılında Konya ili Seydişehir ilçesindeki bir devlet ortaokulunda yer alan 26 sekizinci sınıf öğrencisi oluşturmaktadır. Araştırmanın nicel bölümünde deney ve kontrol gruplarının olduğu yarı deneysel desen kullanılmıştır. Veriler başarı testi ile toplanmış, testlerin analizi IBM SPSS Statistics 22 programı ile yapılmıştır. Deney ve kontrol gruplarının başarı puanlarında istatistiksel olarak anlamlı bir farkın olmadığı ancak her iki grubun akademik ortalama artışlarının aynı olduğu tespit edilmiştir. Bu sonuç sanatla fen öğretiminin öğrencilerin akademik başarıları üzerinde standart müfredat yöntemleri kadar etkili olduğunu ortaya koymaktadır. Araştırmanın nitel desen bölümünde fenomenoloji deseni kullanılmıştır. Veriler yarı yapılandırılmış görüşme formları ve öğrenci günlükleri ile toplanmış, bulguların çözümlenmesinde MAXQUDA programı ile içerik analizinden yararlanılmıştır. Elde edilen verilere göre sanat etkinlikleri ile planlanan fen öğretiminin öğrenenlerde bilişsel, duyuşsal, psikomotor ve girişimcilik becerilerine olumlu etki ettiği görülmüştür. Sanat etkinliklerinin yer aldığı fen bilimleri öğretiminin hayal gücü, yaratıcılık becerileri ve bilgilerin kalıcılığına etkisiyle ilgili araştırmaların yapılabileceği önerilmektedir.

Anahtar Kelimeler: Fen Bilimleri, Madde ve Endüstri, Eğitici Şarkılar, Görsel Sanatlar

Introduction

According to Ellis (2021), when students receive high-quality science education, their problem-solving and critical thinking skills are supported and developed. This suggests that science education, can employ methods and techniques that prioritize student-centered activities where knowledge is discovered, interpreted, and interacted with the environment. Additionally, activities from other disciplines can be integrated to enrich learning (Efe et al., 2021; Sekerci, 2021; Turhan & Kilinc, 2021). Therefore, when teaching is conducted in an interdisciplinary manner without separating disciplines, students are provided with the opportunities to acquire higher order cognitive skills, develop solutions to problems from different perspectives, and learn in high-quality and enriched learning environments (Kar & Cil, 2019; McComas & Wang, 1998).

The connection between art and science, both rooted in exploration, brings them together in systematic and creative activities (Ayvaci, 2021). Science and art are forms of creatively understanding the world (Alioglu, 2010). Integrating science and art can provide individuals with the freedom to think, explore, and make connections (Ayvaci, 2021). A review of the literature indicates that science instruction enriched with art integration utilizing the shared characteristics of both disciplines has been the subject of several studies. Kar (2015) found that science education supported by visual art activities contributed to students' skills in designing experiments, observation, and inference, altough its impact on skills such as in classification, prediction, modeling, data collection, interpretation, and drawing conclusion was limited. It was also noted that this approach did not improve students' skills in recording and presenting data. In Turan’s (2019) study on the effect of learning through music on student achievement, although no statistically significant difference was found, the experimental group taught through songs had a higher arithmetic mean than the control group taught using traditional methods. Demir (2022) found a statistically significant difference in student achievement resulting from of teaching that integrated artistic activities in science lessons. The study identified five different student gains: “cognitive dimension,” “artistic dimension,” “environmental awareness dimension,” “affective dimension,” and “distance learning dimension.” Additionally, research by Poldberg et al. (2013) indicated that when integration was implemented consciously and carefully, visual arts, science, and language arts were positively affected. Isabel (2013) also received positive feedback from university students regarding teaching of science through songs, as it appealed to them, helped them remember key concepts, added variety to classroom learning, and reduced stress levels. These studies serve as examples of how artistic activities can be incorporated into science education.,

Problem Statement and Sub Problems

It has been observed that as the number of sensory organs actively engaged in learning environments increases, the permanence of learning also increases proportionally (Arslan & Adem, 2010). As a result of the literature review, it was found that visual arts applications and educational songs are used in science education to increase the number of active sensory organs in learners and to involve students in the learning process. However, it has been observed that studies in which music and visual arts activities are used together are limited in number. This study was carried out by incorporating popular songs known and loved by students along with various visual art activities, especially in teaching abstract concepts that are difficult to teach and learn in science lessons. The problem statement of this study is as follows: "What is the impact of teaching the subject of matter and industry in 8th grade science classes through art-based activities on academic achievement and student experiences related to the process?" The aim was to determine whether there was a significant difference in academic achievement between the

two groups and to explore the views and experiences of the experimental group students who received instruction with artistic activities. The following sub problems were addressed:

1. Is there a significant difference in academic achievement between the control group students, who were taught the "Matter and Industry" topic in science course using only the standard curriculum, and the experimental group students, who received instruction based on the same curriculum enriched with artistic activities?
2. What are the views and experiences of the experimental group students regarding the learning process in which artistic activities were integrated into the instruction of the "Matter and Industry" topic in the science course?

Purpose and Significance of the Study

In science education, the quartet of 'art, science, design, and product' can be activated in a cyclical manner with the aim of concretising the abstract, scaling the concrete, and simplifying complexity, or with the models created as materials (Ayvaci, 2021). In order to incorporate art, which plays a significant role in our lives, into education and teaching activities, it would be appropriate and suitable to do so in science classes, as they share many common features. Based on this information, the aim of the study is to determine whether there is a significant difference in the academic achievement of two groups of students: the experimental group, who are taught the 8th grade 'Matter and Industry' subject using the methods in the curriculum alongside various visual arts activities involving songs they listen to frequently in their social lives, and the control group, who are taught using only the methods in the curriculum. Additionally, the study aims to include the opinions and experiences of the experimental group students regarding the process in which artistic activities are incorporated into the teaching. In light of these considerations, this study which incorporates both educational songs and visual art activities into science education through an interdisciplinary approach is considered significant as it is expected to contribute meaningfully to the existing body of literature.

Method

Research Model

In this study, an explanatory sequential (quantitative → qualitative) mixed methods research design was used. According to Creswell and Plano Clark (2007), mixed methods research involves collecting and analyzing of both quantitative and qualitative data in one or more phases of a study, followed by the integration of the findings.

Study Group

The study group consisted of eigth-grade students at a public middle school in Seydişehir district of Konya province during the 2023/2024 academic year. In the quantitative part of the research, the sample included a total of twenty-six students. The qualitative study group was determined as the experimental group. Since one of the thirteen students in the experimental group chose not to participate based on voluntary principles, the qualitative study group consisted of twelve students.

Data Collection Tools

In the study quantitative data collection tools were used to measure academic achievement in both the experimental and control groups. These tools included alternative/formative assessment instruments and achievement tests composed of short-answer, open-ended questions aligned with the learning outcomes of the 8th grade science unit "Matter and Industry." The

materials for the quantitative assessments were sourced from the 8th grade science worksheets booklet published by the Ministry of National Education. The assessment tools included:

- A diagnostic branching tree with eleven propositions for the "Periodic Table" topic,
- A diagnostic branching tree with twelve propositions for the "Physical/Chemical Changes" topic,
- An achievement test consisting of ten short answer open-ended questions for the "Chemical Reactions" topic,
- A worksheet with thirty short answer questions and propositions for the "Acids/Bases and Acid Rain" topics,
- A concept map asking for six concepts as a summative assessment for the unit (Aydin et al., 2022).

A rubric-based answer key for the achievement tests, which consist of sixty-nine items in total, was created with the help of expert opinions, and the tests were evaluated on a scale of one hundred points. The reliability coefficient of the sixty-nine item achievement tests was calculated using the Kuder-Richardson 20 (KR-20) test in the SPSS program, where a correct answer was given a score of 1, and an incorrect or blank answer was given a score of 0, based solely on dichotomous measurements. The resulting reliability coefficient was found to be .903 (Bademci, 2007; Barchard & Hakstian, 1997; Suen, 1990). This value indicates that the measurement tools used to determine academic achievement have high reliability. Furthermore, the use of alternative/formative assessment techniques instead of traditional assessment reduced the likelihood of students achieving success by chance. Students were given the opportunity to earn points not only for providing the correct answer but also for the process they followed to reach the correct answer. Since the evaluation focused not only on the outcome but on the entire learning process, the reliability and validity of the assessment were enhanced.

To collect qualitative data from the experimental group, semi-structured interview forms and student journals were used. The semi-structured interview forms, consisting of eight open-ended questions, were developed based on Guc's (2011) thesis titled "The Use of Ebru, a Traditional Turkish Art, in Science Education" and the interview form created by Efe et al. (2021) for their scientific article "The Use of Educational Songs in Science Lessons: The Solar System and Eclipses," along with additional input from two subject matter experts.

When the student responses in the semi-structured interview forms were read and analyzed in detail, it was observed that the answers were relevant to the questions, brief, and clear. Therefore, it was unanimously decided to use each response directly in the data analysis. Subcategories were determined based on the common aspects of the answers. In the student journals, students were asked to write code names instead of their real names in order to freely and genuinely express their thoughts and feelings about the course, in addition to their knowledge of science. To increase the reliability of the data analysis, the information obtained from the student journals was reviewed multiple times, and consensus was reached on some coding discrepancies. To determine the reliability percentage between the researcher and the experts during the analysis process, the following formula was used: Agreement Percentage=[Number of Agreements/(Number of Agreements+Number of Disagreements)]×100 (Miles & Huberman, 2019). Using Miles and Huberman's formula, the inter-coder agreement rate was calculated to be 88%. A reliability percentage of 70% or higher indicates that the codes developed by the coders are considered reliable (Yildirim & Simsek, 2021).

Data Collection

In this study, the subject of “Matter and Industry” in the eigth-grade science curriculum was taught to the experimental group using both the methods outlined in the curriculum and songs commonly listened to in their social lives, along with various visual art activities. In contrast, the control group was taught the same topic using only the standard curriculum methods.

The study was completed over a total duration of thirty class hours, including four science course hours and two environmental and climate change course hours per week, for a period of five weeks. In the research, an achievement test consisting of a diagnostic branching tree, short answer open ended questions, a worksheet, and a mind map was administered to both the experimental and control group students as a pre-test. Subsequently, the topic “Matter and Industry” was taught to the control group students using only the instructional methods and techniques prescribed in the official curriculum. In contrast, the experimental group received instruction using the same curriculum-based methods supplemented with artistic activities. Specifically, the learning outcome “Periodic Table” was addressed through the educational song “Elementsizim,” which integrated relevant concepts and examples along with a modeling activity based on assemblage art, “Physical/Chemical Changes” were taught using sculpture and relief art; “Chemical Reactions” through origami; and “Acids/Bases and Acid Rain” through the educational song “Sourer Than You” and accompanying poster art, both of which reflected core concepts and examples. Unlike traditional assessments conducted at the end of a unit, post-tests in this study were administered after the completion of each sub-topic within the “Matter and Industry” unit. A diagnostic branching tree was used at the end of the “Periodic Table” and “Physical/Chemical Changes” topics; short answer open-ended questions were applied after “Chemical Reactions”; a worksheet at the end of “Acids/Bases and Acid Rain”; and a mind map was employed as a final evaluation tool for the entire unit.

In the study, semi-structured interview forms were administered to the experimental group students before and after the application. These forms, consisting of eight open ended questions and serving as the qualitative data collection tool, were completed through face to face interviews lasting thirty minutes each, conducted with twelve students before and after the intervation. To ensure that students felt comfortable expressing themselves, one-on-one interviews were conducted. During the interviews, questions were explained to the participants, and responses were written in the students' own handwriting on the forms. In addition, throughout the five week implementation process, students in the experimental group were asked to keep weekly journals during the six hours of weekly science instruction. These journals aimed to capture not only students' understanding of scientific content but also their reflections, feelings amd thoughts regarding the lessons.

Data Analysis

In the quantitative part of the study, the IBM SPSS Statistics 22 software program was used to analyze the achievement tests. In order to calculate the data obtained in the study using appropriate statistical methods, normality distributions were first analyzed by examining both the within-group and between-group comparisons of the experimental and control groups. The Kolmogorov-Smirnov (K-S) test was used as the basis for assessing the normality of the data, and the data were also evaluated in terms of kurtosis and skewness values. According to the findings, since the p-values are greater than .05, the data of both groups have a normal distribution (Buyukozturk et al., 2020). The skewness and kurtosis values are within the acceptable range of -2 to +2 for normal distribution. As a result, the data of both the control and experimental groups show a normal distribution (George & Mallery, 2010).

As a result of the analyses, since the data were found to be normally distributed, a paired samples t-test, one of the parametric tests, was used to examine the difference between the pre-test and post-test mean scores within the experimental and control groups. Additionally, an independent samples t-test, also a parametric test, was used to determine whether there was a significant difference between the pre-test and post-test mean scores of the students in the experimental and control groups (Guriş & Astar, 2019).

The qualitative section of the study analysed student diaries and semi-structured interview forms consisting of open-ended questions using content analysis, one of the qualitative methods, with the MAXQDA programme. According to Yıldırım and Şimşek (2021), conceptualisation of data and explanation of meaningful patterns between concepts through themes form the basis of this process in content analysis.

Results

In this study, the results of the pre-test achievement test administered to the experimental and control groups before the experimental procedure are presented in Table 5.

Table 1. Independent samples t-test results for pre-test achievement scores of control and experimental groups

	n	Mean	Std. Deviation	t	sd	Sig. (2-tailed
Control group	13	32.69	16.39	.234	24	.817
Experimental group	13	34.23	17.08			

Table 1. According to Table 1, when the pre-test results of the experimental group are examined, the arithmetic mean is 32.69 and the standard deviation is 16.39; when the pre-test results of the control group are examined, the arithmetic mean is 34.23 and the standard deviation is 17.08. In addition, since the p-value is .817 ($p > 0.05$), it has been determined that there is no significant difference between the experimental and control groups before the experimental process and that the groups are equivalent.

Findings Related to the First Sub Problem

The findings related to the first sub problem, expressed as "Is there a significant difference in academic achievement between the control group students, who were taught the "Matter and Industry" topic in science course using only the standard curriculum, and the experimental group students, who received instruction based on the same curriculum enriched with artistic activities?" are presented in Table 8.

Table 2. Independent samples t-test results for post-test achievement scores of control and experimental groups

	n	Mean	Std. Deviation	t	sd	Sig. (2-tailed
Control group	13	76	12.72	.245	24	.808
Experimental group	13	77.15	11.22			

Table 2. According to Table 2, the post-test arithmetic mean for the experimental group is 76 with a standard deviation of 12.72, while the control group's arithmetic mean is 77.15 with a standard deviation of 11.22. Additionally, since the p-value is .808 ($p > 0.05$), it is observed that there is no significant difference between the experimental and control groups after the experimental procedure. Although there is no statistically significant difference in academic achievement between the experimental group students, who were taught the "Matter and Industry" topic in the science course using educational songs and various visual art activities in addition to the science curriculum, and the control group students, who were taught only through the methods in the curriculum, both groups showed the same increase in arithmetic mean.

Findings Related to the Second Sub Problem

Under the headings below, the findings obtained from the semi structured interview forms administered to the experimental group before and after the experimental process, as well as the student journals written by the experimental group students throughout the implementation, are presented in order in this study.

Findings Obtained from the Semi Structured Interview Forms. The semi structured interview forms used to collect the findings related to the second sub problem were administered as pre and post-tests to twelve students from the experimental group on a voluntary basis, excluding the student coded D4. Under the headings below, the findings regarding the questions in the semi structured interview form related to the second sub problem stated as “What are the views and experiences of the experimental group students regarding the learning process in which artistic activities were integrated into the instruction of the “Matter and Industry” topic in the science course?” are presented in order.

Question 1: What are the positive aspects of the science course in your opinion?

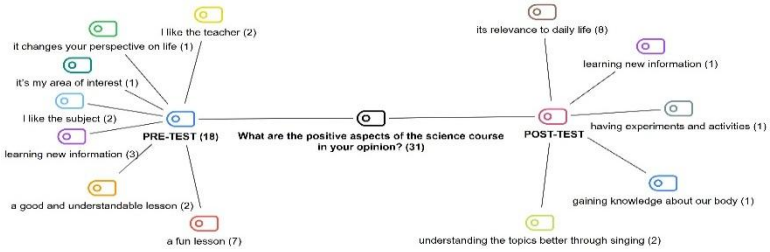

Figure 5. Answer to the question “What are the positive aspects of the science course in your opinion?”

Figure 5. According to Figure 5, while students generally focused on themes such as a fun lesson and learning new information in the pre-test, the post-test highlighted the relationship between science lessons and everyday life, as well as learning opportunities.

A quote from the responses: The student coded D1 answered in the pre-test: “learning new information and that science lessons are fun,” whereas in the post-test, the student stated: “it helps me gain knowledge about situations I encounter in daily life.”

Question 2: What are the negative aspects of the science course in your opinion?

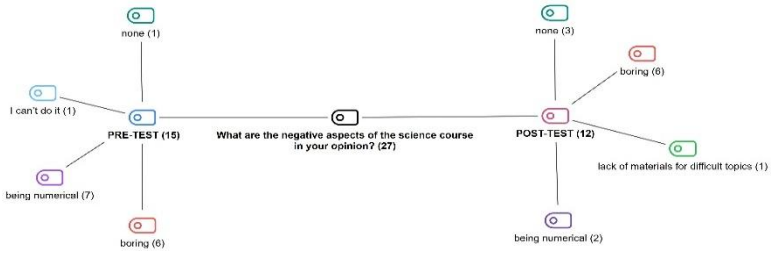

Figure 6. Answer to the question “What are the negative aspects of the science course in your opinion?”

Figure 6. According to Figure 6, students' negative perceptions regarding the numerical nature of the course in the pre-test were replaced by positive perceptions in the post-test.

A quote from the responses: While the student coded D3 answered "being related to mathematics" in the pre- est, their post-test response was "none."

Question 3: With which other courses do you associate science?

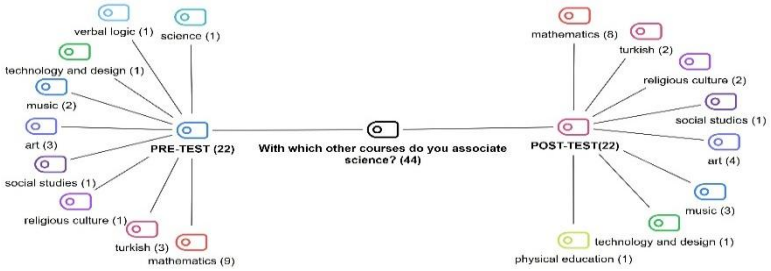

Figure 7. Answer to the question "With which other courses do you associate science?"

Figure 7. According to Figure 7, In the pre and post tests, it was determined that there was no effect on the relationship between science teaching and other subjects.

A quote from the responses: While the student coded D7 answered "mathematics" in the pre-test, their post-test response was "music."

Question 4: Is it possible to teach science and art together? Please explain.

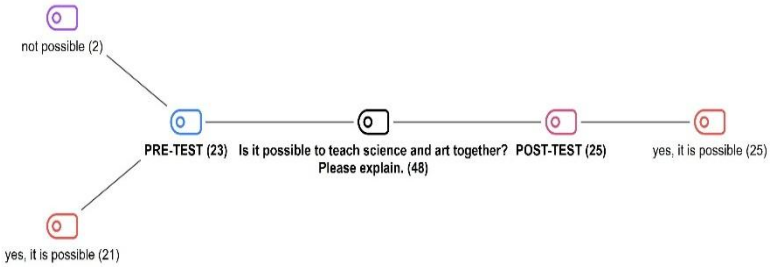

Figure 8. Answer to the question "Is it possible to teach science and art together? Please explain,"

Figure 8. According to Figure 8, in the pre-test, most students answered 'possible,' while two students answered 'not possible.' In the post-test, all students answered 'possible.'

A sample response: While the student coded D1 answered only "possible" in the pre-test, their post-test response was "art created through science becomes more realistic."

Question 5: Can you share your thoughts on using artistic activities in science instruction?

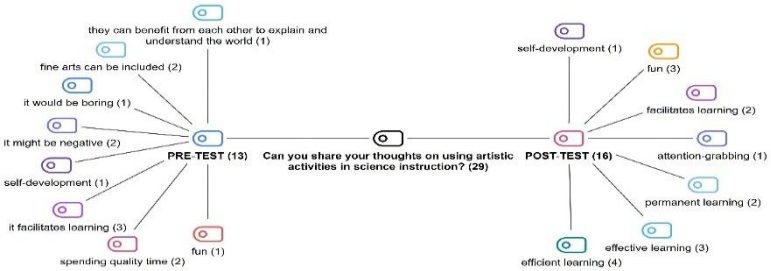

Figure 9. Answer to the question "Can you share your thoughts on using artistic activities in science instruction?"

Figure 9. According to Figure 9, While students focused on the theme of facilitating learning in the pre-test, the post-test generally revealed themes of efficient and effective learning.

A sample response: While the student coded D6 answered in the pre-test, "music, singing and such are boring to me," their post-test response was "because it is more efficient and effective."

Question 6: Can you give examples of artistic activities that could be used in science lessons?

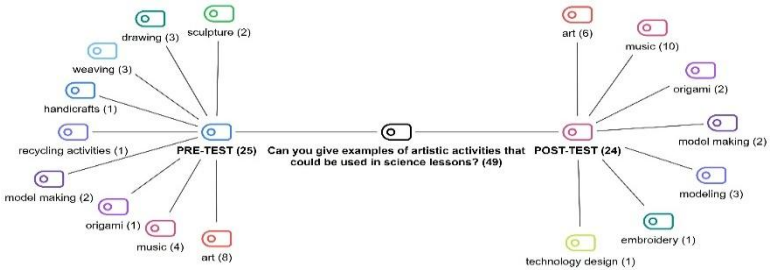

Figure 10. Answer to the question "Can you give examples of artistic activities that could be used in science lessons?"

Figure 10. According to Figure 10, it can be seen that the number of themes and frequencies obtained in the pre-test is lower than the number of themes and frequencies obtained in the post-test.

A sample response: While the student coded D6 answered only "drawing" in the pre-test, their post-test response was "music, drawing, physical education, and technology design."

Question 7: What are the positive aspects of incorporating artistic activities into science teaching?

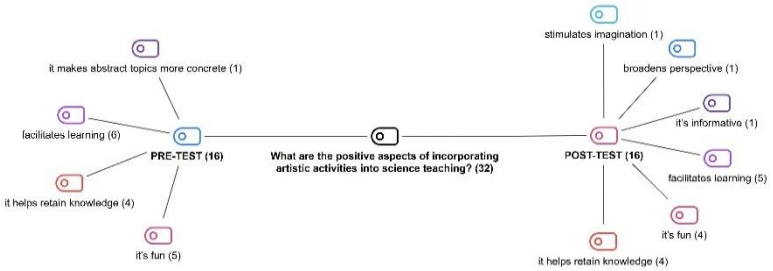

Figure 11. Answer to the question "What are the positive aspects of incorporating artistic activities into science teaching?"

Figure 11. According to Figure 11, while the themes of memorability and facilitating learning are included in both the pre and post tests, the themes of developing imagination and perspective are also emphasised in the post-test.

A sample student response: While student D9's pre-test answer was "it makes for a good time," their post-test answer was "it ensures permanent learning, the information is not forgotten."

Question 8: What are the negative aspects of incorporating artistic activities into science teaching?

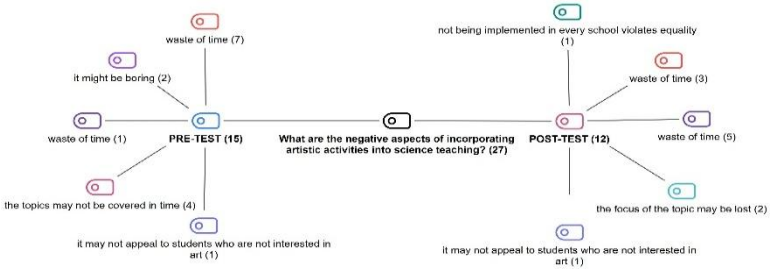

Figure 12. Answer to the question "What are the negative aspects of incorporating artistic activities into science teaching?"

Figure 12. According to Figure 12, in the post-test, negative thoughts about wasting time and not covering all the topics in the pre-test were replaced by positive thoughts, and the number of blank answers increased.

A sample student response: While student D3 responded in the pre-test with “the class might get off track,” their post-test response was “none.”

Findings Obtained from Student Journals. During the implementation process, students D2, D5, and D10 from the experimental group voluntarily kept student journals to collect data related to the second sub-problem. The second sub-problem is stated as: " What are the views and experiences of the experimental group students regarding the learning process in which artistic activities were integrated into the instruction of the “Matter and Industry” topic in the science course?" The findings obtained from the student journals related to this sub-problem are presented below in sequence:

- In the first week, the students noted that a new topic had started in the science class. Since the unit was "Matter and Industry," they initially thought the lesson would be boring, but later found the topic interesting and the class enjoyable. In the second week, new activities were introduced, and because the lessons were enjoyable and engaging, they understood the topic very well. In the third week, even though the topic was difficult and complex, they still found the lesson fun and engaging, and expressed a desire to do more project work. In the fourth week, they stated that they enjoyed learning science-related information, didn’t want the topic to end, and that they really loved science class. Finally, in the fifth week, they described the topic as easy and excellent, said they really enjoyed the class, understood it very well, and were mostly able to answer the test questions correctly.
- As the weeks progressed from the 1st to the 5th week of the implementation, it was observed that student D2 struggled and felt bored both at the beginning of the unit and during some of the sub-learning objectives. However, D2 greatly enjoyed the classroom activities, found them educational, and liked learning about science-related topics. Student D5, who normally had trouble focusing in science classes and often felt sleepy, stated that thanks to the inclusion of artistic activities, the lessons were enjoyable and fun, which led to a positive attitude toward the subject. Student D10, who initially found the “Matter and Industry” unit boring and complicated, expressed that the incorporation of artistic activities made the classes enjoyable, helped them love and understand the topic better, and inspired a desire to do more project work due to the enjoyment and benefit they gained from the activities.

Discussion

To obtain the findings related to the sub problem of the study, “Is there a significant difference in academic achievement between the control group students, who were taught the “Matter and Industry” topic in science course using only the standard curriculum, and the experimental group students, who received instruction based on the same curriculum enriched with artistic activities?”, achievement tests prepared using alternative/formative assessment and evaluation techniques were administered as pre- and post-tests.

When examining the independent samples t-test results of the post-test academic achievement scores of the experimental and control groups, it is observed that there is no significant difference in academic achievement between the groups after the experimental intervention. The findings indicate that in the teaching of the “Matter and Industry” unit in the science course, the use of artistic activities such as educational songs and various visual arts practices as methods, techniques, or materials alongside the science curriculum increased the academic achievement of both the experimental and control group students equally. This result is

consistent with the findings of studies conducted by Ustun (2014), Sagiroglulari (2017), and Turan (2019), which investigated the effect of learning through music on students' academic achievement in science courses. These studies concluded that although the use of educational songs in science classes did not produce a statistically significant difference in academic achievement, the increase in academic averages was equal across groups. However, it contrasts with the results of studies conducted by Ceker (2017), Ayaz (2018), and Aksu (2019), which examined the impact of using music and visual arts activities as teaching materials in science classes and found that such practices had a positive numerical effect on students' academic achievement.

The research findings reveal that teaching science through art is as effective as standard curriculum methods in enhancing students' academic achievement. However, this does not imply that art based teaching approaches are ineffective. On the contrary, it can be said that integrating art into science instruction enriches the educational experience and makes learning more meaningful and engaging. This approach is considered to contributes to transforming science classes into not only cognitive but also emotional and social learning experiences. For example, the process allows students to express science concepts creatively, thereby enhancing not only their scientific thinking skills but also their imagination. Additionally, art-based activities are found to increase students' motivation, help them develop positive attitudes toward learning, and make learning more permanent.

In order to obtain the findings related to the sub-problem of the study: "What are the views and experiences of the experimental group students regarding the learning process in which artistic activities were integrated into the instruction of the "Matter and Industry" topic in the science course?", semi structured interview forms consisting of eight questions were applied to the experimental group students as pre and post-tests. The questions included in the semi structured interview forms are as follows:

"What are the positive aspects of the science course in your opinion?"

In response to the question, students generally perceived the science course as fun and informative before the experimental implementation. However, after the implementation, they began to associate the lessons and topics with real life contexts. This result emphasizes the notion that "science is life." Additionally, students regarded the inclusion of educational songs and visual art activities in the lessons as a positive aspect of the science course. The data obtained from the study aligns with the findings of Efe et al. (2021), who concluded that using educational songs in science lessons allowed students to easily and enjoyably review topics in their daily lives, and with Guc (2011), who found that students developed positive attitudes toward the integration of science and art.

"What are the negative aspects of the science course in your opinion?"

Although the student responses to the question remained the same before and after the experimental implementation, the number of responses varied. The number of students who stated that the lesson was "boring" remained the same before and after the implementation. However, after the implementation, the number of students who stated that the lesson was "too numerical" decreased, while the number of those who stated "no negative aspects" increased. This result indicates that after the experimental implementation, although students continued to perceive "boredom" as a negative aspect of the science course, they abandoned their negative thoughts regarding the course being "numerical" or "math-related." The data obtained from the study is consistent with the findings of Turkoguz (2008), who reported that before integrating science and technology instruction with art activities, students perceived the subject as limited to formulas, but after the implementation, they felt freer thanks to the artistic activities.

"With which other courses do you associate science?"

When the responses to the question were examined, it was found that the experimental implementation had no effect on the subjects with which students associated the science course. When investigating the reason for this result, it was determined that students had opportunities to engage in interdisciplinary activities in other courses as well, and due to the project assignments they completed, they associated science with other subjects both before and after the implementation. The findings of this study do not align with those of Efe et al. (2021), who found that the use of educational songs in science lessons enabled students to give more examples of interdisciplinary connections, including music among the added subjects.

Is it possible to teach science and art together?"

The student responses to the question indicate that the experimental implementation fostered positive attitudes toward the integration of science and art. Students expressed the view that including artistic activities in science lessons makes the classes more enjoyable, engaging, and improves knowledge retention. The findings of this study are consistent with those of Guc (2011), who observed that students' initially negative attitudes in the pre-test shifted toward positive perspectives in the post-test regarding the integration of science and art. Similarly, the results align with Ayaz's (2018) study, which found that science instruction integrated with artistic activities effectively enhanced students' motivation toward science.

"Can you share your thoughts on using artistic activities in science instruction?"

An examination of the responses to the question reveals that students' prejudices toward the inclusion of artistic activities in science classes were eliminated. In addition to positively influencing learning, artistic activities contributed to students' personal development and holistic educational experiences. The findings of the study are consistent with those of Chappell and Muglia (2023), who stated that strengthening transdisciplinary work can foster the cultural change needed to support today's and tomorrow's discoveries in the scientific community, and with those of Smith et al. (2024), who found that music and song promote collaboration across different subject areas and create unique and engaging learning experiences.

"Can you give examples of artistic activities that could be used in science lessons?"

The responses to the question show that, prior to the implementation, students associated the science course with a wider and more diverse range of art disciplines compared to after the implementation. Before being exposed to science instruction that incorporated artistic activities, students considered a broader spectrum of possible artistic practices that could be used in science lessons. However, after participating in the classroom implementations, they limited the artistic activities they associated with science to only those that were carried out or perceived as feasible during the lessons. They were able to connect appropriate artistic activities with science learning outcomes. The findings of the study do not align with those of Efe et al. (2021), who concluded that the use of educational songs in science classes enabled students to provide more examples of science's connection to other disciplines. However, they are consistent with Turkoguz's (2008) study, which found that in science and technology classes integrated with visual art activities, students were able to recall all activities carried out during the lessons.

"What are the positive aspects of incorporating artistic activities into science teaching?"

In the responses to the question, it was found that prior to the implementation, students held positive views about the inclusion of artistic activities in science classes, stating that such activities made the subjects more permanent, enjoyable, and facilitated learning. After the implementation, in addition to these existing opinions, students also noted that their perspectives had changed and their imagination had improved. The inclusion of educational songs and skill-

based visual art activities in science lessons contributed to effective, meaningful, and enjoyable learning and enabled students to view the targeted subjects and learning outcomes from a broader perspective. The findings of this study align with Bakar's (2023) conclusion that entrepreneurship, design, creativity, strategy development, product creation, and innovative thinking skills are common competencies across all subjects, including science. They are also consistent with Lesser et al. (2024), who found that educational songs serve as a reward mechanism to repeat, reinforce, and later recall content, and with Smith et al. (2024), who concluded that engaging in art not only provides significant benefits for children's development but also offers a richer learning experience.

"What are the negative aspects of incorporating artistic activities into science teaching?"

An examination of the responses to the question reveals that before the implementation, all students perceived the inclusion of artistic activities in science lessons as a waste of time and boring. They also expressed concerns that such activities might prevent the curriculum from progressing in accordance with the annual plan. However, following the implementation, some students' opinions changed, and they no longer held negative views about incorporating art activities in science lessons. On the other hand, some students still felt that the artistic activities did not appeal to them, continued to see them as time-consuming, and expressed concern that they might fall behind in subjects and learning outcomes compared to other classes. One of the most significant reasons for the concern that topics might fall behind the annual curriculum schedule is that the study sample consisted of 8th grade students, who are subject to a national standardized exam at the end of the school year. The findings of this study align with those of Dinc and Inam Karahan (2021), who observed negative perceptions among students regarding knowledge and skill deficiencies in science lessons taught through art integration.

To obtain the findings related to the sub-question "What are the views and experiences of the experimental group students regarding the learning process in which artistic activities were integrated into the teaching of the "Matter and Industry" topic in the science course?", students in the experimental group were asked to keep journals throughout the duration of the implementation. The data obtained from these journals revealed the following themes: prior to the implementation, students had prejudices about the course and fears of not being able to understand the subject, particularly due to the nature of the unit. However, as artistic activities were incorporated into the science lessons and the implementation progressed from week 1 to week 5, these existing prejudices and fears gradually decreased. It was observed that students spent quality and enjoyable time during the lessons, understood the topic and learning objectives better than they had anticipated, and were successful in assessment and evaluation practices. It was found that the students understood the topic well and with interest, enjoyed working on project assignments, and, due to the high productivity of these projects, expressed a desire to do more project-based work.

When the obtained data are combined with the findings in the literature, it becomes evident that using dynamic and engaging elements such as songs frequently encountered in students' social lives, along with various visual arts activities, especially in science subjects that involve abstract concepts, supports enjoyable and lasting learning. This approach reduces rote memorization, helps concretize abstract concepts, enhances students' modeling and product creation skills, and increases their interest and positive attitudes toward the subject. Therefore, it can be concluded that art, through an interdisciplinary approach, can be effectively used as an instructional tool in science education.

Conclusions and Recommendations

In this study, educational songs from the field of music and applications from the visual

arts field such as assemblage, clay relief, origami, and poster art were incorporated, alongside specific learning objectives from the "Matter and Industry" unit in the science curriculum where these activities could be effectively applied. The study explores the anticipated changes in teaching quality and learning outcomes when artistic activities are utilized as teaching methods, techniques, or materials within science education.

In science education, incorporating educational songs that include scientific concepts from the field of music has been found to support students in learning abstract science concepts. These songs provide students with opportunities for easy and involuntary repetition, thereby increasing memorability and contributing to the development of cognitive skills. Moreover, since the lessons are enjoyable and student motivation is high, the students' affective skills are also supported. The inclusion of visual art activities such as assemblage, clay relief, origami, and poster art into science education has enabled students to design models and produce tangible outcomes, thereby supporting the development of both cognitive and psychomotor skills. The process of creating these products has fostered creative thinking and the development of entrepreneurial skills, while also contributing to students' acquisition of an aesthetic perspective and their overall multidimensional development.

The inclusion of artistic activities in science education through the use of teamwork techniques has been shown to contribute to students' life skills by positively affecting their abilities in communication, decision making, collaboration, task distribution, task-oriented awareness, and making joint contributions to a shared product. The equal increase in achievement observed in both groups suggests that science education through art should be evaluated particularly in terms of its indirect contributions to the learning process. Teaching science through art contributes not only to knowledge transfer but also to the development of 21st-century skills such as creativity, critical thinking, and problem solving. In this context, it can be stated that art based methods enrich learning by differentiating the learning processes and offering students a broader and more meaningful experience.

In conclusion, science education through art can be considered an innovative approach that can enhance students' understanding of science concepts. Although it achieves the same level of academic success as standard teaching methods, its potential to contribute to the multidimensional goals of education through creative, meaningful, and interdisciplinary experiences should not be overlooked. Therefore, science education through art should be regarded not merely as an alternative to science education, but as a complementary and enriching tool.

Based on the results obtained from this study and taking into account the existing literature on the subject, the researcher recommends that future research, researchers, and science teachers who plan to include artistic activities in their lessons consider the following in the context of science instruction based on artistic activities:

1. Conducting in-depth studies on development of imagination and its impact on creative thinking skills,
2. Investigating the long-term retention and permanence of knowledge and learning outcomes gained through art-integrated science instruction,

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