



The Effect of Song-and-Music-Supported Teaching of “Mitosis and Meiosis” on Different Variables and Students' Opinions

Elif Yürek¹  and Emine Hatun Diken^{2*} 

¹ Science Teacher at Aliya Izetbegovic Middle School, Kars, Türkiye

² Kafkas University, Dede Korkut Faculty of Education, Department of Mathematics and Science Education, Kars, Türkiye

ABSTRACT

The purpose of this research was to determine the effects of song- and music-supported teaching of the topic "Mitosis and Meiosis" on some variables and the opinions of the students after the song-and-music-supported teaching of the subject. A total of 11 students, who were in the 7th grade at a village school in a district of Kars participated in the research. As data collection tools in the study, an achievement test, a self-regulation scale, a self-efficacy belief scale, an "attitude scale", song lyrics related to the subject, and an "interview form" were used. In the quantitative results of this study, it was determined that teaching the topic with the support of song and music improved the students' academic success, self-regulation regarding science, and attitudes towards science lessons, and it did not change their self-efficacy beliefs towards learning science. In the qualitative results of the research, it was determined that after the teaching, they understood it "well" and "very well", and they liked the science course very much. It can be concluded from the research that subjects that are difficult to understand might be taught with the support of songs and music.

Keywords: Mitosis and meiosis, teaching with song and music, 7th grade students.

ARTICLE INFO

Article History:

Received:26.04.2025

Received in revised form:22.05.2025

Accepted:12.06.2025

Available online:28.06.2025

Article Type: Research Article

To Cite This Article: Yürek, E., & Diken, E.

H. (2025). The effect of song-and-music-supported teaching of “Mitosis and Meiosis” on different variables and students' opinions. *Journal of Individual Differences in Education*, 7(1), 31-43., DOI: 10.47156/jide.1684604

1. Introduction

When the most effective science programs used in recent years have been examined, it has been found that such courses prioritize the use of scientific methods rather than rote learning and unnecessary information (Ergul, 1999). Effective science teaching is a process in which students actively participate in the lesson, the lesson becomes enjoyable, learning occurs through experience, and new information is discovered by the students themselves. Students are thus able to relate their knowledge in the field of science to data from the past and their daily lives (Altun & Olgun, 2005). However, the fact that science sometimes includes complex and abstract concepts might lead students to have difficulty understanding the information (Akdeniz, Ayas & Cepni, 1994). When science teachers plan lessons based on traditional teaching methods, this might lead to students failing to understand scientific concepts, and they might develop disinterest and negative attitudes towards the lesson. Students' interest in science lessons depends on how fun and interesting the lessons are (Gurbuz, Ceker & Toman, 2017). Effective science education thus becomes possible if students are able to internalize science concepts in a meaningful way (Coskun, Akarsu & Karpier, 2012). Educational games and

*Corresponding author's address: Kafkas Üniversitesi Dede Korkut Eğitim Fakültesi 36100 Kars, Türkiye
e-mail: hatundiken06@gmail.com

songs are important tools for students to gain the skills desired. The primary goals are to make students' knowledge about science subjects permanent through the use of such songs and games, to increase their interest in the lessons, and to ensure that they focus on the topic at hand (Erdogan, 2013; Gurbuz, Turgut & Salar, 2013). In this context, educational songs can be used as tools that facilitate students' learning of concepts in various courses (mathematics, physics, chemistry, biology, history, geography, etc.) and establish connections between these subjects and their daily lives at different levels of education, whether in preschool, primary school, secondary school, or high school (Aksu, 2009). Music can play an educational role, helping to reduce students' stress levels, improve their capacity to think and learn, make courses more fun, develop listening skills, and extend their attention span in class (Sığırtmac, 2002; Gultek, 2002; Ucan, 1996). In addition, music is a universal language and is an effective tool for communication, as well as expressing emotions and relaxing (Ozçevik, 2007). It also has a significant effect on cognitive development, and can improve children's motor skills, verbal expression, conceptual thinking, and creativity (Say, 2005). Music-supported teaching allows students to better focus their attention on the lesson and increases the permanence of the information they learn (Gurbuz, Ceker & Toman, 2017). Music lessons can provide students with the necessary skills in science and mathematics and help them develop intellectually in these areas (Kahyaoglu, 2005). In addition, materials prepared using animation or music in science education can play a supportive role in teaching (Koroglu, 2014). According to a literature review, while song- and music-supported teaching has often been applied in mathematics lessons at primary- and secondary-school levels, it has only been used for a limited number of topics in science lessons (e.g. digestion, the circulatory system). Due to the lack of studies in the literature on teaching science subjects with the support of songs and music, this study aimed to determine the effects of teaching the topic of "Mitosis and Meiosis" with the support of songs and music on the students' academic success, self-regulation, attitudes, self-efficacy beliefs, and the students' opinions about this teaching. This topic has a high number of expected learning outcomes in the science curriculum for the seventh-grade secondary school students, but these students often experience conceptual confusion and have difficulty in learning it.

2. Method

2.1. Research Methodology

The explanatory sequential design, which is a mixed design, was used in the study. This design begins with the quantitative phase and the quantitative data obtained is supported by the qualitative phase (Kara, 2023). In the quantitative part of the study, a single group pre-test/post-test model was used from among the experimental designs for quantitative research. In the qualitative part of the study, a case study was used.

2.2. Participants

A total of 11 students, six boys and five girls, who were studying in the 7th grade of a village school in a district of Kars province in the research. The study group was selected using the random assignment method. Random assignment method is a sampling method in which all elements in the universe have an equal and independent probability of being determined (Baltaci, 2018).

2.3. Data Collection Tools

In the study, the following data collection tools were used: The Achievement Test for Mitosis and Meiosis, the Self-Regulation Scale for Science, the Self-Efficacy Belief Scale for Learning Science for Secondary School Students, the Attitude towards Science Course Scale, and the Interview Form for Teaching Mitosis and Meiosis with Song and Music Support.

2.3.1. Achievement test for mitosis and meiosis

The first data collection tool used in the study was an achievement test consisting of 10 multiple choice questions on the topic of Mitosis and Meiosis in the 7th Grade Science Course. The questions in

the achievement test were prepared by selecting them from the websites, <http://www.isemdiijital.com/ogretmen.com> and <http://www.isleronline.com/ogretmen>. The questions were chosen in accordance with the opinions of three science teachers. After the questions for the achievement test were selected, they were checked by three faculty members who were experts in the field of biology in order to determine whether there was any misinformation or misconceptions in the questions. After these faculty members had made corrections to some of the questions, the Achievement Test for Mitosis and Meiosis was applied to the 7th-grade students before and after the song-and-music-supported teaching of the topic.

2.3.2. Self-regulation scale for science

The second data collection tool was the Self-Regulation Scale for Science developed by Karaca and Bektas (2020). The scale consists of three factors (critical thinking, effort management, time) and 26 items. It has a reliability coefficient of .940, which explains 48% of the variance, and is based on Zimmerman's (1986) self-regulation model. It is a five-point Likert-type scale with the lowest possible score being 26 and the highest score being 130. Permission was obtained from Karaca and Bektas (2020) to use the scale in the research.

2.3.3. Self-efficacy belief scale for learning science for secondary school students

The third data collection tool was the Self-Efficacy Belief Scale for Learning Science for Secondary School Students developed by Yaman (2016). The scale is a five-point Likert-type scale consisting of three factors (self-efficacy for performance, self-efficacy for individual success, self-efficacy for performance) and 17 items. It has a confirmatory factor analysis internal consistency reliability coefficient of 0.83 and an exploratory factor analysis internal consistency reliability coefficient of 0.85. Permission was obtained from Yaman (2016) for the scale to be used in the study.

2.3.4. Attitude towards science course scale

The fourth data collection tool was the Attitude Towards Science Course Scale developed by Karabulut and Cetin (2018). The scale is a five-point Likert-type scale with a minimum score of 30 and a maximum score of 150, a factor loading greater than .300, and a Cronbach's Alpha value of 0.91. Permission was obtained from Karabulut and Cetin (2018) to use the scale in the study.

2.3.5. Interview form for teaching mitosis and meiosis with song and music support

The fifth data collection tool was the Interview Form for Teaching Mitosis and Meiosis with Song and Music Support. This form consisted of five structured interview questions. The questions were prepared by the researcher together with a faculty member who was an expert in the field of science education. The questions in the form were then checked by a faculty member who had completed studies in this field and some minor corrections were made to the questions. The structured interview form was applied to the 7th-grade students after the song- and-music-supported teaching of the topic.

The structured interview questions in the form were as follows:

1. What do you think about the difficulty of the topic of Mitosis and Meiosis after the song- and music-supported teaching? Please choose one of the following options: "Very Difficult", "Difficult", "Moderately Difficult", "Easy", "Very Easy".
2. Can you evaluate your understanding of the topic of Mitosis and Meiosis after the song- and music-supported teaching? Please choose one of the following: "Very Bad", "Poor", "Average", "Good", "Very Good".
3. How satisfied were you with the song- and music-supported teaching of the Mitosis and Meiosis? Please choose one of the following: "Not at All Satisfied", "Not Satisfied", "Moderately Satisfied", "Satisfied", "Very Satisfied".
4. What were your thoughts, feelings, and emotions after the song- and-music-supported teaching of the topic of Mitosis and Meiosis?

5. What were your thoughts, feelings, and emotions about the science class after the song-and-music-supported teaching of the topic of Mitosis and Meiosis?

2.4. Application Process

First, the necessary written permissions to conduct the research were obtained from the District National Education Directorate, the administrators of the school and the parents of the students. The research was approved by the Kafkas University Social and Human Sciences Scientific Research and Publication Ethics Committee with the decision number 58, dated 08.05.2024 and numbered 9. The researcher, who is a science teacher, entered the classroom where the topic of Mitosis and Meiosis would be taught together with the assistant researcher, who plays the classical guitar, which was the instrument used in the lessons. The researcher informed the 7th-grade students about the implementation of the research. The students were administered the Achievement Test for Mitosis and Meiosis, the Self-Regulation Scale for Science, the Self-Efficacy Belief Scale for Learning Science for Secondary School Students, and the Attitude Towards Science Course Scale as pre-tests. Afterwards, the researcher began to teach 7th Grade Mitosis and Meiosis according to the 5E Learning Model. In the "Deepening" step of the 5E Learning Model, the researcher and the assistant researcher distributed the song lyrics about mitosis and meiosis to each student in written form and made a preliminary application without recording any video by having the students sing the song accompanied by the classical guitar in order to ensure that the students were adapted to the process. They continued this preliminary application until the students had learned the lyrics. After the researcher and assistant researcher were convinced that the students knew the song, they distributed balloons with a Turkish flag design on them; they had inflated one balloon for each student in advance. The primary researcher ensured that the students held the balloons in their right hands and harmonized with the rhythm of the music. The assistant researcher played the classical guitar and sang the song. The students sang along with the balloons in their right hands harmonizing with the rhythm of the music. Afterwards, the assistant researcher played the guitar without singing, while the students held the balloons up and sang the song while swinging them from side to side. All these processes were recorded by a camera mounted on a tripod to obtain a view of the whole class. The focus and direction of the camera were checked frequently by the primary researcher (the teacher of the class). This application was repeated several times. Afterwards, the researcher applied the Achievement Test for Mitosis and Meiosis consisting of 10 multiple-choice questions as a post-test to the students as the Evaluation Step of the 5E Learning Model. The lesson was interrupted for 15 minutes for a break period, and in the second lesson, the Science Self-Regulation Scale, Self-Efficacy Belief Scale for Learning Science for Secondary School Students, and the Attitude Towards Science Course Scale were applied to the students by the researcher as post-tests. After those scales were applied as a post-test, the Interview Form for Teaching Mitosis and Meiosis with Song and Music Support was distributed to the students in order to obtain their opinions on teaching the topic with the support of a song, and the students were asked to answer the questions on this form in writing. At the end of the lesson, the balloons with the Turkish flag designs and some chocolates were distributed to the students as small gifts.

A specially written song with lyrics about mitosis and meiosis was prepared by the researcher and three science teachers in order to teach the topic during the implementation stage of the study. Three faculty members who had conducted studies on biology education were asked to check if there were any misconceptions or scientific errors in the lyrics, and some corrections were made accordingly. The lyrics were as follows:

When cells reach a certain size,
They divide to form new cells.
They are divided into two through mitosis or meiosis.
Mitosis is asexual, meiosis is sexual reproduction.
Mitosis provides reproduction in single-celled organisms,
Growth, development and renewal in multicellular organisms.

The number of chromosomes is fixed, there is no genetic diversity, no no
The two cells formed are the same as the mother cell.
Mitosis occurs in body cells, aaa
Except for muscle, red blood cell, retina, nerve, sperm, egg.
Meiosis occurs in reproductive cells, eeee
It provides for the formation of reproductive cells.
In mitosis, DNA first replicates itself,
Protein synthesis, energy production and consumption accelerate,
Chromosomes become apparent, the nuclear membrane and nucleolus melt, Centrosomes are
pulled to the poles, spindle fibers are formed,
Chromosomes come to the middle of the cell and line up.
Afterwards sister chromatids are pulled to the poles.
Tell me what is left! Come on tell me!
Since the nuclear division is over,
There is cytoplasm division, yes! Agglomeration occurs in animal cells,
But in plants, with intermediate lamella.
Mitosis occurs in body cells.
Except for muscle, red blood cell, retina, nerve, sperm, egg.
Meiosis occurs in reproductive cells.
It provides for the formation of reproductive cells.
In meiosis, the chromosome number decreases by half.
The chromosome number is fixed for generations.
 $2n$ chromosome reproductive mother cells divide with meiosis.
The reproductive cells that are formed unite $2n$ again in front of you.
Mitosis occurs in body cells,
Muscle, red blood cell, retina, nerve, sperm, egg.
Meiosis occurs in reproductive cells.
It provides for the formation of reproductive cells
Meiosis is a preparation phase again.
Chromosomes formed, spindle fibers emerged, the nuclear membrane and nucleolus melted.
Between homologous chromosomes, one from the mother and one from the father,
Part exchange provides hereditary diversity.
Then homologous chromosomes line up.
They are immediately pulled to the opposite poles.
When the cytoplasm divides, two new cells are formed.
Tell me what is left!
Come on, tell me!
Meiosis has two stages, yes!
DNA does not replicate itself again.
The rest is the same as mitosis division.
Finally, four cells are formed.
Mitosis occurs in body cells,
Except for muscle, red blood cell, retina, nerve, sperm, egg, Kars.
Meiosis occurs in reproductive cells.
It provides for the formation of reproductive cells.

Some photographs taken with the written permission of the District National Education Directorate, the administrators of the school and the parents of the students are presented below for a better understanding of how the research was implemented.



Figure 1. The science teacher (the primary researcher) teaching the lyrics of the song to the students



Figure 2. The students singing along with the classical guitar played by the assistant researcher

2.5. Data Analysis

In this study, the effects of song- and-music-supported teaching of the topic of mitosis and meiosis on the achievements of 7th grade students, their self-regulation regarding science, their self-efficacy beliefs towards learning science, and their attitudes towards science lessons were analyzed quantitatively. These analyses were conducted via a package program used in quantitative research. In the analysis of the quantitative data, the Wilcoxon signed rank test was used from among the non-parametric tests. This test takes into account the direction and rank averages of the difference scores of two related measurement sets (Buyukozturk, 2007). The analysis of the students' written opinions about the teaching was conducted qualitatively. Content analysis was performed on the qualitative data. On the basis of the answers given by the students to the structured interview questions, similar themes were brought together by repeated coding and were organized and interpreted in a way that a reader would be able understand and in accordance with the purpose of the research (Karaca, Bektas & Armagan, 2015; Yildirim & Simsek, 2020). The analyzed data were presented in tables and are explained in the Findings section.

3. Findings

3.1. Quantitative Findings

The findings regarding the quantitative part of the study are given in the tables below and the necessary explanations are provided under the tables.

The Wilcoxon signed rank test results regarding whether there was a significant difference in students' success scores before and after teaching the topic of Mitosis and Meiosis with song and music support are shown in Table 1.

Table 1. Wilcoxon signed rank test results of pre- and post-implementation achievement scores

Post-test/Pre-test	n	Rank Average	Rank Total	z	p
Negative Order	9	.00	.00	2.81*	0.005
Positive Order	2	5	45.00		
Equal	0	0	00		

Note: *Based on negative ranks

When Table 1 is examined, a significant difference was found between the pre- and post-implementation scores of the achievement test questions applied to the students on the topic of Mitosis and Meiosis ($Z=2.81$ $p<.05$). When the rank average and totals of the difference scores are taken into account, it is seen that this difference observed was in favor of positive ranks; in other words, the post-test. In Table 1, it was determined that teaching the subject of Mitosis and Meiosis using song and music increased the students' success levels.

The Wilcoxon signed rank test results regarding whether the self-regulation scores for science showed a significant difference before and after teaching the topic of Mitosis and Meiosis with song and music are shown in Table 2.

Table 2. Wilcoxon signed-rank test results of pre- and post-intervention self-regulation scores

Post-test/Pre-test	n	Rank Average	Rank Total	z	p
Negative Order	11	.00	.00	2.81*	0.005
Positive Order	0	5.00	45.00		
Equal	0	0	00		

Note: *Based on negative ranks

As can be seen in Table 2, a significant difference was found between the pre- and post-implementation scores of the scale applied to students regarding their self-regulation regarding science ($Z=2.93$ $p<.05$). When the mean rank and total of the difference scores are taken into consideration, it is seen that this difference observed was in favor of positive ranks; that is, the post-test. In Table 2, it was determined that the song-and-music-supported teaching of Mitosis and Meiosis increased the students' self-regulation regarding science.

The Wilcoxon signed ranks test results regarding whether the song- and-music-supported teaching of the Mitosis and Meiosis led to a significant difference in students' self-efficacy beliefs towards learning science after the application are shown in Table 3.

Table 3. Wilcoxon signed-rank test results of pre- and post-intervention self-efficacy scores

Post-test/Pre-test	n	Rank Average	Rank Total	z	p
Negative Order	9	5.29	37.00	1.72*	0.084
Positive Order	2	4.00	8.00		
Equal	0	0	00		

Note: *Based on negative ranks

When Table 3 is examined, no statistically significant difference was found between the pre- and post-implementation scores of the Self-Efficacy Belief Scale for Students Learning Science ($Z=1.72$, $p<.05$).

When the mean rank and total of the difference scores are taken into account, it is seen that this difference was in favor of negative ranks; in other words, the pre-test. In Table 3, it was determined that the teaching of mitosis and meiosis with the support of songs and music did not have an effect on the students' self-efficacy beliefs about learning science.

The Wilcoxon signed rank test results regarding whether the teaching of Mitosis and Meiosis with the support of songs and music led to a significant difference in the students' attitudes towards science lessons after the application are shown in Table 4.

Table 4. Wilcoxon signed rank test results of pre-and post-intervention attitude scores

Post-test/Pre-test	n	Rank Average	Rank Total	z	p
Negative Order	11	,00	,00		
Positive Order	0	6.00	66.00	2,93*	0,003
Equal	0	0	0		

Note: *Based on negative ranks

When Table 4 is examined, a significant difference was found between the pre- and post-implementation scores of the Attitude Towards Science Course scale ($Z=2.93$ $p<.05$). When the mean rank and total of the difference scores are taken into consideration, it is seen that this difference was in favor of positive ranks; in other words, in favor of the post-test. In Table 4, it was determined that the teaching of Mitosis and Meiosis with song and music support improved the students' attitudes towards science course.

3.2. Qualitative Findings

The themes and frequencies of the themes identified for the qualitative part of the research are given in tables. Afterwards, explanations regarding the themes and frequencies in the tables are provided below the tables. The responses given by the students to the question "What do you think about the difficulty level of the Mitosis and Meiosis subject after the song-and-music-supported teaching of this subject?" are shown in Table 5.

Table 5. Students' opinions about the difficulty of the topic

Students' Opinions	Very Difficult	Difficult	Medium Difficulty	Easy	Very Easy
Frequency (f)			1	5	5

When Table 5 is examined, it is seen that after the song- and-music-supported teaching, one student evaluated the subject as of "medium difficulty", five students evaluated the subject as "easy", and five students evaluated the subject as "very easy".

The responses of the students to the question "Can you evaluate your understanding of the topic of Mitosis and Meiosis after the song- and-music-supported teaching?" are shown in Table 6.

Table 6. Students' opinions about their understanding of the topic

Students' Opinions	Very Bad	Poor	Average	Good	Very Good
Frequency (f)			1	5	5

It can be seen in Table 6 that after the song- and-music-supported teaching, one student understood the topic at an "Average" level; five students understood it at a "Good" level, and five students understood it at a "Very Good" level.

The responses of the students to the question "How satisfied were you with the song- and music-supported teaching of the topic of Mitosis and Meiosis?" are shown in Table 7.

Table 7. Students' satisfaction with the teaching of the topic with the support of songs and music

Students' Opinions	Not at all Unsatisfied	Not Satisfied	Moderately Satisfied	Satisfied	Very Satisfied
Frequency (f)			1	5	5

When Table 7 is examined, it is seen that teaching the topic with the support of a song and music satisfied one student "moderately", while five students were "satisfied", and five were "very satisfied".

The answers given by the students to the question “What were your thoughts, feelings, and emotions after the song- and-music-supported teaching of the topic of Mitosis and Meiosis?” are shown in Table 8.

Table 8. Students' thoughts after the song- and-music-supported teaching

Students' Opinions	Frequency (f)
I learned quickly.	11
It was so much fun.	10
I felt happy and joyful	10
I understood the subject very well.	10
I liked the music very much.	10
I was excited.	7
When I heard the title of the topic, I thought it would be difficult, but when I heard the song, my mind changed.	5
I felt very positive and had good feelings.	3
I wish all lessons were taught with music.	1
I felt like we were all united.	1
Our teacher was very sweet.	1
It helped me get high marks in the exam.	1

When Table 8 is examined, it is seen that 11 students felt they learned the subject quickly as a result of the teaching with song and music support; 10 students had fun; 10 students felt happy and joyful; 10 students thought they understood the topic very well; 10 students liked the music very much; seven students were excited; five students thought the topic would be difficult but changed their minds after singing the song; three students felt very positive and had good feelings; one student said that all lessons should be taught with music; one student felt that the entire class was united; one student said that the teacher was very sweet, and one student stated that learning the topic in this way helped him get a high grade in the exam.

The answers given by the students to the question “What were your thoughts, feelings and emotions about the science class after the teaching of the topic of Mitosis and Meiosis with song and music support?” are shown in Table 9.

Table 9. Students' views on the science class after the teaching of the topic with song and music support

Students' Opinions	Frequency (f)
I liked the lesson very much.	5
I found the lesson very enjoyable.	4
I didn't want the lesson to end.	3
It is very nice to listen to music and sing during class.	1

When Table 9 is examined, it is seen that five students liked the science course very much after the song and-music-supported teaching; four students found the science course very enjoyable; three students did not want the course to end, and one student stated that singing songs and listening to the guitar in the class was very nice.

4. Conclusion and Discussion

The results of the present study are in line with the results of certain previous studies in the literature: Kahyaoglu (2005) found that teaching songs and poems about the circulatory and digestive systems to 6th-grade middle school students increased their success and improved their attitudes towards science lessons. Andac (2016) suggested that teaching music to middle school students using technology improved their attitudes towards music lessons. Cevik (2011) found that female teacher candidates had higher self-efficacy beliefs after teaching classroom teachers with music. Uzunoglu

Yegul (2014) examined the self-efficacy perceptions of teacher candidates regarding music teaching and found that their self-efficacy did not change as a result of music-supported teaching, that music teacher candidates had higher self-efficacy beliefs than preschool teacher candidates, and that preschool teacher candidates had higher self-efficacy beliefs than classroom teacher candidates. Kucuk and Kar (2021) examined the perception of self-efficacy in piano accompaniment in music teacher candidates. As a result of their study, they determined that the education level of music teacher candidates in piano accompaniment did not change according to their gender and grade level, that the perceived self-efficacy of music teacher candidates between the ages of 18-22 was high, and that the perceived self-efficacy of Fine Arts High School graduates in piano accompaniment was high. Gun, Duru and Demirtaş (2016) found in their study that learning music and instrument accompaniment in early school children increased their academic success and cognitive levels. Koca (2016) found, as a result of his study, that preschool teacher candidates' perceived self-efficacy regarding music activities was high. Mentis Koksoy (2017) found that the perceived self-efficacy of classroom teacher candidates who could play an instrument as a result of music-supported teaching was higher than those of teacher candidates who did not play an instrument. Bedir and Akkurt (2012) determined that students' attitudes towards a geography course improved as a result of teaching geography topics to students using songs. Oztutgan (2018) found that preschool teacher candidates who engaged in music activities had high self-efficacy levels with regard to music activities designed to increase motivation.

According to the quantitative results of the research, it was determined that the song- and-music-supported teaching of 7th grade Mitosis and Meiosis increased the academic success of the students on the topic and improved their self-regulation regarding science and their attitudes towards science lessons. It was determined that this way of teaching of the topic did not have any effect on the students' self-efficacy beliefs in terms of learning science. In other words, the song- and-music-supported teaching did not change the students' self-efficacy beliefs in this regard.

According to the qualitative results of the research, it was determined that after the teaching of the topic of Mitosis and Meiosis with the support of songs and music, most of the 7th-grade students evaluated the topic as "easy" or "very easy" and they understood the topic "well" and "very well". Most of the students were "satisfied" or "very satisfied" with the teaching of the topic with the support of songs and music; most of the students learned the topic quickly, had a lot of fun, felt happy and joyful, liked the music very much, were excited, thought the topic would be difficult at first but changed their minds after singing the song, and felt very positive and had good feelings. After the teaching of the topic in this way, most of the students stated that they liked the science class very much, found the lesson very enjoyable, and did not want the lesson to end.

On the basis of the findings of this research, the following recommendations can be made:

1. The instrument used in the study was a classical guitar. However, different instruments, such as a piano, an accordion, a flute and/or a ukulele could also be used for teaching science lessons with songs.
2. Since smart boards and internet access are now available in almost every school, the lyrics of any songs can now be used by science teachers in different schools. Using artificial intelligence modules such as "Suno", songs on the topic of Mitosis and Meiosis could be composed with different melodies and lyrics.
3. Science lessons are generally perceived as difficult by students. Therefore, given that teaching with the support of songs and music can have positive effects, the science topics that students find most difficult could be taught in this way..

Ethics Statement

The research was carried out within the framework of the articles in the Higher Education Institutions Scientific Research and Publication Ethics Directive. We declare that there is no ethical violation.

Conflict of Interest Statement

We declare that there is no academic or financial conflict of interest in the publication of this study.

Informed Consent

Participants voluntarily supported the research. We declare that informed consent forms were obtained for the participants.

Declaration of Contribution of Researchers

All researchers contributed equally to the planning, execution and writing of this research.

References

- Akdeniz, A. R., Ayas, A., & Çepni, S. (1994). The place and importance of laboratory in science education. *Contemporary Education Journal*, 206, 24-28.
- Aksu, C. (2009). *On the concept and definition of educational music*. 1st Izmir National Music Symposium, Izmir.
- Altun, A., & Olkun, S. (2005). *Primary education in the light of current developments: mathematics, science, technology, management*. Anı Publishing.
- Andac, Y., & Temiz, E. (2016). The effect of using technology in music lessons on the attitudes of primary school 4th and 5th grade students towards music lessons. *Fine Arts*, 11(4), 200-209. <http://dx.doi.org/10.12739/NWSA.2016.11.4.D0184>.
- Baltacı, A. (2018). A conceptual review of sampling methods and sample size problems in qualitative research. *Journal of Bitlis Eren University Institute of Social Sciences*, 7(1), 231-274. <https://dergipark.org.tr/tr/download/article-file/497090>
- Bedir, G., & Akkurt, A. (2012). Teaching geography with songs. *Eastern Geography Journal*, 17(28), 303-316. <https://dergipark.org.tr/en/download/article-file/27004>
- Buyukozturk, Ş. (2007). *Data analysis handbook for social sciences*. Pegem Publishing.
- Cevik, D. B. (2011). Examining the self-efficacy levels of classroom teacher candidates in music teaching. *Ahi Evran University Kırşehir Faculty of Education Journal*, 12(1), 145-168. <https://dergipark.org.tr/tr/download/article-file/1492644>
- Ergül, N. R. (1999). Evaluation of science curriculum. *Uludağ University Faculty of Education Journal*, 12(1), 231-238. <https://dergipark.org.tr/tr/download/article-file/265786>.
- Coskun, H., Akarsu, B., & Kariper, İ. A. (2012). The effect of educational games including science stories on the academic success of students in science and technology course. *Ahi Evran University Kırşehir Education Faculty Journal*, 13(1), 93-109. <https://dergipark.org.tr/en/download/article-file/1492219>
- Erdogan, Z. (2003). *Examination of teaching methods used by teachers in science education*. Unpublished master's thesis. Gazi University Institute of Educational Sciences, Ankara.
- Gultek, B. (2002). Positive effects of music on children. *Çocuk-Çocuk Journal*, 11, 29. https://books.google.com.tr/books?id=0DmRDwAAQBAJ&printsec=frontcover&hl=tr&source=gb_s_ge_summary_r&cad=0#v=onepage&q&f=false
- Gun, E., Duru, E., & Demirtas, O. (2016). The effect of music education on cognitive development. *The Journal of Academic Social Science Studies*, 50, 117-124. <http://dx.doi.org/10.9761/JASSS3555>
- Gurbuz, F., Turgut, U., & Salar, R. (2013). The effect of 7E model on academic success and retention in the 6th grade science and technology unit "electricity in our lives". *Turkish Science Education Journal*, 10(3), 80-94. <https://mail.tused.org/index.php/tused/article/view/401/894>

- Gurbuz, F., Ceker, E., & Toman, U. (2017). The effects of educational song and game techniques on students' academic success and retention. *Bayburt Education Faculty Journal*, 12(24), 593-612. <https://dergipark.org.tr/en/download/article-file/395450>
- Jensen, E. (1998). *Teaching with the brain in mind*. Association for Supervision and Curriculum Development, Alexandria.
- Kahyaoglu, M. (2005). *The effect of song and poem on achievement, recall and attitude towards the course in the subject of 'circulatory and digestive system' in primary school 6th grade*. Unpublished Master's Thesis. Marmara University Institute of Educational Sciences, Istanbul.
- Karaca, M., Bektas, O., & Armagan, F.Ö. (2015). Views of 8th grade students on science subjects not asked in central exams. *Gazi Faculty of Education Journal*, 35(1),63-86. <https://dergipark.org.tr/en/download/article-file/77527>
- Koroğlu, G. N. (2014). Views of primary school second level music teachers on the 2006 music course curriculum. *Journal of Art Education (SED)*, 2(1), 127-141. <https://www.ceeol.com/search/article-detail?id=687113>.
- Kara, E. (2023). A Theoretical analysis on mixed research methods through sample research. *Journal of Research in Entrepreneurship Innovation and Marketing*, 7(13), 73-90. <https://doi.org/10.31006/gipad.1310518>
- Karaca, M., & Bektas O. (2020). *The relationship between secondary school students' perceptions of taking a role model and their self-regulation towards science*. Unpublished PhD Thesis. Erciyes University, Institute of Educational Sciences, Kayseri.
- Karabulut, H. & Cetin, A. (2018). *The effect of technology-supported authentic learning activities on students' science learning, attitudes towards science and retention of their knowledge*. Unpublished PhD Thesis. Gazi University Institute of Educational Sciences, Ankara.
- Koca, Ş. (2016). Self-efficacy perceptions of preschool teacher candidates towards music activities. *Mehmet Akif Ersoy University Education Journal*, 40, 375-386. <https://doi.org/10.21764/efd.33645>.
- Kucuk, D. P., & Kar, H. (2021). Individual instrument study habits of music teacher candidates. *Kesit Academy Journal*, 7(28), 402-432. <https://dergipark.org.tr/en/download/article-file/2064508>
- Mentis Koksoy, A. (2017). Examining the self-efficacy levels of classroom teacher candidates in music teaching. *Mehmet Akif Ersoy University Education Journal*, 44, 297-320. <https://dergipark.org.tr/en/download/article-file/388079>
- Mitosis and meiosis division success test*. <http://www.isemdijital.com/ogretmen.com> retrieved 20.03.2020.
- Mitosis and meiosis division success test*. <http://www.isleronline.com/ogretmen.com> retrieved 20.03.2020.
- Ozcevik, A. (2007). *Music therapy and its therapeutic effects on students*. Unpublished Master's Thesis. Istanbul Technical University, Institute of Social Sciences, Istanbul.
- Oztutgan, K. (2018). *A method proposal for improving classical guitar deciphering in institutions providing vocational music education*. Unpublished Doctoral Thesis. Ondokuz Mayıs University, Institute of Educational Sciences, Samsun.
- Say, A. (2005). *Music encyclopedia*. Music Encyclopedia Publications.
- Şıgırtmac, A. (2002). Music education in preschool period. *Cukurova University Social Sciences Institute Journal*, 9(9), 30-39.
- Ucan, A. (1996). *Human and music/human and art education*. Music Encyclopedia Publications.
- Uzunoglu Yegul, B. (2014). *Investigation of pre-service teachers' self-efficacy perceptions in music teaching*. International Balkan Education and Science Congress, Edirne.

Yaman, S. (2016). Adaptation of self-efficacy belief scale for science learning for secondary school students: validity and reliability study. *İnönü University Education Faculty Journal*, 17(2), 123-140. <https://dergipark.org.tr/en/pub/inuefd/issue/26708/280943>

Yıldırım, A., & Simsek, H. (2020). *Qualitative research methods in social sciences*. Seckin Publishing.