Journal of Educational Technology & Online Learning
Volume 5 | Issue 4 | 2022
http://dergipark.org.tr/jetol

Investigation of publications on the use of technology in music education

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Suggested citation: Kardeş, B. (2022). Investigation of publications on the use of technology in music education. *Journal of Educational Technology & Online Learning, 5*(4), 795-807.

Article Info

Keywords

Music
Music education
Technology

Research Article

Abstract

The aim of the study is to determine the research tendencies of publications on music education and technology. Constructed as a mixed methods research, this study follows an exploratory sequential explanatory design. One of the types of data collection technique, document analysis technique was used in the study. The study group of this research consists of articles on music education and technology searched in international databases. The "Publication Evaluation Form" developed by the researcher was used to collect the data of the study. During the data collection phase of the research, databases such as TR Index, Google Scholar, Science Direct, Springer Link, ResearchGate and ProQuest were used. In the search, 213 publications meeting the criteria were reached. As the result of the study, it is determined that usually the studies that are; few-authored, constructed with data collected through survey and observation forms, made with the sample groups selected with regards to availability, made with relatively easier statistical techniques. It is among the findings of the research that the necessary information was not specified in most of the studies examined.

1. Introduction

Technology is an indispensable part of our life and its importance is expected to increase in future. As in other fields, it is very important to adapt to current developments in music education. According to Adelsberger, Collis & Pawlowski (2013), the interest in information technologies has become more prominent in education in recent years. The reflections of this situation are also visible in the field of music education. While developing information technologies, it also enabled the rapid development of communication technologies and accelerated their integration into education. At the same time, social media, which has a place in an important part of people's lives, has made a rapid entry into the field of music education, as in all disciplines. Tess (2013) states that the use of social media in education is a kind of communication technology that is new compared to other disciplines. The acceptance of social media as a communication tool has not only allowed continuous communication, but also been a learning tool that facilitates the interaction of teachers and students with each other, and has also contributed to the learning of students in different educational environments (Ajjan & Hartshorne, 2008). Accordingly, it is necessary to learn about the work that has been done on the use of technology in music education, to offer, structure

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This study was partly presented as a proceeding at the 2nd International Conference on Educational Technology and Online Learning Conference held between June, 23-26, 2022.

Doi: http://doi.org/10.31681/jetol.1146641
Received 21 Jul 2022; Revised 21 Sep 2022; Accepted 22 Sep 2022
ISSN: 2618-6586.

and initiate new research ideas. Due to the global Covid-19 pandemic, it has become a necessity to follow the technological developments in the field of music education recently.

Science is a source from which progress and development are originated. All developments in the scientific field lead to changes in many areas in social, economic and cultural terms. According to Seyidoglu (1995), the concept of science was first used in the middle of the 19th century, and it was stated that science is based on facts and that everything happened in the universe is a phenomenon.

According to Dogan and Demir (2017), science is organized and regular information on human, society and nature, obtained by experimental or theoretical methods. Scientific publications are the studies in which the theses and hypotheses put forward by the researchers are systematically brought to the literature with scientific methods and analyzes (Ataman, Parasiz & Kardes, 2021).

As in every field, the quality of the studies carried out in education is important. On the other hand, it is expected and desired that researches contribute to the field, bring solutions to problems or prevent problems. According to Hertzberg and Rudner (1999), more effective research can be done with a well-prepared research question or hypotheses, by examining and reviewing the content and literature on the subject.

All qualified publications contribute to and enrich the relevant discipline and serve as a guide for new research to be conducted. Grzybowski (2009) states that articles have been published in scientific journals since 1665. When different disciplines such as social and physical sciences are examined, it is seen that the researches are quite old and the number of publications is high, while the studies in the field of music education are more recent and the number is less compared to other disciplines.

Lorenzo, Torres, and Candelas (2007) stated that although there are few publications to evaluate scientific research in the field of music education, these numbers are higher in different disciplines. Kerman (2009) explains this situation as music is not perceived as a science and is a new phenomenon compared to other disciplines. Accordingly, it can be said that music and music education is still in the developmental stage and is not based on a deep-rooted history as other disciplines. With the rapid development of technology, access to current research and information has become easier in music education and it has become fast and reliable to reach the desired research and information thanks to electronic databases. Therefore, these databases have become indispensable in research about music education.

There is no doubt that new digital technologies enable us to access large amounts of information easily in a short time, to communicate with others over long distances, and to share all kinds of information. Music is universal and is used as a common language by all societies. Experiencing the same feelings and thoughts and giving the same reactions when listening to a universal music that reflects the cultural identity of societies shows that music is a universal language. Every society has developed different methods and techniques to learn this universal language and art. The general name of these methods and techniques is called music education. Music is an indispensable part of life and a way of life for all individuals of all ages in different societies living in different parts of the world. On the other hand, all the possibilities of technology are used today to produce, share and listen to music that has become a way of life. Computers, which are used to produce, develop and share information, have been among the indispensable part of daily work, entertainment and social life, and has now become a necessity. The rapidly developing technology and all the positive or negative developments in the world have made it necessary for individuals living in today's information society to follow the technological innovations in their own professional field. According to Nelson (1991), the computer, which is one of the most important inventions of the last century, gradually started to cover all scientific fields and caused these fields to progress faster. Undoubtedly, one of these areas is music, which is at the center of almost all people's lives. Of course, music was produced, developed and progressed without a computer. With the introduction of the computer into the field of music, new styles were tried, new music genres emerged, while old or traditional styles were tried to be preserved. After the introduction of the computer into the music world, these studies have become much easier, faster

and most importantly, open to sharing. Although the applications of electronic systems in musical instruments were few and primitive at the beginning, they have become quite widespread and developed today. In addition to computers, with mobile applications, musical content can be produced, listened to and shared whenever and wherever people want.

Ayhan and Goktas (2015) state that computers have revolutionarily developed. Savage (2005) states that a number of music technologies are used in music teaching today. According to Savage (2007), the rapid development of music technology in the last sixty years has led to an increase in the variety of electronic and acoustic musical instruments, while creating new opportunities for music educators in terms of educational materials. This process, in which new models, software and hardware are developed day by day, has led to important developments in the music world. The most important and revolutionary reflections of the developments in the digital world of music are seen in the field of music recording technologies. Today, many musical processes are performed with computers, hardware and related software. Examples of these are programs prepared for note writing, sound synthesis-editing and educational content, and equipment such as midi keyboard, mixer and microphone. On the other hand, technology has become an indispensable element by gaining a place in all education levels. Accordingly, the aim of the study is to determine the research tendencies of publications on music education and technology. From this point of view, answers to the following questions were sought in the study. What is the distribution of publications dealing with music education and technology according to years, research methods, research designs/models, methods of determining the group included in the study, the number of groups included in the study, sample selection methods, data collection tools, sample groups, data analysis techniques and number of authors?

2. Methodology

2.1. Research Model

This study, the subject of which is the trends of publications on music education and technology, is an exploratory sequential mixed method research. The main feature of the exploratory sequential mixed method is that qualitative research is done before quantitative research. Creswell (2017) explains the exploratory sequential mixed method as a pattern in which the researcher starts by exploring qualitative data and then uses these findings in the quantitative research dimension. One of the types of data collection technique, document analysis technique was used in the study. Document analysis is the gathering and examination of visual and written materials. (Sonmez & Alacapinar, 2014) In addition, according to Yildirim and Simsek (2016), document analysis is the analysis of written items containing information about the facts and events to be investigated.

2.2. Study Group

The study group of this research consists of articles on music education and technology searched in international databases. The sample group in the study was determined by the purposeful sampling method, which is one of the non-random sampling techniques. Purposeful sampling method enables the selection of information-rich situations according to the purpose of the research and deeper research (Buyukozturk, et al., 2016). Gurbuz and Sahin (2016) define the purposive sampling method as the sampling method in which the subjects who meet certain criteria are selected, which the researcher thinks is suitable for the problem based on her/his personal observations. Accordingly, 213 articles meeting the criteria constituted the study group of the research.

2.3. Data Collecting Tools and Data Analysis

The "Publication Evaluation Form" developed by the researcher was used to collect the data of the study. The developed form includes the name of the publication, the year it was published, the research method used, the research design/model used, the method of determining the group included in the study, the

number of groups included in the study, the sample selection method, the sample level, the data collection tool, the data analysis techniques, and the author. In the creation of the Publication Evaluation Form, an item pool was created by first reviewing the literature and examining similar studies on the subject. Based on the item pool, a draft form containing 10 sections was prepared. This form was examined by three faculty members who are experts in their fields and their opinions were taken in the direction that it can be used. During the data collection phase of the research, databases such as TR Index, Google Scholar, Science Direct, Springer Link, ResearchGate and ProQuest were used. The following criteria were considered in the selection of the studies;

i. published in the field of use of technology in music education,
ii. written in Turkish and English languages,
iii. included the keywords 'muzik egitimi ve teknoloji', 'music education and technology'
iv. published between 2000-2022.

In the search, 213 publications meeting the criteria were reached. Papers and theses were not evaluated in the study. Content analysis, which is one of the in-depth analysis methods, was used in the analysis of the data obtained in the study. Content analysis is an approach that provides an objective and systematic examination of written, verbal and other materials (Tavsancil & Aslan, 2001). According to Sonmez and Alacapinar (2014), content analysis is the examination of the content of the text and the document and the classification of the obtained data into classes. The data obtained by content analysis can be divided into classes and converted into numerical data through data analysis programs. In this context, the publications within the scope of the research were examined and the relations between the data were determined by coding and digitizing the fields determined on the publication evaluation form. Number (n) and percentage (%) values were used in the analysis of the data.

3. Results

In the results section, the analyses made on the research data are explained in order in accordance with the purpose of the research.

Table 1.

Distribution of publications by years

Years	n	%
2000	4	1,9
2001	4	1,9
2002	2	,9
2003	3	1,4
2004	6	2,8
2005	4	1,9
2006	1	,5
2007	8	3,8
2008	7	3,3
2009	7	3,3
2010	5	2,3
2011	8	3,8
2012	11	5,2
2013	8	3,8
2014	17	8,0
2015	9	4,2
2016	14	6,6
2017	13	6,1

Years	n	%
2018	17	8,0
2019	17	8,0
2020	20	9,4
2021	22	10,3
2022	6	2,8
Total	**213**	**100,0**

In Table 1, the publication years of the publications related to music education and technology are given. When the table is examined, it is seen that the publications do not show a balanced distribution by years and there is an increasing trend in recent years. The year with the highest number of publications is 2022 with 22 (10.3%) publications.

Table 2.

Distribution of publications in terms of author counts

Author Count	n	%
1	121	56,8
2	70	32,9
3	17	8,0
4	2	,9
5	2	,9
6	1	,5
Total	**213**	**100**

Table 2 includes the number of authors of publications related to music education and technology. When the table is examined, it is seen that 121 (56.8%) publications were made with a single author.

Table 3.

Research method distribution of publications

Research Methodology	n	%
Quantitative Research Method	52	24,4
Qualitative Research Method	62	29,1
Mixed Research Method	14	6,6
Unspecified studies	85	39,9
Total	**213**	**100,0**

According to the table, it is seen that the most widely used research method is the qualitative research method with 62 (42.1%) publications. This method is followed by the quantitative research method with 52 (25.4%) publications and the mixed research method with 14 (6.6%) publications. In 85 publications (39.9%), it was not stated which method the research was used.

Table 4.

Distribution of the research designs/models of publications

Research Designs/Models	n	%
Descriptive Model	96	43,6
Experimental Model	27	12,3
Case Study Model	22	10,0
Musical Analysis	1	,5
Systematic Compilation	2	,9
Unspecified study	58	26,4
Action Research Model	5	2,3

Research Designs/Models	n	%
Exploratory Sequence Mixed Model	1	,5
Document Analysis Model	4	1,8
Correlational Model	1	,5
Ethnographic Model	3	1,4
Total	**220***	**100**

**The total value in the table refers to the total number of models used because more than one model is used in some articles.*

When Table 4 is examined, it is understood that the scanning/descriptive model used in 96 (43.6%) publications is the most used model. This model is followed by the experimental model with 27 (12.3%) publications in terms of the number of uses. It was not specified which design/model was used for 58 publications (26.4%).

Table 5.

Distribution of the ways of determination of the group included in the study

Group Included in the Study	n	%
Study group	32	15,0
Population	1	,5
Sample	7	3,3
Unspecified study	116	54,5
Population and sample	15	7,0
Participants	42	19,7
Total	**213**	**100**

In Table 5, it was seen that the group included in the study was expressed as 'participants' in 42 (19.7%) publications and as the study group in 32 (15.0%) publications. Another data obtained from the table is that 116 (54.5%) publications did not specify the method of determining the group included in the study.

Table 6.

Distribution of publications in terms of number of groups included in the study

Number of Groups Included in the Study	n	%
1-10	15	7,0
11-100	74	34,7
101-200	11	5,2
201-300	6	2,8
301-400	5	2,3
401-500	5	2,3
More than 500	6	2,8
Unspecified study	91	42,7
Total	**213**	**100**

When Table 6 is examined, it is understood that 74 (34.7%) publications included 11-100 participants, 15 (7%) publications between 1-10, 11 (5.2%) publications between 101-200, 6 (2%) between 201-300, 5 (2.3%) publications between 301-400, 5 (2.3%) publications between 401-500, 6 (2.8%) publications with 500 or more participants. In addition, it is understood that the number of participants was not specified in 91 (42.7%) publications.

Table 7.

Distribution of sample selection methods of publications

Sample Selection Method	n	%
Purposive Sampling	27	12,7
Simple/Random Sampling	6	2,8
Typical Case Sampling	3	1,4
Unspecified study	174	81,7
Maximum Variation Sampling	1	,5
Stratified Sampling	1	,5
Easy Sampling	1	,5
Total	**213**	**100,0**

When Table 7 is examined, it is noteworthy that the sample selection method was not specified in 174 (81.7%) publications, which constitute the majority of the publications. In addition, as can be seen from the table, it is seen that 27 publications (12.7%) used purposive sampling method, and 6 publications (2.8%) used simple/random sampling method.

Table 8.

Sample group distributions of publications

Sample Group	n	%
Unspecified study	42	16,7
Kindergarten Students	6	2,4
Elementary School Students	11	4,4
Primary School Students	3	1,2
Music Education Department/Department of Music Education	31	12,3
Undergraduate	5	2,0
Music teacher	22	8,7
Music High School	2	,8
Graduate Education Materials, Thesis	3	1,2
Instrumentalist	4	1,6
Graduate Student	6	2,4
Lecturer/Academician	6	2,4
Material, book, video, internet	27	10,7
Middle School Students	11	4,4
Literature	1	,4
Mobile Apps	11	4,4
Note/Music Software (PC)	17	6,7
Teacher	8	3,2
Conservatory/Faculty of Fine Arts Student	21	8,3
Hardware/Device	6	2,4
Amateur musician	5	2,0
High school student	4	1,6
Total	**252***	**100,0**

**The total value in the table refers to the total number of sample levels used in some articles due to the use of more than one sample group*

According to Table 8, students of Music Education Department/Music Education Department constitute the largest sample group with 31 publications (12.3%). On the other hand, it is understood that in 42 studies (16.7%), no sample group was specified.

Table 9.

Distribution of publications in terms of their data collection tools

Data Collection Tools	n	%
Unspecified study	67	24,2
Survey	57	20,6
Interview Forms	48	17,3
Scale	14	5,1
Observation Forms	25	9,0
Musical Analysis	15	5,4
Sound Recording/Studio Recording	9	3,2
Performance Evaluation Forms	11	4,0
Achievement/Knowledge/Competence Tests	2	,7
Keyword	2	,7
Materiel	4	1,4
Source Scanning	15	5,4
Musical Evaluation Form	7	2,5
Diary	1	,4
Total	**277***	**100,0**

**The total value in the table, amounts to the sum of used data collection tools due to the usage of more than one data collection tools in some articles.*

When Table 9 is examined, it is seen that the most used data collection tool is survey (20.6%) with 57 publications. The questionnaire was followed by interview forms with 48 publications (20.6%), and observation forms with 25 publications (9.0%). On the other hand, it is among the findings that the data collection tool was not specified in 67 publications (24.2%).

Table 10.

Distribution of publications in terms of data analysis techniques

Data Analysis Techniques	n	%
Unspecified study	70	24,4
Percent/Frequency	79	27,5
T-Tests	9	3,1
Correlation Analysis	7	2,4
(ANOVA) Analysis of Variance	8	2,8
(ANCOVA) Analysis of Covariance	2	,7
Audio Analysis	7	2,4
Content Analysis	68	23,7
Musical Analysis	16	5,6
Wilcoxon signed-row test	3	1,0
Factor Analysis	2	,7
Mann Whitney-U	8	2,8
Kruskal-Wallis	5	1,7
Chi-square test	3	1,0
Total	**287***	**100**

**The total value in the table, amounts to the sum of used data analysis techniques due to the usage of more than one data collection tools in some articles.*

When Table 10 is examined, the most frequently used analysis techniques are percent/frequency in 79 (27.5%) publications, content analysis in 68 (23.7%) publications, and musical analysis in 16 (5.6%) publications. In addition, analysis techniques such as ANOVA, t-tests, sound analysis, musical analysis,

correlation, and MANOVA are used, albeit sparingly. On the other hand, it was determined that the analysis technique was not specified in 70 publications (24.4%).

4. Conclusion and Suggestions

In this study, which is about the determination of the research trends of the publications on music education and technology in the international literature, 213 publications discussed with the document analysis technique are included.

The most widely used research method in the publications on music education and technology is the qualitative research method. This method is followed by quantitative and mixed methods, respectively. However, the number of studies using mixed method is very few. Recently, there has been an increase in studies structured with the qualitative method. Unlike the generalization-specific quantitative research method of the positive sciences, qualitative research focuses on the diverse and profound nature of human individual characteristics. Although quantitative and qualitative methods are used together in different fields of science, it can be said that the use of this approach based on a single research logic has decreased in recent years, and qualitative and even mixed methods (using quantitative and qualitative research together) have begun to become widespread in explaining human phenomena. In addition, Baltaci (2019) states that qualitative research is preferred due to its complex nature and flexibility to detail many different situations, and that researchers have a more comfortable working area during the design and execution phase due to its dynamic structure. While quantitative research is the process of transforming data obtained from participants with certain measurement tools into generalized and universal information by using various statistical analyzes (Crabtree & Miller, 1999); Qualitative research aims to express the examined phenomenon in the best way with the depth and details of the knowledge (Connelly, 2016; Marshall & Rossman, 2014). Therefore, it is expected that the qualitative method should be preferred when the answer to the question "why" is sought.

In terms of research patterns/models in publications on music education and technology, it was determined that the scanning model was used the most. This can be explained by the fact that experimental studies require a much longer process compared to other models in terms of methods, and therefore they are avoided by academics (Kemiksiz, 2017).

It was determined that the expression of participants was used as a way of determining the group included in the study in the majority of publications. The use of population and sample expressions is negligible. Another remarkable finding is that in the majority of the publications (116 publications), the method of determining the group included in the study was not specified. According to another similar finding, the publications mostly worked with the number of groups between 11-100, and none of the publications preferred the number of groups more than 500, except for 6 publications. This finding is in line with the findings of the study conducted by Kurt and Erdogan (2015). This can be interpreted as working with a small number of groups takes less time in terms of data collection and analysis.

It was observed that the sample selection method was not specified in the majority of the examined publications. Since it affects the researcher positively or negatively in terms of time, cost and workload, the selection of samples is very important in scientific studies conducted with a group that will represent the population instead of the whole population. Therefore, sample selection is an issue that must be explained in scientific publications. It was seen that the most multi-purpose sampling method was used, except for the publications where the sampling method was not specified within the scope of the research. According to the results of a similar study, it is stated that the purposeful sampling technique is used as a sampling technique (Kurt & Erdogan, 2017). According to Karasar (2005), researches are generally done on samples and the results are generalized to universes. Yildirim and Simsek (2016) state that the sample selected with the appropriate method and number will have the characteristics of the universe and that the data obtained from this sample can represent the universe.

In most of the publications on music education and technology, it has been determined that the target audience is music education students as participants or study groups. On the other hand, in some studies, music materials (books, videos, databases), musical notes/music software and mobile applications were also found. In scientific research, it can be explained by the fact that university students are mostly preferred, the process of obtaining the necessary permissions to conduct research is difficult and long, or the academics prefer to reduce the time they allocate to scientific studies as much as possible due to excessive course load (Secer, Ay, Ozan & Yilmaz, 2014). ; Arik and Turkmen 2009; Cubukcu, Yilmaz and Inci, 2016). According to Kemiksiz (2017), the reason why students are mostly preferred in scientific research is that students are at the center of education and training activities and data collection can be done during class hours. Another remarkable finding is that the population included in the study was not specified in 42 publications.

Survey and interview forms were used as data collection tools in most of the publications. These techniques are followed respectively by observation forms and musical analysis techniques. Considering that the publications are mostly conducted with qualitative research methods, the fact that interview forms are among the most used data collection tools parallels this situation. Secer, Ay, Ozan and Yilmaz (2014), Alper and Gulbahar (2009), Erdem (2011) and Yildiz (2016) stated that surveys were mostly used as data collection tool in studies. The reason why these data collection tools are most preferred suggests that they provide easy access to large audiences and that the application is more economical in terms of time and cost.

Among the publications examined in the study, it was revealed that content analysis was the most in the qualitative ones, and frequency/percentage values were found in the quantitative ones. This can be interpreted as the low number of variables in the studies. In addition, the number of multivariate analyzes in publications is negligible. Yildiz (2016) and Bush and Crawford (2012) stated that the content analysis method was mostly used in the qualitative researches examined. The predominance of qualitative studies in publications, but the scarce use of multivariate analyzes suggests that a research problem is created according to the statistical techniques known to the researchers rather than determining the appropriate techniques for the research problem.

Besides publications with two and three authors, the majority of publications are single-authored. This situation suggests that the academicians who publish may be a result of the academic promotion criteria in their countries. Therefore, it can be said that they give priority to single-authored publications.

According to the data obtained, it has been seen that many publications related to music education and technology have been made and these studies show subject distributions such as distance education, applications, software, applications of technology at every education level. It is very important that the ever-evolving technology is included in music education. Parallel to the developments in recent years, it is seen that the relationship between music education and technology has intensified especially on the axis of distance learning. In this process, there has been a great increase in the preparation of video content in order to make education more efficient.

In the study, it has been determined that there are methodological deficiencies in many studies. It is thought that these deficiencies, which differ according to the studies, may be caused by the author as well as the problems experienced in the publishing processes. On the other hand, 35 studies do not have any methodological information. This is seen as a major obstacle for readers to obtain information on how the relevant research was conducted. Therefore, it is very important to provide necessary and sufficient information in research.

In the studies examined, it has been seen that researches that reach the results obtained from the data collected with smaller groups and similar measurement tools compared to other fields have emerged. Therefore, it is thought that the different ways to be followed will provide a more qualified solution to

provide healthier information in the field of music education and technology and to solve the existing problems.

With the developing technology, it can be said that music and music education has reached a satisfactory point today. As technology develops, it is inevitable that technology will be more integrated into music education and its effects will be reflected positively. Comber, Hargreaves, and Colley (1993) stated that in recent years, many music educators, musicians and music students have used computer-assisted technology more in their music lives. On the other hand, according to studies, the use of technology especially in music education makes it easier for children to establish a closer connection with educational music used in schools and to establish relationships between students' real lives and the music they listen to (Cain, 2004). With the point that technology has reached, music has come to a position where everyone can deal with and improve themselves by going beyond traditional perceptions. New approaches have emerged in the dimensions of music such as listening, playing and creating with the contents on the internet. According to Comber et al. (1993), the use of technology has enabled individuals who do not see themselves as musicians to develop their musical creativity and interact with music more closely. On the other hand, Ho (2004) states that there are pedagogical developments with technological developments, there are new structures in the curricula and there are differentiations in the role of the teacher. The importance of technology use in music education was emphasized with the research, but when compared with other disciplines, it was seen that the studies examined were not sufficient in number. This situation can be explained by the fact that music is a new phenomenon compared to other disciplines, as Kerman (2009) states. On the other hand, it has been found that the studies have some deficiencies in terms of form. This situation caused the sub-headings such as "where, how, when, the participants and their numbers" to be not specified clearly enough. Buyukozturk et al. (2016) state that the presence of certain rules in scientific articles revealed through systematic studies ensures that a common language is formed with the readers. Accordingly, it can be said that the researches written with certain rules set a certain standard and enable the readers to understand the content more easily and to focus only on the content of the article.

From the results of this study;

- In order to publish international publications, it is recommended to determine the research method carefully, to be accepted in scientific research subjects and to choose appropriate methods for the field.
- Studies whose research method has not been specified in detail and transparently can be sent back to the author for review.
- The methodology and the path followed in the researches should be explained in detail, accurately and clearly.
- It is recommended that more practice-based studies be carried out in studies on music education and technology.
- In order for music educators to benefit from the technological opportunities in the field and to follow the developments closely, the subject should be sufficiently included in the curriculum and the necessary hardware and software should be provided.

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