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THE EFFECT OF MUSIC ON READING SKILLS: A META-ANALYSIS STUDY

Review study

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Abstract

This study aims to make a comparison as to what aspects of reading skills are affected by music with its different functions. For this purpose, a total of 31 experimental/quasi-experimental studies published between 2010-2021 investigating the effect of music on reading skills were analyzed by meta-analysis method. Effect size calculations of the studies, heterogeneity analysis, publication bias and moderator analysis were performed through the statistical program Comprehensive Meta-Analysis v2.0 (CMA). As a result of the heterogeneity test, the data obtained from the studies were interpreted in accordance with the random effects model. It was concluded that music had a small effect size (Hedge's g=0.269, 95%CI=0.058-0.481) on the academic success of students' reading skills compared to a quiet learning environment. Moderator variable analysis indicated that the effect size values did not show a statistically significant difference according to how music was used and the duration of the experimental process while these values showed a statistically significant difference according to the reading sub-skills/learning areas, the field of study and the level of education in which the implementation was carried out. This study examines the effect of music, in a comparative way, on reading skills in terms of reading aloud skill, phonemic awareness, reading comprehension, vocabulary and grammatical accuracy, which are sub-skills/learning areas of reading skill, as well as considering each different function of music use. The study is expected to make an important contribution to the literature as it makes a comprehensive synthesis of the studies investigating the effect of music on reading skills with respect to these intermediate variables.

Keywords: music, reading skill, meta-analysis.

1. Introduction

Music has a significant effect on an individual's social, cognitive and affective skills. There are a number of studies indicating that music has a multifaceted effect in terms of affective skills such as reducing anxiety and stress level and hyperactivity and calming down angry students that exhibit undesired behaviors in the classroom environment (Dolean, 2015; Giles, 1991; Lai, et al., 2008; Savan, 1996; Savan, 1998; Scott, 1970) as well as those that investigate the effects of music on cognitive aspects such as mathematics, listening skills and reading skills with a conclusion that it has positive and negative effects on students' learning performance (Dosseville, et al., 2012; Jaušovec, et al., 2006; Schellenberg, 2005; Shih, et al., 2012). Among the studies with a cognitive aspect, the prominent ones are those examining the effect of music on reading skills.

Several studies have shown that music has different effects in terms of its impact on reading skills. There are those who claim that music has a negative effect on students' reading comprehension by creating a distracting effect and that they perform better in a quiet environment (Fogelson, 1973; Furnham & Brandley, 1997) as well as those who state that it has a facilitating effect (Gür, 1995; Hall, 1952; DeMers, 1996; Hallam, Price & Katsarou,

2002) or no effect (Gillis, 2010; Sarıkaya, 2019). Multi-dimensional research has been conducted in terms of sub-skills/learning areas of reading skill such as recognizing phonemes, increasing vocabulary, increasing reading speed, distinguishing words, reading comprehension and reading with the therapeutic aspect of music; however, it seems that no comparison has been made in the related literature in terms of effect size of these aspects. Therefore, this study aims to make a comparison on the aspects of reading skill on which music has an effect. In line with this purpose, sub-skills/learning areas of reading skills were specified, studies examining the effect of music on reading sub-skills/learning areas were reviewed, and then these studies were examined by means of meta-analysis method in terms of reading sub-skills and functions of music.

1.1. Sub-Skills of Reading

Reading skill is a complex process that includes recognizing and making sense of all units of language, from sounds to syntax. Issues like phonemic awareness, morpheme awareness, recognizing words, syntax knowledge, improving vocabulary and relating each one with one another are important in this process. Grabe (1991, p.379) states that a fluent reading process consists of the following elements:

- Automatic recognition skills
- Vocabulary and structural knowledge
- Formal discourse structure knowledge
- Content/world background knowledge
- Synthesis and evaluation skills/strategies
- Metacognitive knowledge and skills monitoring

Automated recognition skills include skills such as phonemic and morpheme awareness, and word recognition. These skills play a very important and dominant role in the identification of lexical access ability (Grabe, 1991, p.380), automated word decoding skills, and reaching fluent reading (Verhoeven & Perfetti, 2011). Vocabulary and structural knowledge of the individual is an important factor in the development of these skills.

The structural knowledge of a word is the information that includes describing its phonemic structure and orthographic form (Yopp, Yopp & Bishop, 2009). The components of the structural knowledge of a word are the orthographic word form, orthographic units, morphological decomposition, morpho-phonological units (morphemes, phonemes) and the semantic system (Verhoeven & Perfetti, 2011, p.458). Of these components, the semantic system includes knowledge of vocabulary. Vocabulary knowledge can be defined by wide reading, high-level oral language skills, word consciousness, distinguishing specific words from others, and using vocabulary learning strategies (Texas Reading Initiative, 2002). These factors indicate the function and usage of words in a language. The function and use of a word in languages is related to the formal discourse structure knowledge and this knowledge can be taught by direct and indirect methods. While the direct method includes an awareness of word structure, the indirect method provides experience gaining opportunity regarding the development and use of word assessment (Sedita, 2005). In the use of these methods, reading is effective as it develops the receptive vocabulary. Listening in the receptive vocabulary is the most efficient way because in this way people can recognize more words than they can produce in the spoken language (Kamil, 2004). Therefore, an effective use of listening texts related to the syntactic use of language at this recognition stage is important for the development of vocabulary. In this context, music is an effective stimulus for the melodic perception of

listening texts. In addition, in order to use a word, it is necessary to know the appropriate syntactic environment (Crow, 1986, p.243). Formal discourse structure knowledge, which refers to the formal schemes required for this environment, is important in understanding "knowledge relative to the formal, rhetorical organizational structures of different types of texts." (Carrell, 1987, p.461). The content area of the text requires the understanding, synthesis and evaluation of texts. This requires use of high-level cognitive skills such as analysis, evaluation and metacognitive knowledge. The process of understanding the content area of a text by employing these skills can be described as follows (Kintsch & Kintsch, 2005, p.73):

• decoding (perceptual and conceptual process),

• analyzing the internal structure of the text,

• situation model (a mental model of the situation described by the text, such as visual images, emotions, and personal experiences).

Decoding is the first step required to comprehend and understand a text and to make text-oriented implementations. This is followed by the stage of text analysis. Upon the completion of this stage, it is the stage of deriving a text-oriented situation model. This final stage is for the evaluation of a text and for an inter-textual comparison. At this stage, it is important for the individual to be exposed to texts of different structures (visual, auditory, audio-visual structure). Therefore, the lyrics of a song and the accompanying melody are one of the methods that can be effective for mental modeling in order to understand the situation model. However, the important thing is to be able to make an inference about the learning area in which music can be more effective.

1.2. Previous Research About the Effect of Music on Reading Sub-skills

A versatile approach has been adopted for the evaluation of music in terms of increasing cognitive performance. There are a number of studies in the literature on the function of many aspects of music in native or foreign language teaching: listening to/singing songs, conducting reading, speaking or writing activities with background music with/without words and classical or popular music. Studies on reading skills including phonological skills, vocabulary and reading comprehension, which are components of reading skill, indicate different effects/relationships (positive, negative, no) in terms of different functions of music.

Phonological skills are the first stage in the process of acquiring literacy skills. This stage involves a complex process built on mental representations of the phonemic structure of languages (Scarborough & Brady 2002), which requires external and explicit direction. This is because exposure to phonemic input alone does not lead to phonological awareness (Adams, 1990). According to Kolb (1996), the most effective way to teach children to learn and appreciate language is to provide a variety of meaningful experiences that develop their ability to hear rhythm, sounds, and melodies. Music is among indispensable stimuli for children to experience an academic, social and emotional positive learning environment (Paquette & Rieg, 2008) and for the development of phonemic awareness skills. It can be seen in the related literature that music has a positive effect in terms of phonological awareness, that is, recognizing the sounds in words with an identification of them as initial, medial and final sound and establishing a sound-letter relationship (Bolduc, 2009; Gromko, 2005; Overy, 2003; Peynircioglu, Durgunoglu & Oney-Kusefoglu, 2002). Studies have also shown that there is a statistically significant relationship between musical attitude together with perception and phonological awareness (Anvari, et al., 2002; Rubinson, 2010) and that it has a positive effect on pronunciation skills (Overy, 2003).

Spelling, naming speed, distinguishing pseudowords, making inferences about the meaning of words, and using a word for different meanings in accordance with the context are all

considered significant in the process of vocabulary teaching. A number of studies in literature indicate that music has an effect on vocabulary teaching, especially in terms of naming the words and increasing the vocabulary (De Groot, 2006; Herrera, et al., 2011 and Moyeda, Gomez & Flores, 2006). Reading aloud and rhythm activities seem to be prevalent particularly in studies on word naming.

Hall's (1952) study is important in terms of reading comprehension. In this study, which investigates the reading comprehension performance of the students with an ongoing background music for which no information is provided, the experiment group listened to music at regular intervals. An increase has been reported in the performance of 58% of 245 students and the students with below-average intelligence and achievement scores were reported to benefit from the function of background music more than students with above-average scores. Hallam, et al. (2002), who also reported a positive effect result, stated that music was more effective with a calming effect when compared to the silent environment in terms of arithmetic performance and reading comprehension skills of the participants aged between 10-12. When the experimental and control groups consisting of 5th grade students were compared in the study of DeMers (1996), it was found that the experimental intervention, which was a Concerto by Mozart, made a statistically significant difference on reading comprehension performance of the students compared to the control group, which was the silence group. Gür (1995) investigated the effect of familiar and unfamiliar music played in the background in foreign language teaching on students' reading comprehension performance and reported a statistically significant difference between the pretest-posttest scores when compared to the control group without music. In Fogelson's (1973) study, it was concluded that popular music without lyrics had a negative effect on 8th grade students' reading comprehension skills. Furnham and Brandely (1997) focused on the reading comprehension performance of participants with different personality types (introverted and extroverted) while listening to pop music. It was concluded that the extroverted participants performed better with pop music while the performance of the introverted participants decreased compared to the case in a quiet environment.

Gillis’s (2010) study investigated the effects of background music on university students' reading comprehension skills. This study was conducted with seventy-one participants, who were asked to read a health-related article in one of three conditions: silence, music with lyrics, and music without lyrics. No statistically significant difference between the groups was reported as a result of the study. We can conclude from the review of these studies that music has a multifaceted effect on students' reading skills depending on its function, genre and experimental intervention time. This effect can be positive as well as negative. It is therefore important to conduct an up-to-date and comprehensive meta-analysis study by synthesizing the prominent studies about the effect of music on the students’ level of development in terms of their reading skills and academic performance.

1.3. Related Literature

A number of meta-analysis studies are available in the related literature in the context of research on the effect of music. While Chabris (1999) conducted a meta-analysis with 16 published studies on the Mozart effect, Hetland (2000) reviewed 36 independent studies comparing Mozart as well as other classical music pieces as a part of an experimental process in different conditions (in silence, with relaxation instructions, other musical genres etc.). This review focused on studies that investigate visuospatial abilities. Pietschnig, Voracek, and Formann (2010) reviewed 39 studies (3000 participants in total) comparing listening to a Mozart piece (K. 448) with listening to a non-musical stimulus or sitting quietly. Sala and Gobet (2020), on the other hand, concluded in their meta-analysis study that participation in

music has no effect on people's non-musical cognitive skills or academic achievement, reviewing 54 studies published between 1986 and 2019.

Dumont, Syurina, Feron, and Hooren (2017) conducted a meta-analysis study between January 2010 and June 2016 investigating the effect of music on the development of primary school children and found that 15 of 46 studies focused on reading skills, but reported no conclusive remark due to the presence of studies reporting a positive impact of music on reading skill as well as those that reported it had no impact on reading skills. In the study by Kämpfe, Sedlmeier, and Renkewitz (2010), who examined the effect of background music with a meta-analysis method, it was concluded that background music impairs the reading process, has some minor detrimental effects on memory, but has a positive effect on emotional responses and improves learning performance. Gordon, Fehd and McCandliss (2015), in their meta-analysis study on the development of children's literacy skills through music education, focused on 13 studies in the context of phonemic awareness and reading fluency, and concluded that music has an increasing effect on phonemic awareness and rhyme skills. Melby-Lervåg, Lyster, and Hulme (2012) reviewed a total of 235 studies including extreme group comparisons that addressed children's phonological skills and word reading skills. As a result of the meta-analysis, it was concluded that children with learning difficulties show a greater deficiency in phonemic awareness compared to children of the same age with normal development, and that the important role of phonemic awareness as a predictor of individual differences in reading development should be promoted. In this support process, it is also important to determine the effect size of music in the treatment of learning disabilities, and an answer was sought as one of the sub-problems of this study. Eccles et al. (2021), as a result of their narrative synthesis study that reviewed five studies between 1975 and 2013 on the literacy development of children aged 5-8 years, found that there is a lack of research in low-middle-income countries in the area of music education as a supportive approach for phonemic awareness and early literacy. In this study was concluded that there is no comprehensive analysis pertaining to the effect size of music on reading skills, and that the issue is limited to a single aspect. For this reason, in this study, the effect of music in terms of sub-skills/learning areas of reading skills has been addressed and the aim of this research is "to examine the effect of music on the development of reading skills". In this context, experimental or quasi-experimental studies investigating, at all levels of education from pre-school to undergraduate level, whether music has a statistically significant effect on students' academic achievement in terms of reading skills when compared to traditional techniques were examined with a meta-analytical approach. The use of music (as a background stimulus with an integrated curriculum, as a treatment method (for dyslexia, hyperactivity, specific learning disorder), by singing/listening), reading skill area (phonemic awareness-pronunciation, reading aloud (word/text reading), reading comprehension, vocabulary, grammatical accuracy etc.) have been addressed in terms of the teaching level at which the intervention was carried out, the characteristics of the intervention group and the duration of the intervention. Accordingly, answers to the following questions were sought in the study:

1. What is the general effect size of music on students' reading skill achievement?

2. How is the distribution of the effect size of the music according to the use of music, the sub-skills/learning areas of the reading skill, the fields of study, the teaching level, and the duration of the experimental intervention?

2. Method

2.1. Research Design

Meta-analysis method was used to determine the effect size of music on sub-skills/learning areas of reading skill. Meta-analysis is a method that involves the statistical analysis of the numerical data obtained through certain criteria from independent studies on similar subjects and reaching a general conclusion accordingly (Borenstein, Hedges, Higgins and Rothstein, 2019; Dinçer, 2014). The implementation of this method usually involves the following three steps: (1) identification and selection of appropriate studies, (2) coding of study data and determination of effect sizes, (3) statistical analysis of the effect and effect sizes of study data (Höffler & Leutner, 2007, p.724). In the implementation of these three steps, the meta-analysis has three main objectives: (a) to test whether the study results are homogeneous, (b) to obtain an overall index of the confidence interval for the effect size and statistical significance of the relationship studied, and (c) to identify possible variables or features that shape the results if there is heterogeneity between studies (Huedo-Medina, Sánchez-Meca, Marín-Martínez & Botella, 2006, p.3). For these purposes, the following process was followed.

2.2. Criteria for Selection of the Studies

The criteria for being selected for analysis in the research were determined and applied as follows:

• Studies on teaching reading skills,

• Scientific articles published in printed or electronic journals,

• The presence of at least one experimental group in the studies and the teaching of reading skills through music to the participants who constitute the experimental group,

• The presence of at least one control group in the studies and the teaching of reading skills through music to the participants who constitute the control group

• The studies that were published between 2010-2021,

• The studies in which the sub-skill/learning areas of the reading skill is the dependent variable,

• The studies that include quantitative data such as sample size, standard deviation and arithmetic mean values required to determine the effect size.

• The studies that were published in the field index (SSCI, ERIC, AHCI, TR Index,…)

• The studies published in either English or Turkish

• The studies with an open access to full text.

2.3. Selection Process of the Studies

Before the meta-analysis study, a general search of the studies on music and reading skills was made, and as a result of the preliminary scanning, it was decided to scan with Google Scholar, Web of Science, Educational Resources Information (ERIC), EBSCOhost, ScienceDirect, Scopus, Springerlink and Ulakbim Social Sciences databases. The keywords to be used in the searches made in the relevant databases were determined as music effect, reading skill, reading ability, reading comprehenesion, music effect on reading, experimental design/research, with their Turkish equivalents. In addition, additional keywords were searched: initial literacy skill, vocabulary, phonemic awareness.

In the first database search (Google Scholar), 2050 studies were reached. However, 852 studies were recorded as a result of the search made in the criteria of the selected databases. In the second stage, as a result of analysis which aims to identify which studies meet the inclusion criteria 722 studies were excluded: 76 studies which their full text could not be accessed; 64 studies which were written in a different language even if it had an English abstract; 178 studies which were duplicated in different databases; 208 studies which were conducted with different reserch methods and 196 studies which were not related to teaching reading skills. The remaining studies were re-evaluated within the framework of previously determined criteria. As a result of this evaluation, 92 records, the reasons for which were explained in detail in the PRISMA Flow Chart in Figure 1, were excluded from the study and it was concluded that a total of 32 studies were examined.

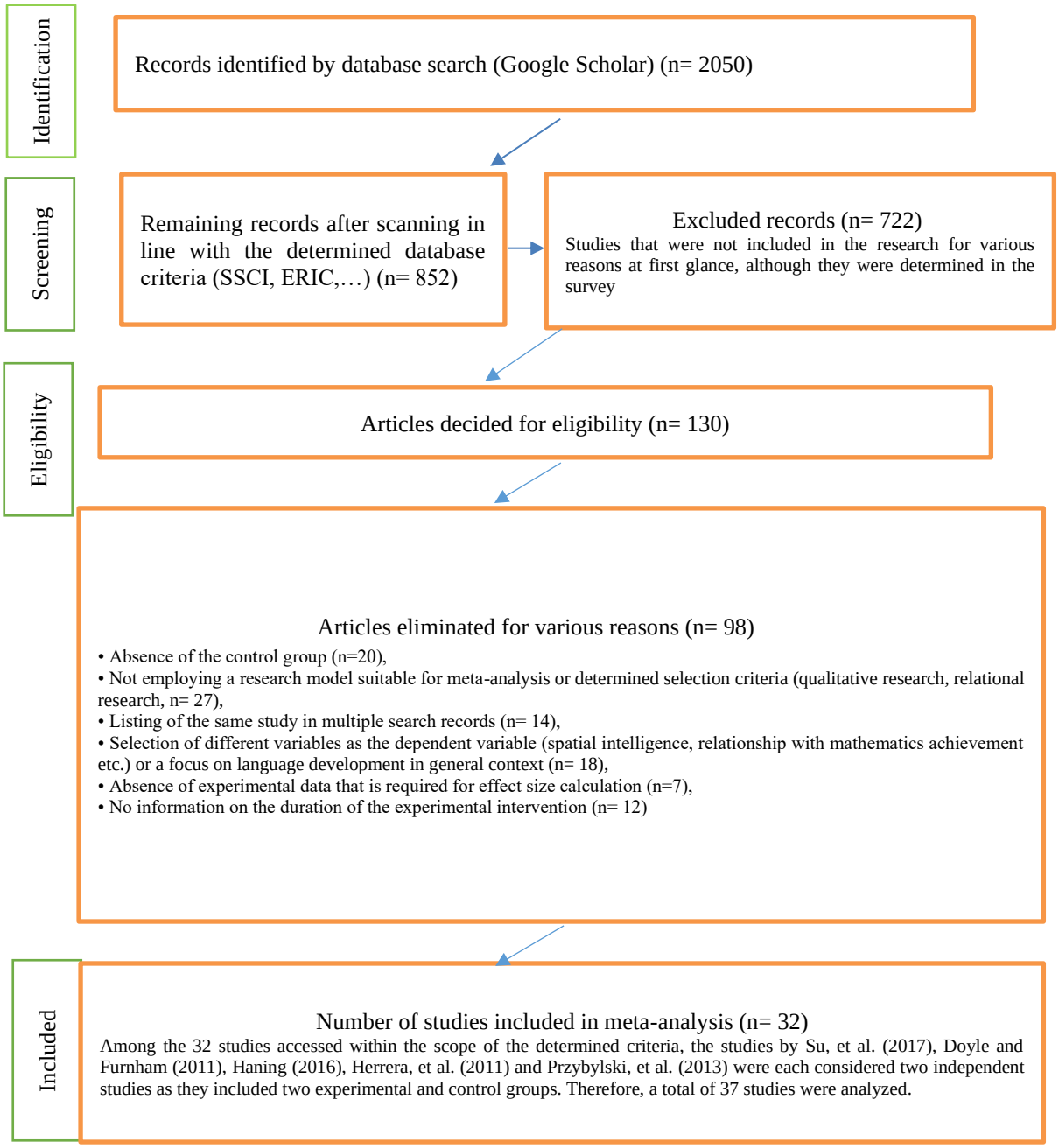

Figure 1. PRISMA diagram (This diagram was used in the study of Moher, et al. (2009))

2.4. Coding and Ensuring the Validity and Reliability of the Coding Process

The studies that have met the criteria determined based on literature review were coded with the help of a form developed by the researcher. This form, which is structured depending on the purpose and sub-objectives of the research, consists of two parts. The first part includes study number, name of study, author(s) of study, year of study, field of study (mother tongue teaching/foreign language teaching), level of education in which the study was conducted, duration of experimental procedure, use of music in the study, field of reading skill targeted, group types and findings. In the second part, there were values such as standard deviation, arithmetic mean, number of samples, t value, p value, etc. required for effect size calculations. In addition, several meta-analysis studies in the literature (Dağlı, 2021; Dağyar & Demirel, 2015; Dinçer, 2014; Kaldirim & Tavşanlı, 2018; Kansızoğlu, 2017) were examined in order to ensure the content validity of this form, which was finalized in the light of these studies. In order to ensure the reliability of the coding, the coefficient of agreement was checked. All the studies examined within the scope of meta-analysis were re-coded by the researcher at one-month intervals. Miles and Huberman's formula was used to calculate the reliability coefficient. As a result of the calculation, the reliability rate was found 97%, incoherent parts were also reviewed and corrected.

3. Findings

Descriptive data related to the studies included in this research are given in Table 1. Descriptive data regarding the publication year of the studies, the studies according to how music is used, the sub-skills/learning areas of reading skill, the studies according to their fields and the studies according to the education level is in Table 1.

Table 1. *Descriptive data of the studies*

Variables of the studies		Frequency (f)	Percentile rate (%)
Publication year	2010-2013	13	42%
	2014-2017	13	42%
	2018-2021	5	16%
Utilization of music	In the background	14	45%
	With an integrated curriculum	10	32%
	As a treatment method	4	13%
	By singing/listening	3	10%
Sub-skills/learning areas of reading skill	Grammatical accuracy	3	10%
	Reading aloud (word, paragraph, text reading)	10	32%
	Phonemic awareness-pronunciation	3	10%
	Reading comprehension	13	42%
	Vocabulary	2	6%
Field of the study	Mother tongue teaching	27	87%
	Foreign language teaching	4	13%

Level of education	Pre-school	8	26%
	Primary school	8	26%
	Middle School	2	6%
	High school	2	6%
	Higher education	11	36%
Duration of experimental intervention	1-3 weeks	14	45%
	4-6 weeks	4	13%
	7-9 weeks	4	13%
	10-16 weeks	4	13%
	5 months and above	5	16%

As can be seen in Table 1, there is a decrease in the number of publications since 2018 (f=5). In terms of the use of music, there are mostly studies on the use of music in the background (f = 14). In the field of reading skill, it has been determined that studies on reading comprehension skills (f=13) and reading aloud (f=10) are predominant sub-skills in the studies. In addition, it is seen that the effect of music on reading skills is predominantly studied in the field of mother tongue teaching (f=27) and higher education level (f=11). In terms of experimental intervention duration, 1-3 weeks for the duration is prominent among the studies (f=14).

3.1. Evaluation of Publication Bias

At the stage of the analysis, the publication bias of the studies was examined. There are many reasons for publication bias. Among these reasons are perceptions that studies reporting large effects will be published more easily, studies with significant results are more likely to be published, published studies are more likely to be included in the meta-analysis as well as language bias, availability bias, cost bias, familiarity bias and repetition bias (Borenstein, et al., 2019).

First of all, the funnel plot of publication bias was examined. The funnel plot is a graphical presentation that evaluates effect sizes in terms of how large a study is (Rodriguez, 2001; Sterne, Egger & Smith, 2001; Sutton, 2009). The funnel plots that are evenly distributed to the right and left of the symmetry axis, which provide information about the distribution of the calculated effect sizes, suggest that there is no publication bias (Bakioğlu & Göktaş, 2017). Figure 2 illustrates that the vertical line estimating the average effect size is asymmetrical on both sides.

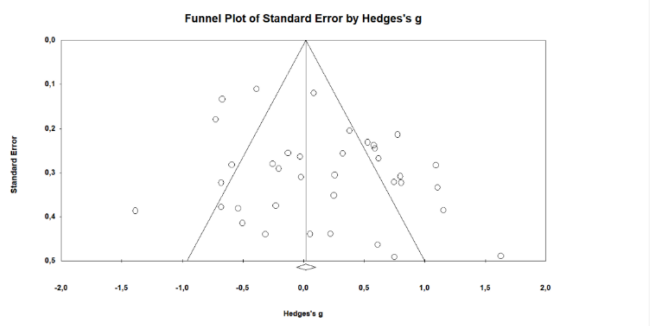

Figure 2. Funnel plot for publication bias of the reviewed studies

However, Rosenthal safe N (fail-safe N-FSN) value was also calculated based on the assumption that the shape of the funnel plot may be misleading regarding publication bias and that any asymmetry may result from a real heterogeneity (Üstün & Eryılmaz, 2014). Since FSN was 18 and the number of studies examined was limited, the studies were revisited for publishing bias. For this purpose, weighting was considered, and six studies affecting the weighting were excluded from the scope of the study. Considering the publication bias analysis of a total of 31 (26+5) studies, first of all, a symmetrical distribution was observed in the middle and lower regions of the funnel plot (Figure 3). The Egger test p value was also not statistically significant, which examines whether the funnel plot is asymmetrical or not, indicating that the funnel plot is not asymmetrical (p=0.241>0.05).

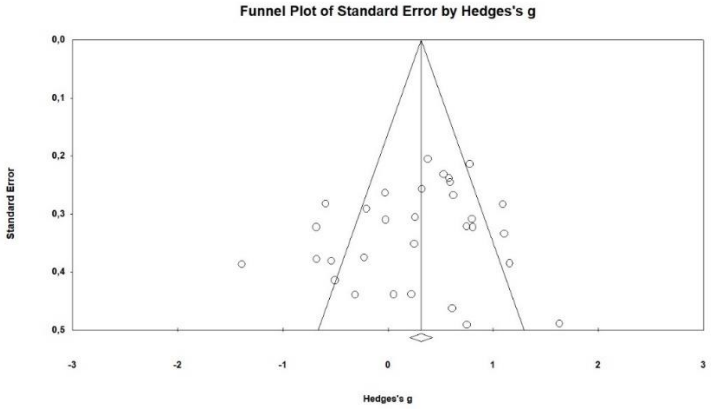

Figure 3. Funnel plot of the reviewed studies as a result of weighting

In addition to the funnel plot and Egger test, publication bias was also examined in terms of Rosenthal and Orwin's Safe N Value, and Duval and Tweedie's Trim-and-Fill Method.

Table 2. *Rosenthal and Orwin's confidence test results on the publication bias of the examined studies*

Rosenthal's Safe N Value	Z value for the studies reviewed	4.98207
	P value for the studies reviewed	0.00000
	Alfa	0.05000
	Direction	2.00000
	Z value for alpha	1.95996
	Safe N number	170
Orwin's Safe N Value	Hedge's g for the studies	0.31452
	Criterion for a 'trivial' odds ratio	0.10000
	Mean Hedge's g for missing studies	0.00000
	Number of missing studies that would bring p-value to >alpha	67.0000

As can be seen in Table 2, Rosenthal's safe N value is 170. This value indicates how many studies with no effect size will be added so that the meta-analysis can lose its significant effect. Although there is no conclusive rule about how large the FSN should be in order to minimize the publication bias, the results of the meta-analysis can be considered resistant to publication bias if the N/(5k+10) formula proposed by Mullen, Muellerleile, and Bryant (2001) exceeds 1 (Üstün & Eryılmaz, 2014, p.18). The calculated value resulting from this formula (170/5×31+10) is 1.03. This study can therefore be considered resistant to publication bias. The Hedge's g value in the observed studies is 0.31452 for Orwin's safe N value. A total of 67

studies with no effect size should be conducted in order to bring Hedge's g value to 0.1 for the overall effect size values to be considered insignificant.

Table 3. *Duval and Tweedie's test results regarding the bias in the studies*

Duval and Tweedie's confidence test	Values of Confidence Test
Observed effect size value	0.6950
Corrected effect size value	0.35672
Number of trimmed studies	2
Direction of trimmed studies	Right

As shown in Table 3, the number of trimmed studies according to Duval and Tweedie's trim and fill method is 2, and the direction of the trimmed studies is on the right. The small number of studies that need to be added indicates that the publication bias in this study is quite limited.

3.2. Choosing the Meta-Analysis Model

There are two models in the meta-analysis study: fixed and random effects model. The fixed effect model represents homogeneity, and the random effects model represents a heterogeneous distribution. In the fixed effect model, it is assumed that the true effect size is the same in all studies. In the random effects model, on the other hand, this size varies from study to study (Borenstein, et al., 2019, p.79). In order to decide which model to use in this study, a heterogeneity test was performed on 31 studies included in the meta-analysis, the calculated I^2 value was 72.254 (Q=108.122; P<.05). According to these results, 72.25% of the observed between-study variance can be attributed to different true effects. The I^2 value used to measure the degree of heterogeneity indicates low heterogeneity if 25%, medium if 50%, and high heterogeneity if 75% (Higgins, Thompson, Deeks & Altman, 2003). The calculated I^2 value in this study is 72.25% and the heterogeneity is moderate. Since this value is greater than 50%, the level of heterogeneity was considered to be significant (Mittlbock & Heinzl, 2006).

The studies were examined based on the random effects model and the fact that the studies were heterogeneous. The findings were discussed in line with the research questions.

3.3. The General Size Effect of Music on Students' Reading Skill Achievement

Findings pertaining to the sub-research question "What is the general effect size of music on students' reading skill achievement?" are given in Table 4. The findings regarding the effect sizes of the studies based on the random effects model are provided in the following Table 4:

Table 4. *The general effect size of the studies*

Mean Effect Size (*g*)	Number of Studies	Standard error (SE)	Variance (v)	Z	*p*	95% Confidence Interval for Effect Size (ES, 95%)	
						Lower Bound	Upper Bound
0.269	31	0.108	0.012	2.495	0.000	0.058	0.481

As shown in Table 4, general effect size value of music regarding the achievement level of students in reading skills is g=0.269 with a standard error of 0.108 according to the random effects model. This value is a small effect according to Cohen's (1988, p.82; 184-185) classification. In addition, according to the random effects model, the lower bound of the effect size is 0.058 and the upper bound is 0.481 in the case of 95% confidence interval. The values of the effect sizes are statistically significant (Z=2.495; p=.00). In line with these values, music seems to have a small effect on the academic achievement levels of students in their reading skills.

3.4. The Effect Size of The Moderator Variables

The effect sizes of the studies were examined according to variables. Each moderator variables are shown in Table 5.

Table 5. *The effect sizes of the studies in terms of moderator variables*

	Hedge's g	95% Confidence Interval for Effect Size (ES, 95%c1)		df	Heterogeneity test	
		Lower Bound	Upper Bound		Q value	p value
Utilization of Music						
In the background	0.136	-0.156	0.429			
With an integrated curriculum	0.360	0.037	0.682	3	4.702	0.195
As a treatment method	-0.130	-0.653	0.393			
By singing/listening	0.577	0.080	1.074			
Total	0.240	-0.052	0.533			
Sub skills/ Learning areas						
Grammatical accuracy	0.508	-0.263	1.302			
Reading aloud (word, paragraph, text reading)	0.294	-0.251	0.403			
Phonemic awareness-pronunciation	1.080	0.419	1.877	4	13.528	0.009
Reading comprehension	0.162	-0.207	0.356			
Vocabulary	-0.561	-1.417	0.333			
Total	0.399	-0.191	0.663			
Field of the Study						
Mother tongue teaching	0.208	-0.032	0.448	1	4.135	0.042
Foreign language teaching	0.594	0.310	0.878			
Total	0.369	0.186	0.553			
Level of Education						
Pre-school	0.478	-0.054	1.010			
Primary school	0.317	0.103	0.531			
Middle School	-0.623	-1.066	-0.180	4	26.410	0.000
High school	0.747	0.439	1.055			
Higher education	0.088	-0.290	0.465			
Total	0.290	0.146	0.434			

Duration of Experimental Intervention						
1-3 weeks	0.182	-0.150	0.514			
4-6 weeks	0.389	-0.219	0.997			
7-9 weeks	0.127	-0.495	0.749	4	3.635	0.458
10-16 weeks	0.766	0.169	1.363			
5 months and above	0.105	-0.432	0.642			
Total	0.291	-0.009	0.590			

As seen in Table 5, the effect sizes in all aspects of music use are positive except for the use as a treatment method (g=-0.130). In terms of effect size, it can be seen that the value of the studies conducted with singing/listening activities is the highest (g= 0.577). While the effect size value in singing/listening is medium, other types of music use have a small effect on reading skill. Other types of music use are reading activities with an integrated curriculum (g= 0.360), reading activities with background music (g= 0.136), and reading activities for treatment method (g= -0.130) in the order of effect size value. Regarding whether the effect sizes obtained from the studies differed significantly according to the direction of music usage, it was found that the value of Q=4.702 was below the critical value of 7.815, which was determined with 3 degrees of freedom at the 95% significance level in the $\chi 2$ table. The fact that the Q value between the groups is below the critical value does not indicate a statistically significant difference in the academic achievement of the students according to the use of music.

When looked at reading sub-skills, the effect sizes are positive except vocabulary (g=-0.561), and the effect size value in phonemic awareness is higher than other skills with the value of g= 1.080. Phonemic awareness is followed by grammatical accuracy (g=0.508), reading aloud (g=0.294) and reading comprehension (g=0.162) respectively. Music has a large effect on phonemic awareness, medium effect on grammatical accuracy, small effect on reading aloud, and insignificant effect on reading comprehension and vocabulary. Regarding whether the effect sizes obtained from the studies differed statistically significantly according to the sub-skills/learning areas of reading skills, it was found that the value of Q=13.528 was above the critical value of 9.488 with 4 degrees of freedom at the 95% significance level in the $\chi 2$ table. The fact that the Q value between the groups is above the critical value indicates a statistically significant difference in terms of academic achievements of the students in reading sub-skills.

In terms of the field of the study, the effect size value (g= 0.594) in the field of foreign language teaching is higher than the value in the field of mother tongue teaching (g= 0.208). While the effect size of music in the field of foreign language reading skill is medium, it has a small effect size in the field of mother tongue teaching. According to the statistic of Q values (Q=4.135, $p<.05$), the efect sizes differ significantly between the fields of the studies.

The other variation is the level of the eduction. Music has a positive effect on all education levels except secondary school. High school level (g= 0.747) is the education level with the highest effect size, followed by preschool (g= 0.478), primary school (g= 0.317), higher education (g= 0.088), and secondary school (g= -0.623) respectively. While music has a medium effect size at high school, it has a small effect size in preschool and primary school, and insignificant in higher education and secondary school. In terms of the value of Q, the effects sizes show a statistically significant difference.

The last variation is the duration of experimental intervention. As seen in Table 5, all effect sizes were positive. While effect size with the highest value was observed in the studies conducted between 10-16 weeks (g= 0.766), there appears to be no statistically significant difference between the studies with the longest duration and the studies with the least duration. The difference in effect sizes is not significant as the value of Q=3.635 was above the critical value of 9.488 with 4 degrees of freedom at the 95% significance level in the $\chi 2$ table. This indicates that the academic achievements of students do not show a statistically significant difference in terms of duration of the experimental intervention in which music was used.

4. Discussion and Conclusion

A total of 31 studies were investigated through the meta-analysis method within the scope of this research, which aimed to determine whether music has a statistically significant effect on the success of students in the terms of reading skills. It was concluded as a result of the review that 10 of the studies had negative effect sizes and 21 had positive effect sizes. The findings revealed that music had a small effect size on academic achievement in the terms of reading skills (Hedge's g=0.269, 95%CI=0.058-0.481). While Sala and Gobet (2020) reported that music had no effect, no conclusive claim was made regarding whether it had a positive or negative effect in the study by Dumont, Syurina, Feron, and Hooren (2017). Therefore, it can be argued that the small effect size may have caused the results to differ.

The effect of music on reading skills was also examined in terms of the use of music, reading skill sub-skills/learning areas, field of study, the teaching level at which the intervention was applied, and the duration of the intervention. The following results were obtained as a result of the analysis made according to these moderator variables:

First of all, in terms of the use of music, it was found that the effect sizes obtained from the studies did not differ significantly (Q=4.702< $\chi 2$=7,815). The value in the studies conducted with singing/listening activities was the highest compared to the other uses of music and the effect size value was moderate. Considering the effect of music as a treatment method, in the background and with an integrated teaching program, a small effect was detected. In the study of Kämpfe, Sedlmeier, and Renkewitz (2010) on the process of reading skill practice with background music, which is one type of music use, it was concluded that background music disrupts reading but improves the learning process. Therefore, it can be concluded that the background music does not have a sufficient level of effect, but it has a positive effect in terms of emotion and a small effect in terms of reading skill. Regarding the studies that used music as a treatment method, it was suggested that the common objective was to improve the word reading and phonemic awareness skills of children with learning difficulties. In these studies, music did not have sufficient level of effect size. In the study of Melby-Lervåg, Lyster, and Hulme (2012), it was concluded that children with learning difficulties showed a greater deficiency in phonemic awareness compared to children of the same age with typical development. It can therefore be concluded that it is more effective to use music for teaching reading skills through singing rather than as a treatment method, as a part of an integrated program or in the background.

As another research problem on whether the effect of music differs according to reading sub-skills, it was concluded that it is mostly effective on phonemic awareness (pronunciation, first-last letter recognition, distinguishing pseudo words, …). While music has a large effect on phonemic awareness, it has a medium effect on grammatical accuracy and a small effect on reading aloud, which are other reading sub-learning areas. Music has an insignificant effect on reading comprehension while it has a negative effect on vocabulary. Eccles et al. (2021) discussed the effect of music on children's literacy development and reported an absence of a

comprehensive evaluation of the effect size of music on reading skills as well as phonological awareness. In this study, as a result of the analysis in the context of reading sub-skills, it was concluded that music has a functional effect on grammatical accuracy as well as phonemic awareness, but it is limited in activities performed as a part of reading skills such as reading aloud, reading comprehension, and vocabulary. The fact that music has an effect on the phonemes and grammatical structure of the language shows that systematic language codes can be processed better with music. According to Chomsky (2001), individuals develop competency in a linguistic knowledge that includes an infinite set of possible deep structures, and identify semantic and phonetic interpretations of these abstract objects by associating deep structures with surface structures. In addition, a child with a preformation for language analysis needs to be exposed to enough input for the language acquisition mechanism to process. With this understanding, music can be considered an important input for the child's language acquisition mechanism to transform this structure into a productive and transformative one.

In terms of the effect size of music according to the study area, the effect size value in the field of foreign language teaching was higher than it was in the field of mother tongue teaching. Regarding the medium effect size of music in the area of reading skill in foreign language teaching, it has been concluded that music can be used more widely in foreign language teaching compared to mother tongue teaching. However, the use of music as a motivation instrument in mother tongue teaching is crucial in terms of shaping the affective filter of students. Krashen (2002) states that language acquisition is much more important than learning with an emphasis on the effect of an individual's feelings (motivation, self-confidence, anxiety) on learning with his "affective filter hypothesis" and states that individuals should be exposed to enough comprehensible input. For this reason, music can be viewed as comprehensible input for students in both mother tongue and foreign language teaching. It can therefore be used as a tool which develops positive emotions in the learning environment.

Considering the effect of music on reading skills according to the education level, music was found to have a positive effect at all education levels except secondary school. The highest effect size was at high school level, which was a medium effect. There was a difference between the levels of education in terms of effect size. This underlines the need for educators to organize materials according to students' developmental stages in a particular field. According to Case (1993), one of the pioneers of neo-Piagetian theory, the stages in the mechanism of information processing development are not clearly separated from each other since the final stage also includes the first stage. Although the stages of musical development do not show a sequential progression, each stage is a precursor to the next (Paananen, 2006). In addition, musical ability is connected to different forms of intelligence. While children learn musical notes, they also use their language skills (Çuhadar, 2017). For this reason, addressing reading skills and music in a cyclical manner at each level of education and conducting vertical research between the levels can contribute to a better understanding of the differences between the levels.

As to the effect of music on reading skill according to the final sub-problem, which was the experimental intervention, it is seen that all effect sizes are positive, and there is no significant difference between the studies with the longest and shortest duration according to the duration of experimental intervention. Therefore, it is more important to determine how music will be used and which reading sub-skill is to be addressed as well as the materials used in the educational environment rather than the experimental intervention duration in the terms of the developmental characteristics of the students.

5. Limitations and Suggestions

There are some limitations in this study, which focuses on the effect of music on reading skills. First of all, the meta-analysis consists of only articles written in Turkish and English. This may negatively affect the reliability of the research as it may be a reason for language bias. In addition, the studies reviewed within the scope of meta-analysis are limited to experimental studies conducted only in the area of reading comprehension. For this reason, further analysis can be made on the studies within the scope of other language skills and learning areas other than reading skills such as speaking, listening, writing and grammar in order to examine the effect of music on all language skills in a comparative way. In addition, further research can focus on the effects of characteristics like age and gender on different moderator variables in studies in which music is used as an experimental intervention tool.

6. Conflict of Interest

The author declares that there is no conflict of interest.

7. Ethics Committee Approval

The author confirms that the study does not need ethics committee approval according to the research integrity rules in her country.

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Note: Resources marked with an asterisk are studies reviewed in the meta-analysis study.

Appendices

Appendice 1.

Study No	Author and Year	Effect Size
1	Adeetee Bhide, etc. (2013)	0,055
2	Beng Huat See, Lindsay Ibbotson (2018)	-0,027
3	Bünyamin Sarıkaya (2019)	-0,021
4	Catherine Moritz, etc. (2012)	1,155
5	Christine Augustine (2015)	0,746
6	Elena Flaugnacco, Luisa Lopez, etc. (2015)	0,203
7	Farshid Tayari Ashtiani, Amir Mahdavi Zafarghandi (2015)	1,105
8	Iris Rautenberg (2015)	0,380
9	Jessica Slater, etc. (2014)	0,259
10	Johanna Rivera Ibaceta, Karen Moreira Tricot (2020)	1,629
11	Laure-Hélène Canette, etc. (2020)	0,751
12	Lucia Herrera, etc. (2011)	0,251
13	Lucia Herrera, etc. (2011)	-1,388
14	Lucy L. M. Patston and Lynette J. Tippett (2011)	0,580
15	Maddie Doyle, Adrian Furnham (2011)	-0,539
16	Maddie Doyle, Adrian Furnham (2011)	-0,228
17	Maria Manuel Vidal, etc. (2020)	0,799
18	Marshall Haning (2016)	-0,503
19	Marshall Haning (2016)	-0,314
20	Nasser Rashidi, Farman Faham (2011)	0,323
21	Özlem Erten, Ahmet Serkan Ece, etc. (2015)	-0,592
22	Patrick D. Walton (2014)	0,777
23	Przybylski, Bedoin, etc. (2013)	0,223
24	Przybylski, Bedoin, etc. (2013)	0,611
25	Qian Su, Fei Wang (2010)	0,808
26	Sakineh Sahebdel, Mohammad Reza Khodadust (2014)	0,620
27	Silvia Bonacina, etc. (2015)	-0,679
28	Swathi Swaminathan, Jini K. Gopinath (2013)	0,529
29	William Forde Thompson, etc. (2011)	-0,680
30	Yen-Ning Su, Chih-Chien Kao, etc. (2017)	0,590
31	Yen-Ning Su, Chih-Chien Kao, etc. (2017)	1,093
Total		0,269