

WORKING MEMORY IN THE PROCESS OF TEACHING SONGS

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Abstract. *The control processes and mnemonic strategies used in working memory are important both in the general learning process and in the music learning process. In the acquisition of music, the working memory determines the formation of auditory notions, which is an essential dimension in the development of musicality. Its qualitative indicators are (1) accuracy - accurate perception and reproduction of memorized music material; (2) persistence - duration of remembrance. Therefore, it is pedagogically important to improve it at the primary school age, because working memory forms the basis for creating more complex conceptual content constructions both in music and in other fields. The aim of the research is to promote the development of working memory in the process of teaching songs. In order to achieve the goal of the research, a song teaching strategy for the development of working memory has been developed, a pedagogical observation of the music learning process for a duration of three years at the primary school level has been performed, and the obtained data have been analysed using descriptive statistics. The sample of the study consists of 200 primary school students. The data obtained in the article allow us to conclude that the purposefulness and regularity with which the chosen exercises are used, the quality of music perception and attention, and musical thinking all contribute to the development of musical memory in primary school music education. The relationship between song acquisition and working memory described in this publication expands the understanding of music educators and helps them improve their professional skills.*

Keywords: *music pedagogy, song teaching strategies, working memory.*

Introduction

Research on working memory in education is becoming an increasingly important field of research, including in music education. The results of studies confirming that music education is associated with improved work memory also continue to grow (Yurgil, Velasquez, Winston, Reichma, & Colombo, 2020). Music pedagogy increasingly emphasizes not only the importance of playing the instrument physically or using a voice device (skills), but also the importance of the processes that take place in the mind (Muceniece, Medne, & Gintere, 2020). Musical memory in the process of cognition, in unity with the perception and thinking of music, are identified as the main components in the study of music, which determine the musical activity of the composer, performer, and listener.

These components are also crucial in the music learning process. Therefore, it is considered that both performers and listeners need a high level of working memory for any musical activity (Pozenatto, 2020). Working memory is an essential component in the process of listening to music, making music and improvising, as it promotes the assimilation of the means of musical expression - melody, rhythm, texture, dynamics, tempo, etc. - in the process of music perception and performance (Pozenatto, 2020). For example, when singing songs, it would not be possible to play a melody after hearing it if the musical impressions were not perceived and stored in memory. While listening to music, working memory is directly related to the identification of tonal, harmonic, and rhythmic relationships that make any fragment of music understandable. Working memory uses the accumulated information and provides the selection of the necessary information to perform a musical activity (Vilde & Medne, 2014). The control processes and mnemonic strategies used in working memory are important both in the learning process in general and in the music learning process. In learning music, the working memory determines the formation of auditory notions, which is an essential dimension in the development of musicality. Therefore, it is important for both musicians and music educators to know the specifics of working memory and related processes, as well as techniques for improving this cognitive process in the pedagogical process, in order to use appropriate teaching strategies.

It is emphasized that not only musical experience, but also age, is an important variable in terms of working memory. The earlier education in music, the more sustainable the results are (Pozenatto, 2020). In order to promote this in practice, the issue of the relationship between the dimensions of individual development and social factors is raised, where the quality is determined by the experience of subjective acquisition of both things and social situations (Medne, 2019). At the primary stage, the aim of the music subject is to promote the development of students' musical abilities and skills, to acquire the skills necessary for creative musical activity, and to gain musical experience through individual, group, and collective music. Singing is one of the basic activities in music lessons at the primary school stage, and teaching a song after hearing it is a method of learning singing skills based on the ability to perceive, memorize, store the melody in memory, and reproduce it according to the real object – the song.

Therefore, it is pedagogically important to improve it at the primary school age, because working memory forms the basis for creating more complex conceptual content constructions both in music and in other fields. The aim of the study is to identify the development of working memory in the process of teaching a song. The aim of the study is to identify the development of working memory through song teaching by ear strategy.

Working memory in music pedagogy

The ways in which the brain processes perceived information and how an understanding of the image, melody, and rhythm of music is formed is consistent as information is processed in other areas, especially in the perception of language (Patel, 2010; Snyder, 2016). Musical memory ensures memorization, preservation, recall of the perceived musical image, means of expression and musical thought created in consciousness and reproduction of musical material (Vilde, 2013). Musical memory is a condition of human contact with music, because in order to understand the meaning of music, it is necessary to preserve the characteristics of sounds, harmony, melody and their characteristic intonations and changes in the flow of music (Sloboda, Lehmann & Woody, 2007). Musical memory captures not only the sound of music, but also the essence of human experiences, separating them or merging them with the image created by music (Juslin & Sloboda, 2011), integrates musical impressions, as well as the ways and techniques of their formation (Snyder, 2016). Understanding the types of musical memory can make it more effective to apply appropriate learning strategies and exercise tasks in the music learning process. Musical memory is divided into three types by the duration of information retention: short-term, working, and long-term memory. Working memory is based on both short-term memory information and activates long-term memory reserves (Vedins, 2011). Working memory helps to understand and intonate sounds. Its processes allow you to understand the content of music and the logic of its development, while allowing the body to physically perform the appropriate movements necessary for making sound using a musical instrument or voice apparatus. By repeating similar processes of working memory, certain skills can be improved, which is the result of storing information in long-term memory (Pozenatto, 2020). The main function of working memory is to create and preserve a musical image (wholeness) in the perception and performance of music. Without it, it is impossible to understand and intonate sounds. The image of music stored in the working memory also includes the psychological essence of understanding and experiencing music. For most people, the minimum unit of musical memory is a motif, and the maximum is a number of motifs or phrases. For musicians, the minimum and maximum size of the operative unit is much wider and can cover not only long melodies, but also detailed multi-layered music fragments. The amount of memory units can be influenced by the composer's level of mastery of the music language as well as the composition's stylistics (Startheus, 2003). Thus, it can be concluded that the image of music stored in the working memory also includes the psychological essence of understanding and experiencing music. Working memory participates in the process of learning music material from a long-term perspective, so it is essential in the process of learning a song. In singing, working memory is expressed in the ability to reflect the height of the perceived sounds and rhythmic

movements in the consciousness, the ability to detect changes and the logic of development, as well as the ability to reproduce the melody of a song (Vilde, 2013). Thus, when making music, working memory processes allow us to assimilate the concepts of music (dynamics, height, rhythm, texture, and tempo).

The development of musical memory is significantly influenced by the student's level of music perception and musical thinking, the quality of memory training, as well as the musical experience that arises from making music, composing, listening to and analysing music (Vilde & Medne, 2014). Working on the perception of the melody and analysis of the song, which includes the identification of the direction, characteristic intonation, and rhythmic movements of the melody, promotes the accurate perception and conscious memorization of the melody of the song. Therefore, musical memory is developing simultaneously with musical hearing, perception, and thinking, which helps to listen to and analyse what is heard, allows us to perceive music emotionally and intellectually.

In order to promote the improvement of working memory in music teaching, a strategy for teaching song by ear has been developed, which includes the activities of a music teacher and a student, reflecting the interaction between teaching and learning songs (Figure 1).

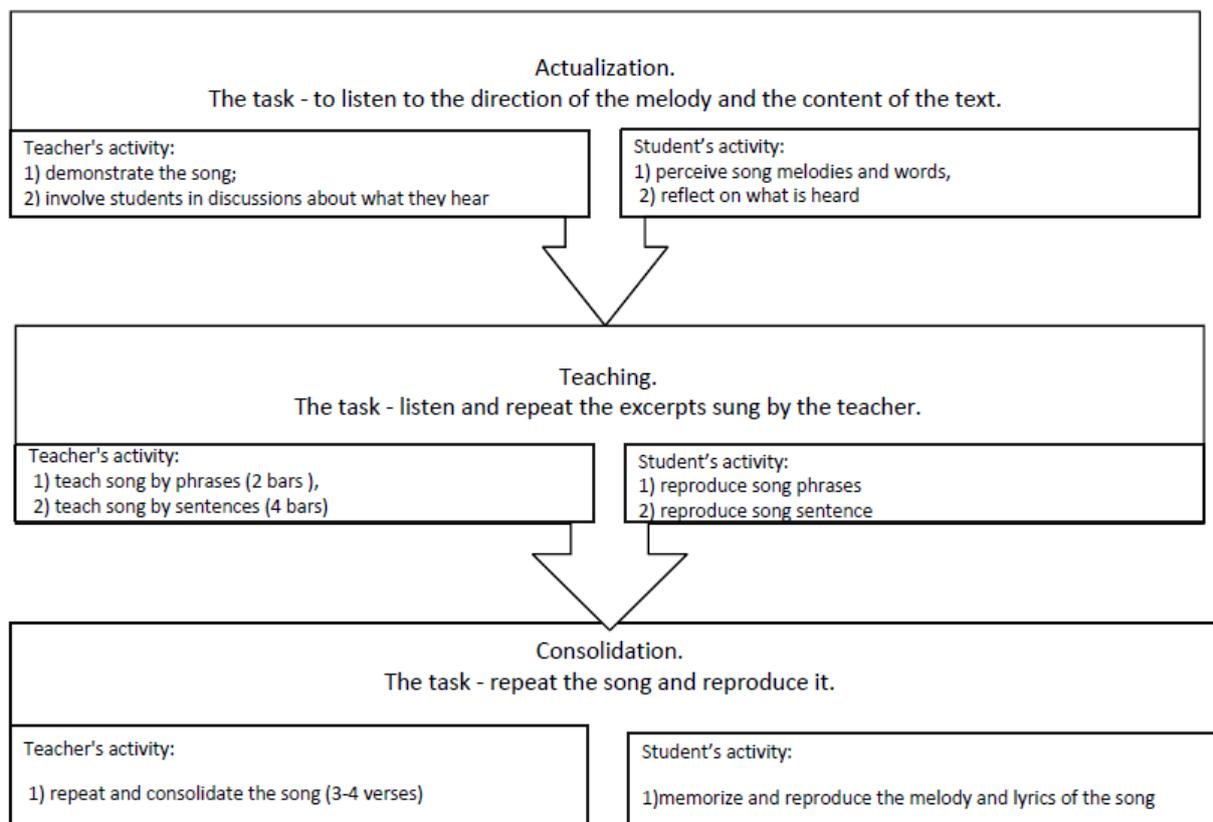


Figure 1 Song teaching by ear strategy (Compiled by the authors)

This strategy is based on a cognitive activation approach and involves three steps: (1) task-based learning promotes students' ability to focus on the content of

a particular activity; (2) teaching - involves teaching the song in stages - phrases and broader structures / sentences, using voice - echo techniques to determine the accuracy and extent of working memory; (3) consolidation involves the repetition and reproduction of the song in its entirety (with 3 or 4 verses) to determine the persistence of the working memory.

Organization of empirical research and substantiation of methods

The research was conducted in a school that implements the General Basic Education program, and music lessons in primary school take place twice a week. The study involved 200 respondents who, at the beginning of this research studied in grades 2 and 3 and at the end of this research were in grades 4 and 5. Such a group of respondents has been chosen according to musical working memory function, namely, that they form the basis for the development of more complex concepts, which are important both in music teaching and in the educational process in general. The study was conducted in accordance with research ethics: informed consent was obtained from the parents of all minor students.

Method: Pedagogical observation was identified as the most appropriate method to achieve the goal of the study. In this study, a structured observation methods (here - observational protocols) were chosen for the implementation of the research, which is characterized by an intensive preparation period when systematic observation maps corresponding to the research questions are developed. Observations are the best way to obtain first hand data (Creswell, 2014). The observation method in this study design included (1) the identification and leveling of the observation criteria, (2) and the assessment of the adequacy and reliability of the evaluation criteria, (3) the observation procedure. The observation was performed by an expert teacher (n=1) and students - future music teachers (n=6), self-assessment was performed by the pupils themselves (n=200). The person being studied (pupils) was also chosen as an observer. Because the musician is best able to feel and describe changes in his musical performance such a method of data acquisition is justified (Muceniece, Medne, & Gintere, 2020).

Observation criteria: In order to determine the level of development of working memory, the dynamics of development, and the amount of learning in music education, according to the explanation of skills acquisition levels in secondary education, five levels were determined, which are formed by the scale of headings (Table 1). To determine the amount of working memory, three criteria were chosen, which were determined using a hierarchy in terms of the amount of memory - from shorter, narrower to longer, wider constructions: 1. receives and repeats song phrases (approximately 2 bars), 2. perceives and repeats broader structures, i.e. the sentence of a song (approximately 4 bars), 3. sings a song memorized by heart. The students sang the song they learned during the data collection process in the next lesson.

Table 1 Criteria and levels of musical memory development (Compiled by the authors)

1. Perceives and repeats short phrases	Level 1 - Very poor perception and repetition of short phrases Level 2 - Poor perception and repetition of short phrases Level 3 - Moderate perception and repetition of short phrases Level 4 - Good perception and repetition of short phrases Level 5 - Excellent perception and repetition of short phrases
2. Perceives and repeats music material of a larger structure (4–8 bars)	Level 1 - Very poor perception and repetition of larger structures (4–8 bars) Level 2 - Poor perception and repetition of larger structures (4–8 bars) Level 3 - Moderate perception and repetition of larger structures (4–8 bars) Level 4 - Good perception and repetition of larger structures (4–8 bars) Level 5 - Excellent perception and repetition of larger structures (4–8 bars)
3. Sings a song by heart	Level 1 - Very poor singing of folk songs by heart Level 2 - Poor singing of folk songs by heart Level 3 - Moderate singing of folk songs by heart Level 4 - Good singing of folk songs by heart Level 5 - Excellent singing of folk songs by heart

Six independent experts (music teachers) were involved in testing the reliability of the observation criteria and their levels. The reliability of the evaluation tool was tested using the Cronbach's alpha coefficient. The reliability of the tool was evaluated for each criterion separately to determine whether the criteria and their levels are mutually consistent, and whether the evaluation tool provides reliable information. The evaluation tool's reliability in each section was good, the answers were mutually consistent, and the Cronbach's alpha test showed good reliability ($\alpha \geq 0.87$ and $\alpha \geq 0.87$). The reaction index of the articles and the limits of the reaction index were then calculated, which had to be in the range from -1.20 to 1.20. Evaluating the article response index, it is concluded that 13 of the 15 article response indices vary within the response index from -1.18 to 1.20 and should be included in the instrument. The discrimination index and article discrimination indices within the scales were also calculated. It was concluded that all criteria fall within the range of the discrimination index from 0.25 to 0.76 ($M = 0.55$). Assuming that the lower limit of the discrimination index is 0.20 and the upper limit is 0.80, and that all articles must fall within these limits, it can be concluded that all articles are relevant to the measurand. Analysing the result of the discrimination index within the scales, it can be concluded that in both scales, both the criteria and the levels fall within the desired range of the discrimination index from the lowest 0.20 to the highest 0.80.

Procedure. In order to evaluate the students' working memory in the music lesson, measurements were taken: at the beginning of the school year (starting the study, data code SMA), at the end of the semester (mid-term assessment, VMA), at the end of the school year (final assessment, BVA). The set of pedagogical

techniques for the development of working memory consisted of: (1) teaching the song by ear, using the developed song teaching strategy. The song was taught in stages, i.e. in the amount of a phrase (two bars) and a sentence (4 bars and more), using the voice-echo technique; (2) voice-echo exercises in singing, playing, and rhythm by ear and memory that promote pitch and rhythm accuracy, as well as duration of retention, without the use of sheet music, and (3) memory expansion exercises that promote the memorization and retention of perceived music over a long period of time through multiple repetitions, pitch, and rhythm enhancement, involving respondents in the analysis of music to determine melody direction, intonation, and rhythm structures. Descriptive statistics were used for data analysis, Friedman test.

Results

Evaluating the results of all stages of the study (Figure 2), it can be concluded that already in the first stage students' working memory is assessed at a high level (levels 4 and 5), thus it can be stated that respondents have a sufficiently developed ability to perceive and reproduce short phrases. These results can be explained by the fact that the respondents had good previous musical education (both pre-school and first grade). On the other hand, the ability to remember and repeat the longest structures (4-8 bars) and sing the learned song caused difficulties for the respondents, because many of the respondents sang with intonational and rhythmic errors. Often, a phrase of a longer structure was repeated with sufficient precision only after repeated demonstrations by the teacher. In the second stage, the amount of working memory for the respondents has expanded, because when comparing the levels with the results of the first stage of the study - the ability to repeat larger structures (4-8 bars) and sing the song learned by heart, there is a significant increase in the number of students with levels 4 and 5. The results of the third stage of the empirical study reflect (Figure 4) that levels 4 and 5 predominate. This shows that the working memory of the respondents develops evenly and in a balanced way. Significant development dynamics was found in the ability of respondents to perceive and repeat short phrases, where the highest percentage of evaluations came from level 5. Singing songs by heart - most of the respondents showed levels 4 and 5. In practice, it could be observed that the respondents remembered the song they had learned quite accurately - both melody and words.

According to the results of the Friedman Test, it can be concluded that the most significant differences between all stages of the empirical study can be identified; this is indicated by the coefficient - significance $p = 0.00$ in all indicators. Thus, the results of the research allow us to conclude that the working memory of the respondents has developed in the music learning process and that the pedagogical methods used are effective for improving working memory.

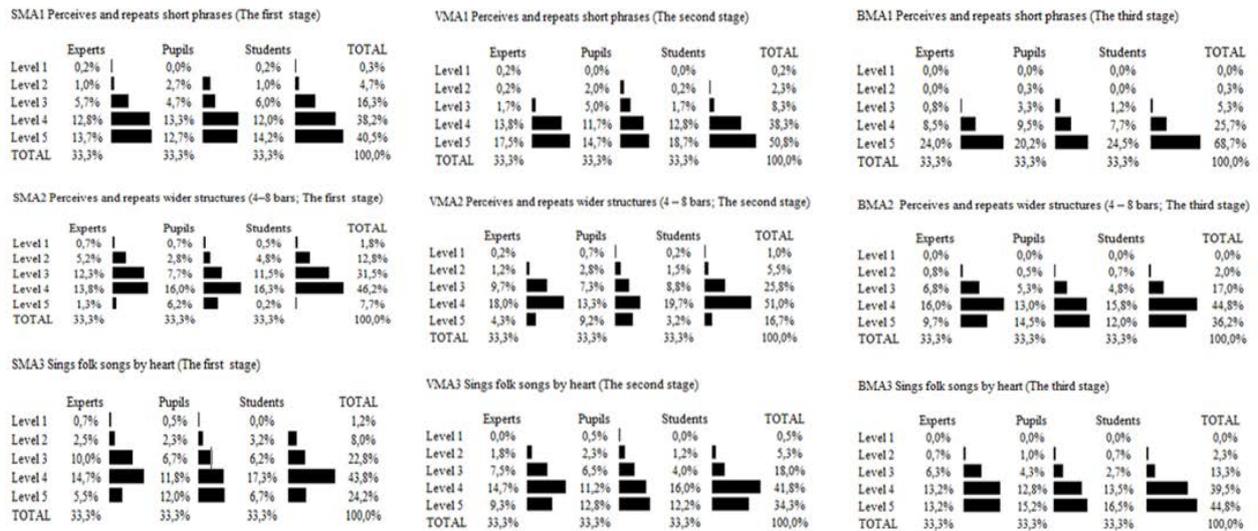


Figure 2 Measurement results of the research stages (Compiled by the authors)

Discussion and Conclusions

Music educators' understanding of working memory processes can facilitate the choice of effective learning strategies. One of them could be the use of a post-listening song teaching strategy, which consists of three steps: (1) actualization to promote students' ability to focus on the content of a particular activity through specific tasks, such as asking questions about the melody movement of the song being performed, the characteristic rhythm groups, and the content of the song's lyrics; (2) teaching, which includes the teaching of a song in stages - phrases and broader structures (4-8 bars), using the voice-echo technique; (3) consolidation, which involves repeating and reproducing the song in full (with three or four verses of the song). After mastering the song, it is recommended to encourage students to engage in creative activities such as composing or improvising the accompaniment of the song, using sound gestures or musical instruments.

The development of working memory was facilitated by the choice of exercise tasks appropriate to the level of education, the main functions of which were to listen to, memorize, preserve, and reproduce the musical material. In practice, it could be observed that the attention of the respondents is important in the performance of musical activity, the persistence of which is facilitated by various methodological techniques and changes in musical activities - singing, rhythmic using rhythm instruments, and sounding gestures. This conclusion is in line with the results of other studies, namely that an appropriate pedagogical process promotes changes in working memory capacity (Bergman Nutley, Darki, & Klingberg, 2014).

Although the study found correlations between the song teaching strategy and the increase in working memory at primary school age, the results of this

study are not generalizable and should be considered trends, as the study had significant limitations:

- the topic is not sufficiently known in the respective field,
- no industry-specific theoretical literature was found on working memory and its improvement for students in a general education school,
- the study did not take into account various side factors such as stress, health status, or music school attendance.

In search of answers to the discussion questions and expanding the boundaries of the research, the research could be continued to include the following dimensions of the research: firstly, by expanding the number of research participants; and secondly, by diversifying the research methods.

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