



Development of musical experiential model to enhance executive functions of early childhood

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Abstract

The development of the cognitive skills of young children using music training has become the focus of a growing number of research studies in recent years. This study investigated the components, development, and effects of the Musical Experiential Model to enhance the executive functions of 4-to-5-year-olds in their early childhood in Nonthaburi area 1, Thailand, using a three-phase mixed methods experimental design. Phases 1 and 2 found that the Musical Experiential Model development consisted of 5 components; (1) the 6 principles, (2) the objectives of promoting 4 aspects of executive functions, including working memory, inhibitory control, cognitive flexibility, and planning and organizing, (3) the contents which were integrated music content and learning content in the Early Childhood Curriculum, B.E. 2560 (2017), (4) the GPAC music experience process, as follows: music goal-setting (G), music action planning (P), action in music (A), music creating (C), and (5) 3 phases of assessment and evaluation, which were satisfactory at a high level. Phase 3 involved an educational experiment using the Musical Experiential Model with a sample of 30 young students. The pairing sample t-test and repairing measures with the analysis of covariance revealed that there was a significant difference in performance improvement ($p < .05$). The findings from this study benefit music experience interventions, including important issues regarding intervention duration, experimental design, music experience process, contents of music experience, executive function testing, measuring tools and music teacher attributes.

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Introduction

The world today has grown and changed rapidly in terms of economy, society, culture, politics, and technology. This is Globalization. The 21st century is full of complicated dynamics, violence and various stimuli that affect humans, including trends in population entering aged society, advancements in digital technology and various other

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technologies. This context is challenging in how people live. How do children and youth survive safely and how are they able to cope with the changes, adapt, learn and be tolerant towards these changing circumstances?

Early Childhood Care and Education (ECCE) is more than primary school preparation; it aims at the holistic development of a child's needs in order to build a solid and broad foundation for lifelong learning and wellbeing (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2019). This period is an important time in life. To develop social, emotional, cognitive, and physical skills, education is considered a significant factor as it is in the development of the human resources of the nation by cultivating the skills of thinking, learning, problem solving and living with others. Therefore, adults should begin to cultivate the thinking skills of children starting in early childhood, which is the foundation of life, as it is an ideal window of opportunity for preparing children to have a successful life in the future.

Executive functions, also known as cognitive control, are a set of top-down processes involved in the planning and regulation of cognition and behavior (Diamond & Ling, 2019) that is used to predict the quality of Thai youth in the next 10–15 years. Nearly 30 percent of young Thai children aged 2–6 years have less executive function development than the average ($T < 45$) and over 30 percent of the children have more behavioral problems related to executive functions than the average ($T > 55$). The executive function impairment will not disappear if children are not developed at this early age, and could result in various social problems when the children grow up, becoming obstacles to national development in the long term (Chutabhakdikul, 2017). Young children aged 3–5 years old have the highest growth of executive functions (Center on the Developing Child, 2012). The foundation of executive functions during this age is important for the child to grow with quality and complete humanity.

Executive function development is considered to be the development of the brain. Music is one experience that helps promote the brain (Moreno et al., 2011; Neville et al., 2008). Music can be a method to help and allow children to participate, practice and promote development in various aspects simultaneously (Suttachit, 2001). Unfortunately, nowadays Thailand has still not adopted the Musical Experiential Model to the enhance executive functions of young children. Therefore, the researcher is interested in and focused on education using music experience as a basis to encourage young children to improve their thinking skills for the learning processes of thinking, practicing and managing life in order to achieve success in activities, as well as applying these skills to make themselves successful in other aspects of life.

Literature Review

Experiential Model

The Experiential model is a method used to arrange experiences from theories, principles and concepts that demonstrate the relationships between the various components in order to encourage students to learn according to the objectives of the model (Khammani, 2016; Suthasinobon, 2012). The model consists of important components, including theories, basic beliefs or principles, objectives, contents, teaching procedures, applications, and measurements and evaluations (Joyce, Weil, & Calhoun, 2015; Lasley, Matczynski, & Rowley, 2002). In conclusion, the Experiential Model is a pattern of music experience management for young children using theories, principles, and concepts.

Music Experience

Music experience management for young children is to provide a musical experience focusing on encouraging the students to participate and have the freedom of learning by allowing them to conduct research and discover the answers on their own through the interactions between people (Piaget, 1960), society and environment (Erikson, 1950) that is warm and safe in order to achieve goal learning and adaptation to living in a happy society. This can be accomplished through the management of integrated music experiences involving music contents and necessary contents from the Early Childhood Curriculum, B.E. 2560 (A.D. 2017) (Ministry of Education, 2017). The learning is done through a process providing students the opportunity to gain direct experience from conducting various musical activities, such as listening, singing, moving, playing musical instruments to make a beat, role playing, tales, etc. (Orff, 1963; Praphruitkit, 1993; Suttachit, 2001; Dalcroze, 2020). Music is a multisensory group activity, which simultaneously engages multiple cognitive skills (Miendlarzewska & Trost, 2014). In conclusion, music experience for young children will use the music problem solving process to control and direct them to solve problems, make decisions and apply knowledge obtained in order to create motivation for success in learning and use in other situations.

Executive Functions

Executive functions are considered to be a product of the coordinated operations of various processes to accomplish a particular goal in a flexible manner (Funahashi, 2001) and reflect the ability to manage and regulate one's behavior in order to achieve desired goals

appropriately in various situations (Baddeley, 1986; Luria, 1973). It is considered the ability of the brain and mind to control thoughts, emotions, desires and actions which require high level thinking skills and systematic thinking to solve the problems encountered and proceed with the tasks that will lead to a successful goal set. This is achieved by using many skills to solve problems, including working memory, inhibitory control, cognitive flexibility, as well as planning and organizing (Chutabhakdikul, 2017; Diamond, 2013; Meltzer, 2007; The understood Team, 2018).

Methodology

The Mixed Methods Experimental Research

The research process was designed based on the research purpose. The purpose of this study was (1) To study the components of the Musical Experiential Model that enhance the executive functions of early childhood, (2) To develop a Musical Experiential Model to enhance the executive functions of early childhood, and (3) To study the results of implementing the Musical Experiential Model enhancing the executive functions of early childhood. The research was divided into 3 phases using the experimental research design in advanced mixed methods where the qualitative data is added before and during the experiment using core mixed methods for 2 methods (Creswell & Plano Clark, 2018; Klangphahol, 2020). That is to say, an exploratory sequential design was used in Phases 1 and 2 and a convergent design in Phase 3. A conceptual framework of the study is presented in Figure 1.

The Exploratory Sequential Design

This research design involved data collection and data analysis using qualitative research methods, then implementing the qualitative research results in order to develop a research tool, which was followed by conducting the quantitative research (Creswell & Plano Clark, 2018; Klangphahol, 2020). The following research design was

implemented to conduct the research in Phase 1 – Studying the components of the Musical Experiential Model, collecting data from document surveys, synthesizing findings from discoveries and interpretation to explain the conceptual framework and the connection theory, using the information obtained to interview 7 experts selected by specific designation, taking the interview data to analyze the content in order to develop the Musical Experiential Model and finally implementing the executive function assessment form with 105 early childhood students from 4 schools in Region 1 of Nonthaburi Province, Thailand, who were selected using multi-stage sampling, which used the confirmatory factor analysis (CFA). Phase 2 – Developing the Musical Experiential Model refers to the development of the model and the documents supporting it. The data were collected and had quality checks done by experts. The pilot project to implement the model was conducted with 30 non-sample early childhood students in Region 1 of Nonthaburi Province, Thailand selected using multi-stage sampling. This was done to investigate the practical possibilities, and determine the quality of the research tools by conducting musical experience management 6 times at 25 minutes each time. Executive functions were assessed after the study using the executive function observation form and the executive function assessment form based on “the Maze” situation. The data were analyzed by finding the mean, standard deviation, and the reliability by applying Cronbach’s alpha coefficient.

The Convergent Design

The research design combined the results of the quantitative and qualitative data analysis (Creswell & Plano Clark, 2018; Klangphahol, 2020), which was Phase 3 of the research. The sample consisted of 30 early childhood students from Region 1 of Nonthaburi Province, Thailand, who were selected using multi-stage sampling. The duration of the experiment was 10 weeks. Week 1 – Monitoring Assessment was conducted using the executive function assessment form based on “the Maze” situation. Week 2 to week 9 – Arranging the music experience management according to the Musical Experiential Model 3 times a week, 25 minutes each time, for a total of 24 times, together with observations of executive function behaviours. In the 3rd, 5th, 7th, and 9th week, this was done using the executive function observation form, and in the 10th week, the Conduct Summative Assessment was done using the executive function assessment form based on “the Maze” situation. The data were analyzed using the mean, standard deviation, paired sample *t*-test, repeated measures one way with the analysis of covariance (ANCOVA), and content analysis.

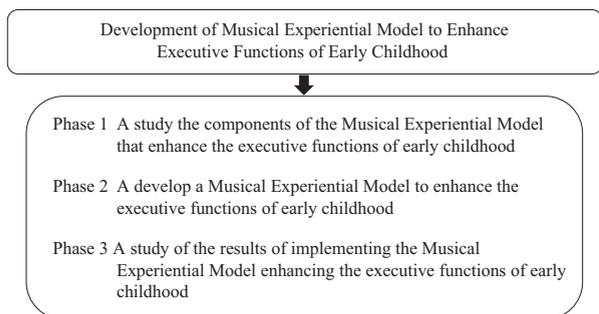


Figure 1 Conceptual Framework of the study

Results and Discussion

Regarding the results of the study on the composition of the Musical Experiential Model, it was found that the composition of the music experience management consists of 5 components, namely principles, objectives, content, 4-stage music experience process, and assessment and evaluation. The components were related to each other and were developed systematically (Joyce et al., 2015; Khammani, 2016). The information in the second component (i.e. the 4 aspects of the executive functions) were revised and the quality of the research instruments and the executive function assessment form were reviewed by the researchers by setting criteria of analytical scoring rubrics. The development and review were consistent with the concepts of Bargainnier (2003), who stated the following: Criteria must be clear; Language must be descriptive; Positive attainments must be focused; There must be differentiation of performances, products and efforts, and validity and reliability are required. In addition, the results of the first order confirmatory factor analysis (CFA) of the executive functions suggested that the overall fit of the model with the data was good ($\chi^2 = .06$, $df = 2$, $p = .97$, $\chi^2/df = .03$, $RMSEA = .00$, $GFI = 1.01$, $AGFI = 1.03$). These values were congruent with the empirical data of the conceptual framework, and there were 4 observed variables: planning and organizing, working memory, cognitive flexibility, and inhibitory control. The factor loadings were .53, .44, .41, and .24, respectively. According to the confirmatory factor analysis of the executive functions of the 105 early childhood students, it was found that there was working memory, inhibitory control, cognitive flexibility, and planning and organizing. All indicators passed the criteria. This showed that the model was consistent with the empirical data. The findings were consistent with the study by Diamond (2013), Merz, Harlé, Noble, and McCall, (2017) and the concepts of The Understood Team (2018), who stated that executive functions had three aspects: working memory, inhibitory control, and cognitive flexibility or shifting. It involved planning that is a higher-level executive function.

Regarding the development of the Musical Experiential Model to enhance the executive functions of early childhood students, a quality inspection of models and documentation by 7 experts found that the Musical Experiential Model consists of 5 components, namely 6 important principles, objectives for promoting 4 aspects of EF, contents consisting of music contents and necessary contents from the Early Childhood Curriculum, B.E. 2560 (A.D. 2017), the GPAC music experience process, which includes (1) Music goal setting: G, (2) Music action planning: P, (3) Action in music: A, and (4) Music creating: C. Finally, the last element is assessment and evaluation. The appropriateness of the

Musical Experiential Model was at a high level ($\bar{x} = 4.31$, $SD = 0.54$) and the manual for the Musical Experiential Model was suitable at a high level ($\bar{x} = 4.00$, $SD = 1.10$). Then, the model was amended again according to the experts' recommendation until the Musical Experiential Model was complete as shown in Figure 2. The other documentation was validated using the Index of Item-Objective Congruence (IOC) by seven experts, showing an IOC ranging from 0.71–1.00. Then, the reliability was tested using a pilot test with a group with similar qualifications as the sample group. In total, 30 questions were tested, and Cronbach's Alpha values of the executive function assessment form based on "the Maze" situation and the executive function observation form were .86 and .81.

Regarding the results of implementing the Musical Experiential Model enhancing the executive functions of young children, the quantitative data revealed that the average executive function of each aspect, from all 6 measurements, increased as shown in Table 1. The average executive functions measured six times, was significantly different at the significance level of .05.

The average executive function before learning and after learning showed that the children's performance improved significantly between the first time and the last time as shown in Table 2. It was found that the students' average executive functions after the implementation were significantly higher than before the implementation at the significance level of .05.

Table 3 shows that the managing music experiences, according to the Musical Experiential Model by controlling the covariate, were the result of the music learning affecting the development of the executive functions. The covariate variables also had significant results at the significance level of .05.

This was because the GPAC had four stages. Firstly, music goal setting (G) consisted of (1) studying musical problems, (2) reviewing and surveying musical problems, and (3) setting learning goals. These three sub-steps provided opportunities for the children to set musical learning goals. The instructor(s) stimulated them to learn things by facing musical problems appropriate for their age group and which allowed them to use existing knowledge. As a result, they could also set learning goals. Secondly, music action planning (P) comprised of (1) mutual planning, (2) arranging musical practices, and (3) reviewing and planning. The children had opportunities to survey and review solutions to determine appropriate singing methods, movements, musical instruments, rhythms, and lyrics, while specifying symbols step by step before taking action, reviewing and making decisions. Thirdly, action in music (A) included (1) reviewing and planning, (2) implementing the plans, (3) switching leader and follower roles, (4) evaluating their results, and (5) discovery learning. In this step, the children had to review

their plans again before implementing them while setting rules or agreements concerning leader and follower roles. Fourthly, music creating (C) consisted of (1) studying new

situations and setting goals, (2) making musical plans, (3) implementing the plans, (4) evaluating themselves, and (5) discovery learning.

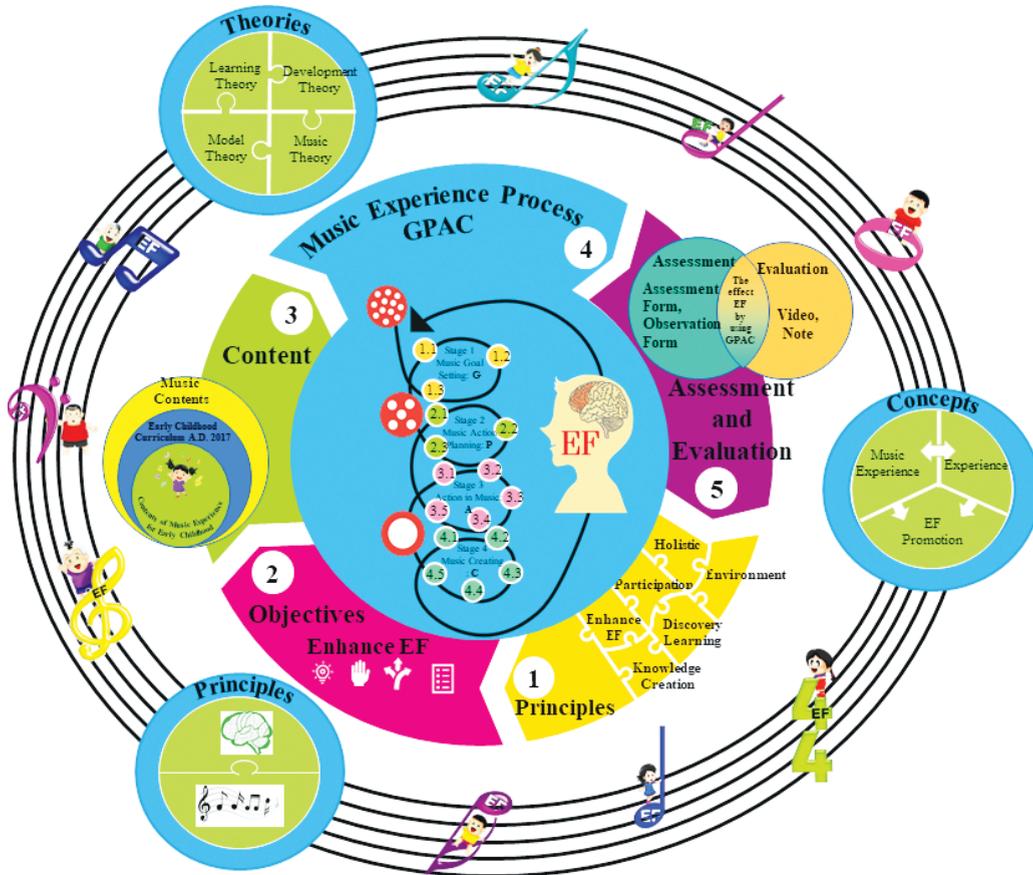


Figure 2 The Musical Experiential Model to enhance the executive functions of early childhood

Table 1 Means and standard deviations of the executive functions of early childhood students based on measurements repeated 6 times n = 30

Times	Executive Function			
	Working Memory	Inhibitory Control	Cognitive Flexibility	Planning and Organizing
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
1 (Pre-test)	9.37 (2.58)	25.87 (3.82)	10.20 (2.83)	12.47 (3.11)
2	10.87 (2.91)	27.57 (3.82)	12.07 (1.78)	16.93 (3.46)
3	12.60 (2.22)	29.27 (2.54)	13.27 (1.76)	19.00 (2.95)
4	14.20 (2.06)	30.80 (1.94)	13.93 (1.14)	20.80 (2.56)
5	15.77 (1.71)	31.97 (1.19)	14.40 (1.04)	22.37 (1.65)
6 (Post-test)	17.60 (1.04)	32.60 (.81)	14.47 (1.17)	23.63 (.76)

Table 2 Comparison of the average scores of executive functions before and after learning

Executive Function	Pre-test		Post-test		t	p
	Mean	SD	Mean	SD		
	57.90	9.13	88.30	2.93	21.20*	.000

Note: *p < .05.

Table 3 Analysis results of one-way repeated measures with the covariance

Source	Sum of Squares	df	Mean Square	F	p
Within					
EF ¹	1498.18	2.39	626.72	18.73*	.000
EF*music ²	387.35	2.39	162.03	4.84*	.000
Error	2239.51	66.93	33.46		

Mauchly's $W = .05$, $\chi^2 = 77.427$, $df = 14$, $p = .00$; Greenhouse-Geisser

Note: 1 - Within-Subjects Effects, 2 - The estimation of the total average is adjusted from the Covariate of music learning results.

* $p < .05$.

The children completed tasks according to the goals using various aspects of the executive functions (Diamond, 2013). By giving musical experiences to the children and having them differentiate problems and obstacles from failures or inability to remember planned procedures, the children could improve themselves and keep trying until they learned things by themselves. Using the covariate variables of the executive functions six times revealed that the musical learning results involving the executive functions of the early childhood children. The qualitative data showed that the children had to use their memories while solving the different musical problems. To analyze the problems in order to obtain the musical goals, they had to use their memories to plan solutions. To solve the problems with their musical skills and musical works, they needed patience, rationale, and flexibility. Therefore, many skills were used simultaneously in the situations. This was consistent with Funahashi (2001), who stated that the executive functions resulted from using various skills and flexible coordination to achieve goals. If these systems collapsed, then they would not be able to control their behaviors. In other words, the developed model encouraged the students to have improved executive functions. This could also serve as the foundation for them to better handle quickly and globally changing situations in the future.

Conclusion and Recommendation

The study concluded that the Musical Experiential Model could enhance the executive functions of early childhood. The composition of the model included 5 components consisting of (1) the 6 principles, (2) the objective of enhancing executive functions in 4 aspects, (3) integrated contents combining music contents with Early Childhood Curriculum B.E. 2560 (A.D. 2017), (4) the GPAC music experience process, and (5) assessment and evaluation. The effects of using the Musical Experiential Model were that early childhood students had higher executive function development. This Musical Experiential Model should be adapted to design a music experience in accordance with the principles of the Musical Experiential Model, music contents, learning of contents, organizing the

learning environment and taking into account the development of children. Future research should be conducted on the study of the results of implementing the Musical Experiential Model that promote other aspects of executive functions namely initiation and goal-directed persistence. In addition, long-term studies should be conducted to monitor executive function development. The Musical Experiential Model should be developed to promote the executive functions of children in other grades and studies on the composition of the executive functions in young children of other ages should be conducted.

Conflict of Interest

There is no conflict of interest.

References

- Baddeley, A. D. (1986). *Working memory*. New York, NY: Oxford University Press.
- Bargainnier, S. (2003). *Fundamentals of rubrics*. Retrieved from https://www.webpages.uidaho.edu/ele/scholars/Practices/Evaluating_Projects/Resources/Using_Rubrics.pdf
- Center on the Developing Child. (2012). *Executive function (In brief)*. Retrieved from <https://developingchild.harvard.edu/resources/inbrief-executive-function/>
- Chutabhakdikul, N. (2017). *Tool development and evaluation criteria for assessment of executive function in early childhood*. Retrieved from <http://164.115.27.97/digital/items/show/9859?> [in Thai]
- Creswell, W. J., & Plano Clark, L. V. (2018). *Designing and conducting mixed methods research* (3rd ed.). Thousand Oaks, CA: Sage.
- Dalcroze, J. E. (2020). *What is eurhythmics?* Retrieved from <https://www.dalcroze.ch/english/what-is-eurhythmics/>
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64, 135–168. doi: 10.1146/annurev-psych-113011-143750
- Diamond, A. & Ling, D. S. (2019). Review of the evidence on fundamental questions surrounding and efforts to improve executive functions, including working memory. In J. Novick, M. Bunting, M. Dougherty, & R. W. Engle (Eds.), *Cognitive and working memory training: Perspectives from psychology, neuroscience, and human development* (p. 487). New York, NY: Oxford University Press.
- Erikson, E. H. (1950). *Childhood and society*. New York, NY: Norton.
- Funahashi, S. (2001). Neuronal mechanisms of executive control by the prefrontal cortex. *Neuroscience Research*, 39(2), 147–165. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/11223461>
- Joyce, R. B., Weil, M., & Calhoun, E. (2015). *Models of teaching* (9th ed.). Upper Saddle River, NJ: Pearson.

- Khammani, T. (2016). *Science of teaching: Cognitive processes in order to learn effectively* (20th ed.). Bangkok, Thailand: Chulalongkorn University Press. [in Thai]
- Klangphahol, K. (2020). Mixed Methods Research. *Journal of Graduate Studies Valaya Alongkorn Rajabhat University*, 14(1), 235–256. [in Thai]
- Lasley, T. J., Matczynski, T. J., & Rowley, J. B. (2002). *Instructional models: strategies for teaching in a diverse society* (2nd ed.). Belmont, CA: Wadsworth.
- Luria, A. R. (1973). *The working brain: an introduction to neuropsychology*. London, UK: Penguin Books Ltd.
- Meltzer, L. (2007). *Executive function in education: From theory to practice*. New York, NY: The Guilford Press.
- Merz, C. E., Harlé, M. K., Noble, G. K., & McCall, B. R. (2017). Executive function in previously institutionalized children. *Child Development Perspectives*, 10(2), 105–110. doi: 10.1111/cdep.12170
- Miendlarzewska, E. A., Trost, W. J. (2014). How musical training affects cognitive development: Rhythm, reward and other modulating variables. *Frontiers in Neuroscience*, 7, 279. doi: 10.3389/fnins.2013.00279
- Ministry of Education. (2017). *Early childhood curriculum B.E. 2560 (A.D. 2017)*. Bangkok, Thailand: Aksornthai Printing Ltd., Part.
- Moreno, S., Bialystok, E., Barac, R., Schellenberg, G. E., Cepeda, J. N., & Chau, T. (2011). Short-term music training enhances verbal intelligence and executive function. *Psychological Science*, 22(11), 1425–1433. doi: 10.1177/0956797611416999
- Neville, H., Andersson, A., Bagdade, O., Bell, T., Currin, J., Fanning, J., ... Yamada, Y. (2008). *Effects of music training on brain and cognitive development in under-privileged 3-to-5-year-old children: preliminary results*. Retrieved from <https://pdfs.semanticscholar.org/2c37/847ea43daee8d8fb1ec2e11db012410ce7e7.pdf>
- Orff, C. (1963). The Schulwerk – Its origin and aims (Arnold Walter, translated). *Music Educators Journal*, 49(5), 69–74. doi: 10.2307/3389951
- Piaget, J. (1960). *The psychology of intelligence*. Paterson, NJ: Littlefield, Adams.
- Praphruitkit, N. (1993). *Developing young children* (Academic document, 66). Bangkok, Thailand: Religious Printing House. [in Thai]
- Suthasinobon, K. (2012). *The development of integrated instructional model based on Buddhist principles reflects sufficiency economy philosophy in context of modern Thai society*. (Research Report). Bangkok, Thailand: Srinakharinwirot University. [in Thai]
- Suttachit, N. (2001). *Content of music education* (1st ed.). Bangkok, Thailand: Chulalongkorn University Printing House. [in Thai]
- The Understood Team. (2018). *3 areas of executive function*. Retrieved from <https://www.understood.org/en/learning-thinking-differences/child-learning-disabilities/executive-functioning-issues/types-of-executive-function-skills>
- United Nations Educational, Scientific and Cultural Organization. (2019). *Early childhood care and education*. Retrieved from <https://en.unesco.org/themes/early-childhood-care-and-education>