Smart Band Technology: A Music-based Activity for the Thai Elderly

Pornprapit Phoasavadi[+] (Thailand)

Abstract

The Smart Band Application is a music application paired with a hardware device designed for the Thai elderly at foster care homes to enhance group participation in musical-based activities. It is small, wireless (or wired) and easily attached to most instruments that produce pitches. For this research a set of eight angklungs (a SE Asia bamboo tube shaker instrument) covering the range from C to high C was selected. Angklungs are affordable, easy to play and have an appealing sound. Eight Smart Band devices, which consist of a set of sensors and vibrators, were attached to the angklungs to collect data during the research. The study's participants were 30 elderly female volunteers who had no music background, living in the Tiwanon's Friendship and Welfare Foundation care facility in Nonthaburi. The "Smart Band" devices were incorporated into group musical activites in the care home where they providing timing cues to each participant during song playing sessions. Participants were interviewed to provide feedback on its effectiveness and functionality. The potential for self-led or leaderless sessions and the impact on motor skills, cognitive and focus factors are also discussed.

Keywords: *Music, Smart Band, Therapy, Music Activity, Angklung, Elderly, Thai Aging Society, Music Therapy*

+ Pornprapit Phoasavadi, Associate Professor, Faculty of Fine and Applied Arts, Department of Music, FAA Emili Sagol Creative Arts Research and Innovation for Well-Being Center, Chulalongkorn University, Thailand.
email: rosphoasavdi@gmail.com website: https://scholar.google.co.th/citations?user=JOHuz04AAAAJ&hl=en.

Received 4/15/22 – Revised 6/13/22 – Accepted 6/15/22

Introduction

According to Economic Research Institute for ASEAN and East Asia, Thailand is one of the fastest-aging countries in the world. The proportion of the population aged 60 and over is projected to increase from 13% to 44% in 2040. (Lorthanavanich, 2021). The result of economic, social development, advancement in science, technology and medicine leads the longevity of people to be longer. In addition to the advancement of science and technology, family planning and fertility control policies have been reducing fertility conditions rapidly while the population mortality rate has been decreasing continuously. In Thailand, the elderly who aged higher than 60 years old were 10,569,021 people out of 65,203,979 people in 2015. In 2022, the number of elders had increased to 12,116,199 people accounting for 13.89% of the total Thai population (Department of Older Persons, 2022).

The elderly are divided into three groups: (1) independent group who can help themselves very well and having good health without chronic diseases and being able to live on their own; (2) home addictive group are those who can help themselves but need some help because they have multiple chronic diseases; and (3) bedridden group are those who are unable to perform daily activities and always need help from others (Sweetser, 1984).

Health problems in the elderly increase unavoidably when they become older due to body deterioration. Thus, the elderly are always at risk of being inflicted by diseases and prone to having accidents. The World Health Organization (WHO) stated that 50 million people worldwide are diagnosed with dementia, Alzheimer's which accounts for 60-70% of total treatment (Bulletin of the World Health Organization, 2017). Recently, non-pharmacological approaches, such as music therapy and creative arts therapy, are recommended to improve and support the life quality of elderly. Musical activities and social interactions can reduce brain damage, store brain memories, and reduce anxiety (Binson, 2018; Hanser, 2012; Dileo & Zanders, 2012; Silverman, 2022).

In Thailand, medical practitioners offer music-based activities to assist the elderly and to recover from aliments of the body and/or mind in rehabilitation centers. For example, the Thai Red Cross Rehabilitation Center in Samut Prakan province, located about 40 kilometers south of Bangkok. The facility specializes in providing treatment and rehabilitation service to patients with handicap and patients with a low level of self-help from diseases such as ischemic stroke, brain injury, spinal cord injury, chronic medical conditions, and pediatric patients with growth and developmental problems and patients with cerebral palsy. The facility is one of the first rehabilitation centers in Thailand that provides musical activities with a facilitator who graduated with a Bachelor's degree in music. The facility introduced music activities to patients in the 1980s. However, one important problem in arranging musical activities in such center is the lack of staff. The facility has only one staff who can lead a musical activities. At present, apart from the Thai Red Cross rehabilitation center, there are two local public hospitals in Bangkok. There is only one music therapist who works full-time as a permanent employee at each local public hospital in Bangkok. These two local public hospitals are the largest hospitals in the country. Siriraj Hospital is one of the busiest medical centers in Southeast Asia with a capacity of more than 2,000 beds and visited by more than three million patients per year. A music therapist position was only introduced to

Siriraj Hospital ten years ago. The situation in local nursing homes, long-term care facilities and hospices in Thailand indicates the even more difficulties in providing musical activities due to the lack of full-time positions of music therapists. One significant obstacle in arranging musical activities in nursing homes is the fact there are no full-time musicians employed or musically trained staff to lead the activities.

The Musical Instrument – Angklung and the Usage of "Kodaly" Hand Signals

Chastin (2015) stated that social activities can improve the elderly's mental health including their depressive disorder. Musical activities are social activities that entertain, give a sense of belonging to a group, and allow the participant as a social member. Therefore, musical activities can add up the value and meaning of life for the elderly. To play angklung in a band gives the players delight and emotional aesthetics, one of the important features of being humans.

Originating from Indonesia, the angklung is a bamboo musical instrument with two tubes. A single angklung can produce one specific pitch, and the collective of the instruments are tuned to the western scale. By tuning the angklung to follow the western scale, angklung can be used to play various kind of music, including local and international repertoires. An angklung player can hold up to a maximum of 7-8 angklung on the left hand and uses the right hand to shake a selected angklung of a particular pitch.

Figure 1. Indonesian angklung rehearsal at the Faculty of Fine & Applied Arts, Chulalongkorn University, Thailand: March 2013 by Indonesian Members of "Gita Rasa Swara Interna" from the Dept. of Internal Medicine, Faculty of Medicine, Universitas Padjadjaran, Dr. Hasan Sadikin Central General Hospital, Indonesia.

When the Indonesian angklung was introduced into Thai culture in 1907, Thailand adopted the instrument and modified certain features of the angklung. The Thai

angklung consists of three bamboo tubes and a hardwood frame to hold them. As the Thai angklung is relatively heavier compared to the Indonesian angklung with its lighter bamboo frame each musician can only play a maximum of two angklungs – one held in each hand. The Thai angklung is also tuned to follow the Thai scale which is equidistant heptatonic scale. This modification embraces the Indonesian angklung into the Thai traditional music culture, but is only able to play Thai traditional repertoires. Figure 1 shows the example of an Indonesian angklung and its playing methods while Figure 2 shows the Thai angklung and its playing methods.

Figure 2. Thai Angklung Ensemble at Siriraj Hospital by Students from Department of Thai Music, Faculty of Fine and Applied Arts, Chulalongkorn University, Thailand: March 2013.

The Kodály approach (also known as the Kodály concept) is an approach on music education developed by Zoltán Kodály in Hungary during the mid-twentieth century. In recent decades, the Kodály approach has blossomed and has been implemented in many music education programmes, especially in music programmes at primary education levels. One significance of the Kodály approach is the usage of hand signals, that assigns a single pitch to a particular hand sign. Many researches on the Kodály approach has proven that this approach does not only improve students' musical ability, and according to deVries (2001, 24-25), the Kodály approach also improves the development of general intellectual and motor skills. The Kodály approach has been adapted and used to teach music, especially in the angklung ensemble in Indonesia. The Kodály approach has also been applied to Thai elderly at Chulalongkorn Memorial Hospital by Dr. Praphutsorn Wongrattanapitak as a volunteer providing musical activities to a group of Thai elderly

at the Comprehensive Geriatrics Clinic. This group comprised of 70 persons who signed up for a musical activity. With their focusing on hand signals, it helped improve both their hand-eye coordination, memories and related motor skills. This elderly group were consider active and without chronic diseases. These supportive types of activities assist in their maintanence of good health.

Tiszai (2015) has also conducted a research on Kodály approach in the crossroad between education and music therapy. Tiszai further elaborates on the emphasis and differences of the development of education and music therapy, specifically looking at Community Music Therapy.

> Education started to emphasize the nonmusical benefits of musical activities and therapy started to focus on social connectedness as a crucial element of health and wellbeing. While previous definitions of music therapy emphasize the decisive characteristics of therapeutic progress, opposing therapy with education, Community Music Therapy accentuates the common roots and inseparable complex effects of any musical activity. (Tiszai, 2015)

Besides Tiszai's research, there are other studies that applied Kodály approach in different aspects of music therapy, both generally and in specific field such as music therapy for children with autism (Lathom, 1974; Chiengchana & Trakarnrung, 2015). The findings of Chiengchana & Trakarnrung (2015) in their research has proven that the Kodály approach to music education can apply to music therapy.

Objectives

In general, non-pharmacological interventions in elderly care and in foster homes such as music-based activities were limited in Bangkok. Only few places were able to organize music-based activities. For those places that were able to organize music-based activities suffered even a lot more from the COVID-19 restrictions, making it more difficult for music facilitators to visit the establishments.

As mentioned above, the objectives for this study are as follows:

1. To develop a music application which is user-friendly for the elderly in foster home units that facilitate the continuation of musical activities in absence of a facilitator.
2. To test the music application developed on its functionality.
3. To observe the change in the quality of life of the elderly throughout the process of testing the music application.

Methodology

This study was sectioned into three phases and was conducted over a period of 8 months starting from October 2020. However, due to COVID-19 and lockdown, the project was on pause from April–July 2021.

Phase 1 of this project was to brainstorm and create the music application that is user-friendly for the elderly. In this first phase, the researcher developed the idea to realize a prototype for the music application with the Faculty of Sciences at Chulalongkorn University. The development of the application and devices went on for about 4 months and it gave birth to the "Smart Band" device.

Phase 2 of the project was to select the songs from lukthung (Thai country music) repertoire and re-arrange musical scores which included angklung, saxophone, piano, guitar and bass. The selections were based on the rationale and rearrangement of the songs. Each song was transcribed and then the selections of the pitches in each melodic phrase was selected to make the angklung line in accordance with the abilities of the sampling population who were not musicians. Apart from the musical background of the sampling group, the frequency of pitches within a phrase were taken into consideration to make the angklung line. Then, the re-arrangement of the songs was made to support the angklung ensemble and to hold the angklung melodies. The objectives of the rearrangement were to accompany the group activity and to allow the melodies of the angklung to flow with continuity. The selections of the repertoires were based on an interview data with the sample population of this project.

Phase 3 of the project involved the development of prototypes which were then tested on the sample population group of 30 volunteer elderly females at Tiwanon's Friendship and Welfare foundation for Female Elderly in Nonthaburi, Thailand. Figure 3, figure 4 and figure 5 are images of testing the prototype by the researcher.

Figure 3. Prototype testing with orange unit and white battery taped to both arms.

Figure 4. Testing with vibration unit inside the palm area of the gloves.

Figure 5. Wearing gloves and inserting a vibrator inside a glove on the back.

After multiple tests and trials, the research team has agreed to use the prototype as seen in Figure 6, where the device will be placed on the table. Elaboration on how the device function will be discussed in the next section of this article.

Figure 6. Smart Band devices: showing both the sensor attached to the angklung and the hand-glove vibrator units above.

Phase 3, which dedicated to testing the application and devices started in July 2021 until August 2021. This phase mainly used a qualitative approach by conducting the experiment with the respondents, obtaining their feedback through

observations and interviews, including interviewing the facilitator of the angklung activity, Dr. Paphutsorn Wongratanapitak. The respondents consisted of 30 volunteers who had no music background and were elderly ladies living in Tiwanon's Friendship and Welfare Foundation for Female Elderly in Nonthaburi. All of them were at the age between 60–84 years old.

Due to COVID-19, the experiments and activities were conducted via Microsoft Team Online programme. The project committee prepared and set up the device, web application, and provided training to the facilitator. Only two non-foundation members were allowed to enter the foundation building to help and lead the sessions. Another limitation caused by the pandemic was the total number of participants allowed at a particular moment, which led to dividing the 30 volunteers into 5 groups with 6 members in each group. After each session with each elderly group, the researcher an Dr. Wongratanapitak interviewed the members of the group few key questions to understand their feelings and feedback towards the activity and the use of the device.

Observations and Results

After phase one of the project, the smart band device – consisting of 8 sensors, 8 vibrators and a website (http://smart-angklung.web.app – was developed. The prototype device was the outcome of multiple meetings, discussions and trials amongst the inventor committees. Overall, the whole Smart Band application can be divided into two major components: the virtual component – website; and the physical components – the sensor and vibrator.

To further understand the Smart Band Application, one must first understand the website application and its function. The website created has a simple interface that allows its users and the researcher to navigate easily. In the website, the research team has to create individual profiles for each player. The website also allows the players to be sorted into groups. Once the profiles of each player were created, the facilitator can then group each player or choose the players for a particular song. The application will automatically assign an angklung number to the players and the facilitator only needs to hand out the instruments according to the number assigned to each player. When the device and the website application are set up, the players are able to start playing the angklung following the signals sent to the sensor and vibrator. At the end of each song, the score of each player are tallied. Besides managing the whole ensemble, the application also allows the facilitator to track the progress of individuals. As this application is intended to allow the elderly to have easy access to making music, especially making music in a group without an instructor, the device also allows the instructor/teacher to upload different playlists that suit the group. For this study, Dr. Wongratanapitak and the reseracher has specifically selected a playlist of 12 songs and this will be discussed later in this article.

The website application will not be able to function without the Smart Band device. The Smart Band device is made up of 2 parts: the sensor and the sensory aide. The sensor device is the orange box that is attached to the instrument, and

in this study is the angklung. The main function of the sensor is to detect the vibration of the angklung when the instrument is being played by the player. This sensor is also responsible for recording the scores of the player. The scores recorded by the sensor is saved and can be used to observe the progress of the individual player. Another device is the sensory aide, which is the white box shown in Figure 6. The sensory aide consists of a visual aide that shows light signals and a vibrator. The sensory aide is used to send signals to the players so that they will be able to play the instrument when cued. After discussing with the research team, it has been decided that these two sensory cues are used in order to support elderly with different level of sensitivity towards a particular sensory signal.

In this study, the Smart Band device is designed to be both wired and wireless. The design is light and small and it supports the idea of being mobile and easily accessible at any location. Figure 6 in the previous section showed the wireless set up of the device while Figure 7 shows the setup of the paired devices when wired together. The small size of the device allows the facilitator and/or the researcher to attach it to any instrument, or in this case, the angklung. It also allows the possibility of the activities to be carried out in a range of environments or contexts.

Figure 7. Shows the Smart Band devices being attached to the instrument via wired connections.

Background Music and Rearranged Notation for Angklung

Wongratanapitak (Interview, 2021) emphasized during an interview that it was important to select the songs for elderly's Smart Band Application. She explained that, based on her experience conducing an angklung ensemble for the elderly's group at King Chulalongkorn Memorial Hospital in Bangkok, music can help bring back the elderly's memories and physical abilities. There were many times after conducting an elderly's angklung ensemble at King Chulalongkorn Memorial Hospital, the senior members would share with her their sweet and bitter memories related to the songs. Some members with Alzheimer, who could not remember anything, happened to be able to sing along the songs during the angklung sessions. There were many members could not catch up the queue to shake their angklung and hardly made some movements or on the wheelchairs but tapped their feet or nodded their heads along the rhythm throughout the whole sessions.

Because of her experiences mentioned above including an interview with the population sample from the Tiwanon's foster home, Wongratanapitak and the researcher selected four songs from 1950s - 1970s from the lukthung repertoire, a genre of popular country music which was composed during the 1950s - 1970s, for Smart Band Application that fit the follow descriptions:

1. The songs selected had a various range of tempos – from slow tempo to fast tempo ones (averaging 85-100 beats per minute).
2. Composers granted this reserach project permission to use their copyrighted music.
3. Songs that do not include accidentals. (the angklungs used in this study only supported the diatonic scale).
4 Thai songs used diatonic scale instead of pentatonic scale.
5 Thai songs that is suitable to be played on the angklung; the notes are sparse enough for the angklung.

Based on Wongratanapitak's experiences and comments from the elderly, Wongratanapitak and the researcher selected the following songs to be used for this study:

1. *Num na ro nang* (TH: **หนุ่มนารอนาง**) is a tune featuring a country man who waits for his girlfriend to return home. She had left him since Songkran (the Thai new year celebration in April). The lyrics brings out the surrounding nature. It connects to the mood of the young man immensely and impressively. The tune and lyrics was composed by Sanith Manohrat around 1980.

2. *Thepthida thewi* (TH: **เทพธิดาเทวี**) is a Thai country folk tune. It compares the beauty of a woman as exquisite as a goddess. The tune and the lyrics was composed by Surapol Sombatcharoen.

3. *Num na khao sao na kluea* (TH:**หนุ่มนาข้าว สาวนาเกลือ**) is a fun and upbeat tune because it is a duet between a male and female vocalist. It features a young man and a young woman who just met and got to know each other. A man is rice farmer from the northeastern part of Thailand and the young lady is a salt maker. The tune was composed by Sorapetch Pinyo in 1985.

4. *Theptida doi* (TH: **เทพธิดาดอย**) is about the loyalty of a hilltribe woman who keeps her love and loyalty for her beloved man. But the relationship is impossible. Although the lyrics portrays such a tragic story, the tune is set in fast tempo. The melodies were borrowed from a Chinese local tune. The lyrics was composed by Wara Worawecha in 1980.

Sacks (2008) argues that the importance of the use of songs that were listened to and played by elderly especially during their adolescence and young adulthood can bring back their memories. Thus, the selections of the songs were made to their interview that recalled their adolescence and the music has been rearranged so that it was suitable to be played by the angklung.

Observations and Respondent's Responses

During the pilot study, the researcher observed the process and the progress of the respondents. The researcher also conducted short interviews with the respondents and with Wongratanapitak to find out how the respondents feel after each session, as well as to obtain feedback on both the device and the activity. In an interview with one of the respondents, the respondent replied that the device cannot replace the instructor, but it helped during practices and/or when the instructor was unable to be present. Another respondent also shared that the device helped her to improve her focus as the device requires her to play the angklung when the signal was given. She also said that it improved her response time when the signal was given.

In an interview with Wongratanapitak, she opined that the Kodály hand signals definitely was better when conducting the angklung activities for the elderly. This was because the hand sign encouraged the players to communicate and respond to her signals. It also encouraged social interactions between the players. Being part of the experiment herself, she opined that the device was not suitable to substitute the instructor in the long run, but it was very beneficial to help the elderly during practices or during temporary absence of the instructor. Dr. Wongratanapitak also shared her experience and observations where she was able to see small improvements in terms of the response from the respondents and considered that the device can further be developed to be more interactive.

Discussion

Improvement of Quality of Life of Elderly

The Smart Band application showed some promising results in this study. Through the observations done throughout the experiment, it can be seen that there were some improvements in certain aspects, such as concentration, focus and the respondents' response time. The Smart Band device also helped facilitators to carry out group activities at elderly homes with the absence of an instructor. However, it is not recommended that the device should substitute the instructor in the long run because at the current stage of the application development, it encourages more of a one-way interaction with the device in comparison with the initial goal of social interaction between players. This is because the player tends to be more focus on playing at the right time in order to get the score.

The Smart Band application is definitely a good concept that is on par with the advancement of technology. This pilot study has also shown that technology can be used to assist in improving certain aspects among the elderly. As mentioned previously that the application helps to improve the elderly's focus on angklung playing, this can help the elderly with their cognitive skills, providing them continuous stimulations and helping them to remain cognitively active. This technology also encourages foster facilities such as elderly homes to conduct group activities without the presence of an instructor. The scoring system of the Smart Band application helps the facilitator to monitor the activity and it allows the facilitator to temporary substitute the instructor. When compared to playing recordings of the instructor using the Kodály hand signals, the Smart Band application can be

more accurate in assisting to correct mistakes while playing as it is more interactive compared to the respondents watching and following the recording of the instructor.

Limitations and Suggestions of the Smart Band Application

Even though the Smart Band Application does have some promising results, there are still a number of limitations that can be further improved. One of the limitations of the Smart Band Application is the scoring system. The scoring system is used by the instructor, facilitator and the researcher to observe the progress of the respondents. Nonetheless, the scoring system can also be discouraging for the respondents. Currently, the scoring system is based on the individual pitch that was set in the MIDI file and the score is not equally distributed among the players. Based on the experiment, there were a few times where no scores were recorded by the player when the pitch assigned to the player has low frequency throughout the song and the player is unable to respond to the signal on time. At times, the scoring system also caused the respondents to shake the angklung even when they are not cued to play, in order for the respondent to obtain full score in the system. The overall feedback of the respondents was positive, but based on the observation of the researcher, the respondents felt stressed at times, especially when they made mistakes while playing. The scoring system can be modified to be a group score instead of individual score, to further encourage social interactions and to encourage teamwork among the players.

Another limitation of the device is its flexibility to adjust. Similar to all other current technologies, the device is unable to adjust to the level of the players. Players are required to follow the speed of the music set by the device, where the tempo might not be suitable when used with a different group of players with different level of cognitive response. In comparison, the instructor is able to control the tempo and the overall performance. Further adjustment to the minus one setting in the website application can be done to help make minor adjustment while the music is being played. Even though the device is small and light, the position of the sensory aide of the device can be further improved to provide more accuracy in cueing the players and to assist the players to play the instrument on cue.

Conclusion

COVID-19 pandemic has disrupted many traditional social norms and changed the way people interact. Group activities have been limited and many foster homes for the elderly were unable to connect with instructors and external facilitators to conduct group activities within the organizations to improve the well-being of the members due to the restrictions set by the government. It was because of this very reason that the researcher came up with the idea of using the advancement of technologies to help bridge this gap. Hence, this research project aimed to come up with a device that is user-friendly for the elderly that can help improve the quality of life of the elderly at foster home units.

This study is a part of a bigger project in trying to bridge the gap of lack of instructors/facilitators at elderly foster home units, especially during this pandemic. One

of the results of this project was the completion of the prototype for the Smart Band application. The Smart Band application consisted of two parts – the virtual component, that is the website application; and the physical component that consists of two devices, the sensor and the sensory aide. This Smart Band application prototype can function when wired together and also wirelessly to provide easy access to the user when using this device.

The second part of this pilot study was to test the device with 30 respondents from Tiwanon's Friendship and Welfare Foundation for Female Elderly in Nonthaburi. The experiment conducted using the Smart Band application to temporary replace the instructor did have some promising results, where there were improvements to the respondent's motor and cognitive skills, as well as their focus on trying to complete a particular task. As the Smart Band application is still a prototype, there were a few suggestions provided in the discussion that can be improved to make the application more user-friendly for the elderly.

Recommendations for Future Research

Due to the limitations of this study, it opened more opportunities for further research on combining technologies and musical activities for different age groups in Thailand. One of the limitations was the duration for the study, that is a duration of around 8 months starting from September 2020 till August 2021, with a break from April–July 2021 due to lockdown measures implemented by the local government. With an extended duration, the study can further be developed and broaden to include different age groups and gender. An extended duration can also allow a more extensive research to be conducted, especially to observe other aspects of improvements of the quality of life of the targeted sample groups. With extensive research over a longer duration and including different gender and age groups, the findings will be able to better represent the benefits of technological interventions in musical activities for the elderly community.

Acknowledgements

The author would like to acknowledge Professor Dr. Bussakorn Binson for her leadership in developing a well-established music therapy programme at Chulalongkorn University; Dr. Haisang Javanalikihikara for developing ART4C, an on-campus experimental lab for musical ideas, galleries, and art hub; Dr. Prapon Kumjim and Dr. Sirithorn Srichalakom for grant support from the Faculty of Fine and Applied Arts Multidisciplinary Art Innovation Center (FAAMAI), a creative research project initiated by the Faculty of Fine and Applied Arts, Chulalongkorn University. Funded by the Chulalongkorn University Second Century Fund (C2F), the innovation centre aims to provide digital art facilities and equipment for students, researchers, artists, and the general public. The author would like to thank you all members and the Director of Tiwanon's Friendship and Welfare Foundation for Female Elderly in Nonthaburi for participating in this study.

References

Binson, Bussakorn. *Music Therapy* (in Thai). Bangkok Chulalongkorn University Press, 2018.

Chastin, S. F., J. Palarea-Albaladejo, M. L. Dontje & D. A. Skelton. "Combined Effects of Time Spent in Physical Activity, Sedentary Behaviors and Sleep on Obesity and Cardio-Metabolic Health Markers:

A Novel Compositional Data Analysis Approach." *PloS one* 10(10), (2015). e0139984. https://doi.org/10.1371/journal.pone.0139984

Chiengchana, Natee, and Somchai Trakarnrung. "The Effect of Kodály-Based Music Experiences on Joint Attention in Children with Autism Spectrum Disorders." *Asian Biomedicine* 8, no. 4 (2014):547–55. https://doi.org/10.5372/1905-7415.0804.326.

Department of Older Persons. "Statistic of the Elderly: Statistic of the Elderly with Thai Nationality and Whose Names are Listed in the Household Registration (**สถิติผู้สูงอายุ: สถิติผู้สูงอายุ สัญชาติไทย และ มีชื่ออยู่ในทะเบียนบ้าน มกราคม** 2022." Department of Older Persons, Ministry of Social Development and Human Security. (accessed April 18, 2022). https://www.dop.go.th/th/know/side/1/1/1159.

Devries, Peter. "Reevaluating Common Kodály Practices." *Music Educators Journal* 88, no. 3 (2001): 24-27. doi:10.2307/3399754.

Dileo, C. and M. Zanders. "In-between: Music Therapy with Patients Awaiting a Heart Transplant." *Journal of Urban Culture Research* vol 6 (2013):72-83.

Hanser, S.B. (2012). "Music Therapy-based Mechanisms for Coping With Stress and Pain." *Journal of Urban Culture Research* Special Issue. (2012):98-108.

Hayson, Meghan. "Indonesian Angklung: Intersections of Music Education and Cultural Diplomacy." Smithsonian Freer Gallery of Art & Arthur M. Sackler Gallery. March 25, 2020. (accessed November 18, 2021). https://asia.si.edu/essays/article-hynson/.

Lathom, W. "Application of Kodaly Concepts in Music Therapy." *Journal of Music Therapy* 11, no. 1 (1974): 13-20. https://doi.org/10.1093/jmt/11.1.13.

Lorthanavanich, Duangjai, Osuke Komazawa, Arunee Tanvisuth, Nopadol Rompho Rompho, Surat Teerakapibal & Narumol Nirathron. "Population Ageing in Thailand." Research Project Report. Economic Research Institute for ASEAN and East Asia, June 25, 2021. (accessed November 18, 2021) https://www.eria.org/publications/population-ageing-in-thailand/.

Sacks, Oliver, W. *Musicophilia: Tales of Music and the Brain.* New York: Vintage Books, 2008.

Silverman, Michael, J. "Therapeutic Mechanisms Within Music Therapy for Adults with Mental Health Conditions." *Music Therapy in Mental Health for Illness Management and Recovery* (2022):141–58. https://doi.org/10.1093/oso/9780198865285.003.0007.

Sweetser, Dorian Apple. "Love and Work: Intergenerational Household Composition in the U.S. in 1900." *Journal of Marriage and the Family* 46(2) (1984):289-293.

Tiszai, Luca. "Kodály Approach in the Crossroad of Education and Therapy." *Voices: A World Forum for Music Therapy* 15, no. 2 (2015). doi:10.15845/voices.v15i2.804.

Wongratanapitak, P. Interview by author. October 14, 2021.