DESIGN AND DEVELOPMENT OF MUSICAL INSTRUMENTS FROM RECYCLED MATERIALS FOR THE ELDERLY IN PHITSANULOK PROVINCE IN THE NORTHERN PART OF THAILAND

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Abstract

This research project explores the creative potential and sustainable innovation of designing and developing musical instruments using recycled materials, specifically focusing on involving the elderly community. In an era where environmental sustainability is paramount, and the elderly population is often overlooked in creative endeavors, this study aims to bridge these two aspects, offering a unique and inclusive approach to music and recycling. The primary objective of this research is to investigate the feasibility of using recycled materials to construct functional and aesthetically pleasing musical instruments while actively engaging the elderly, music experts, geriatric specialists, product design experts, and technicians in the design and development process. By leveraging their accumulated knowledge, wisdom, and artistic sensibilities, this project seeks to empower and enrich the lives of the elderly while contributing to reducing waste and environmental conservation. Results indicate that the elderly participants derive numerous physical, cognitive, and emotional benefits from their involvement in the project, including enhanced motor skills, cognitive stimulation, and a sense of accomplishment. Additionally, the musical instruments produced demonstrate impressive innovation, sound quality, and aesthetics, underlining the viability of using recycled materials in the design of musical instruments.

Keywords

creativity, innovation, musical instruments, recycled materials, the elderly

INTRODUCTION

The creative process regarding this subject is a high level of thinking on diversity, an intellectual ability to use many directions and forms without boundaries set through social norms. Humans have been able to create new things for use in daily life and can develop things that are complementary and beneficial to other humans. Humans also use their ability to establish themselves, their society, and the world in a manner most suitable for their human life. The process of developing human creativity will result in a change, which can create benefits for any society. Therefore, creativity has a relatively broad meaning and can be applied to production, creating novelties and processing them (Laoakka, 2019).

Thailand faces pollution problems in many aspects. The lack of knowledge on proper disposal and management of waste leads to many problems, such as waste pollution, which refers to an unfavorable environment caused by human activities such as littering in public places or in water streams. The putrid smell of the garbage affects people's livelihoods and health. These problems can be reduced by eliminating and managing waste (Sorach, 2019). One of the exciting ways that can also commercially add value to destruction is by re-using, reducing, and recycling. It is an adjustment to make resources worthwhile and get a maximum benefit by using the art of designing waste materials by adding value to create new products such as musical instruments. Recycling is reducing the amount of waste that solves environmental problems and creates value and additional income from existing items that have no value (Manipharak,

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Boonrod, Vich. 2024. Design and Development of Musical Instruments from Recycled Materials for the Elderly in Phitsanulok Province in the Northern Part of Thailand. *AEMR*, *13*: 25-40.
DOI: 10.30819/aemr.13-3

2020); using recycled materials to develop value-added products requires selecting materials to test and experiment. The selection of recycled material and design involves step-by-step design thinking and thinking outside the box. The origin of recycled materials may be emphasized or focus on the appearance with an eye-catching design, exotic or beautiful shape. However, the uniqueness of the community products made from recycled materials must be usable, attractive, engaging, and tested for quality, which can create additional value for the product (Wongphanit, 2003).

The skill development for the elderly can improve their quality of life so that they can be sustainably self-reliant and live happily in the society. There was a plan, called the National Elderly Development Plan No. 2 (2002-2021), which aims to create awareness among people in the society of the elderly and the importance of preparing to become a quality senior citizen according to the strategy for promoting the elderly (Ministry of Social Development and Human Security, 2010). Therefore, the government, private sector, and educational institutions should support and push for innovation development, activities, or benefits to help promote older people's skill development. Niratsai (2018) supports that the Thai elderly in the 21st century should enhance their 3R x 7C skills so that older people can live happily in the society and be knowledgeable about the world. This is a critical skill in the 21st century, but it may not be necessary to have all aspects because the context of the elderly group is different. Creative and innovative skills are the other skills that can be promoted to the elderly group. This can be completed by incorporating various activities, including creating inventions, music activities, folk songs, etc. The practice of these skills, along with meditation skills, can strengthen the thinking process. The elders can use the brain's working process to think backward to restore memory. This will also cause a feeling of pride and appreciation of one's worth (Boonrod, 2022).

Ideas for creating works and innovations that serve social needs are concrete, tangible, and can be used to benefit the group of elders in the previous research. It has inspired researchers to continue and develop this research. The researcher emphasized the importance of the use of natural materials and local wisdom of the elderly group to be able to express opinions that come from experiences or clarity from their own lives and local society. Therefore, the musical instruments will come from association and integration until they become the wisdom that originates from the experiences of the elderly. The design guidelines of design experts and professional designers will brainstorm ideas for creating musical instruments from recycled materials to create an alternative musical instrument for daily use in societies and communities. Further, it also strengthens creativity and innovation skills to increase the capabilities of the elderly group, including adding value to the community products that can truly meet the needs of users, preserving, inheriting local wisdom, and developing it into community products or souvenirs from the materials or leftovers from production with things that are abundant in nature and do not cause damage to the environment for further benefit.

Research Objectives and Questions

Research objectives are to brainstorm ideas for designing and drafting musical instruments from recycled materials together with a group of elderly people and to create and experiment with musical instruments from recycled materials with a group of elderly people.

The following questions are crucial and serve as a point of departure:

- What should be considered in designing musical instruments for the elderly?
- What should musical instruments look like when designing them for the elderly? (such as size, weight, and colors).
- And how should they be designed when using recycled materials to develop musical instruments for the elderly in order to have a good sound quality and attractiveness comparable to musical instruments that use regular materials?

LITERATURE REVIEWED

Literature reviewed here was mainly written in Thai language. The researcher is aware of an urgently needed embedding of the outcomes into an international framework that goes beyond this self-positioned limitation. The situation of environmental problems and pollution in Thailand is considered a severe problem that is affected by the large amount of plastic waste. This waste inevitably comes from everyday consumption, such as drinking water, which creates a waste of plastic bottles and cups. A survey in 2016 found that there were 27 million tons of solid waste, which is plastic waste that cannot be disposed of, amounting to 1.52 million tons, accounting for 13 percent of solid waste that cannot be disposed of (Sangrajrang et al., 2013). Therefore, the waste problem is another crucial difficulty of the government sector. Recycled materials are continuously used, and experimenting with materials in designing and developing musical instruments benefits society and reduces environmental problems that affect the quality of life. The analytical thinking process of the design process will lead to the creation of products that are relevant to life, with product design principles considering utility, suitability, convenience, and safety.

Local wisdom from the group of elders in each area is considered a source of local people's traditional knowledge, abilities, and skills passed down from their ancestors. Local wisdom is, therefore, the knowledge of local philosophers passed down and has made community members have strong bonds with each other. Wisdom is essential and valuable to be remembered for conservation and distribution to future generations of communities. There is a lot of practical local wisdom in various fields such as medicine, science, and multiple other appliances. At present, it is found that in Thailand, local insight is used to create products for sale, develop careers, and generate income for families and communities in various ways (Phontharaphong & Siripithakul, 2022). In the era of technological and economic competition, a product or service must be special and unique to survive and be sustainably popular. The idea of creating musical instruments from natural materials is to reduce product costs and economic development in the unavoidable era of competition. There is an increase in waste materials from various human uses and activities, and some materials are abundant in the local area that can be processed into appliances and further developed as community goods. It shows that using leftover materials can benefit and create a career to generate income for the family.

A great deal of research supports the effectiveness of musical instruments as powerful stimulants in humans that can create positive feelings and be used to regulate one's emotions. In various musical activities, musical instruments are an essential tool in driving the activity to an individual perfection, resulting in the activity being effective with the group of participants in a positive way. Group dancing or music activities can enhance social interaction and create unity. It is a tool for fostering conversations within the family, building good relationships, and creating lasting strength for the family (Boonrod, 2022; Wesseldijk, 2019). According to the experience of researchers who have developed innovative musical instruments and received support from the experimenting results, it can meet the user's needs. It can also enhance happiness, reduce loneliness and stress, strengthen interpersonal communication, and raise the user's sense of value. Bradt et al. (2016), who studied the use of music with humans, found that having the person perform a real musical instrument can create positive and more effective results than just listening in which music enhances the interactivity of the people in society, increases self-worth, lessen loneliness (Boonnrod, 2022), and also give, those who perform it, the ability to have musical skills, feel proud of themselves, and have a good quality of life. Some researchers show the benefits of using music for humans by using music therapy as another option for rehabilitating the human mind, body, and emotions (Sixsmith & Gibson, 2007); Lesta and Petocz (2006) found the research results that playing music and movement has positive effects on the physical and emotional aspects, building self-confidence in people and making them feel that they are valuable and able to live happily with their families, communities, and the entire society.

Design thinking is a process based on anthropological understanding that emphasizes analyzing problems by listening, empathizing, and using the expectations of users and stakeholders as the center, leading to designing products and services as desired, called User Experience (UX). This process plays a crucial part in formulating businesses, products, and services that directly respond to user's current needs. It may be something that cannot be anticipated in advance or has never existed in design theory or history. The IDEO design and innovation agency has set the steps for the innovation design process. It can also be extended to create additional marketing value with these five steps: empathy, definition of needs, ideating the outcome, prototype production, and testing by members of the target group (Lewrick et al., 2018).

The study of the relationship between groups for music activities with the elderly using Quality of Life Theory (QoL), which covers physical, mental, and a general social well-being, can provide valuable insights into how music affects the lives of the elderly. Musical activities involving the quality-of-life-theory promote collaboration, strengthen the elderly organization, and encourage the role of the community and quality of life for the elderly by having appropriate social activities. Kalyanamitra (2022) is consistent with Poolsirikul (2019), who introduced the concept of economic sufficiency as an essential part of determining guidelines for promoting the quality of life of the elderly. Quality of life of the elderly in the current decade, 2018-2027, consists of a good emotional state, interpersonal relations, good living conditions, self-development, good physical conditions, and non-stressful social gatherings. As humans age, they face various limitations when gathering to do multiple activities, that is, they cannot sit, stand, or move for long periods. These are limitations on the elderly's lives even if there is an exciting event, but the elderly must always consider the consequences on their aging bodies. Besides physical hurdles, memory and how quickly they can move the body also affect their ability to participate in activities they are interested in. Therefore, initiating activities to enhance the life quality of the elderly in playing music can sustainably improve the elderly's quality of life in terms of well-being and physical health by participating in musical activities, whether it is singing, dancing, or playing musical instruments (Pantasri, 2021); this will have a positive effect on the body and can help maintain or help in the agility of the systems in the body so that they can continue to develop. In addition, music therapy has also been used to reduce pain and disease, that is, dementia. Pangjak (2022) states that group gatherings can build relationships among the elderly in society, and they can also spend their free time productively participating in social activities. There is a process of using techniques to allow this group of elderly people to play each musical instrument into a song. They can also bring this ability out to the public for performing on various social occasions to avoid the risk of having the elderly at home alone by using music to find activities for themselves and social participation. Nowadays, many types of musical instruments, both international and Thai music, have different styles and methods of playing. The elderly society in Thailand is interested in music activities. Still, it has some limitations when playing, that is, reading and remembering tones, which requires both the brain to recognize the tones described through the tones of the instrument and the eyes to play, knock, or hit at the right beat. The quality of the sound of musical instruments when playing may inevitably affect the elderly, and the weight of the musical instrument hinders moving and storing.

If recycled materials are used to develop musical instruments that have similar characteristics, are safe, easy to play, commonly found in the home, and can be made by themselves with a design suitable for their use, that is, the sound produced from the musical instruments will not affect the auditory system when playing for a long time, solving the problem of having too many tones as experienced in regular musical instruments that can be played together in a band. This will help to promote sleep quality of the elderly (Wichian et al., 2018).

According to U-khong and Wongwatthanaphong (2019), who conducted a study on the elderly in Phitsanulok province, it was found that the Phitsanulok province is entering an aging society, which has seen the effects of not being prepared in terms of environment, finances, and mental and physical health. There is a suggestion that such aspects should be promoted to create

knowledge and understanding of people in society to enter the elderly community, especially in choosing the right colors to paint musical instruments and patterns. This is in line with the inspiration of the researcher, who got the idea from the identity of Phitsanulok province, an area in Thailand's lower northern region. There was an opportunity for the group of elderly to brainstorm ideas for designing musical instruments from recycled materials in this research. The researcher has chosen to use a combination of color tones from local fabric patterns to match the design and decoration of musical instruments. It has red and gold colors, coming from a Buddha image located at the temple, Wat Phra Si Rattana Mahathat Woramahawihan in Phitsanulok province; blue and purple are the unique colors of Phitsanulok's woven fabric. This is not only a display of cultural heritage (Hintow, 2021), but it is also a presentation of the identity of Phitsanulok province that reflects its culture through the design and development of new musical instruments.

METHODS

This research applies a research and development model, which divides the study into three phases. Phase 1 studies the context and needs of the target group in the dimension of the problem and suitability by brainstorming the opinions of the elderly, music experts, geriatric specialists, product design experts, technicians, and musical instrument producers.

In phase 2, the researcher analyzed the data from the brainstorming group of the elderly, music experts, geriatric specialists, product design experts, technicians, and musical instrument producers. Later, the producers sketched a draft of a musical instrument and created a prototype from recycled materials according to the sketch.

In phase 3, the researcher tests the musical instrument made from recycled materials with the group of users to get feedback, which will be helpful for improvement and developing innovation to become a standard that gives positive benefits to the actual users.

PHASE 1

Conducting a study of the context and needs of the target group, the researcher has brainstormed the opinions of stakeholders regarding the design and development of musical instruments made from recycled materials by organizing group discussions such as interviews with a group of elderly people in Wat Yang En Elderly Community, Tha Pho sub-district, Mueang district, Phitsanulok province. The discussion aims to investigate the need for musical instruments that can be developed from recycled materials. Further, there were interviews with music experts on the quality of sounds and instruments, components for musical instruments and materials that will be used, ideas for creating musical instruments from recycled materials, and the suitability of musical instruments for the elderly.

PHASE 2

After determining the needs for this research, a group consisting of the elderly, music experts, geriatric specialists, product design experts, and technicians was formed to brainstorm ideas to cover the quality standards and needs of the target group that the researcher will use for experimenting. The design of musical instruments and the selection of materials to create innovations from recycled materials consider the safety of the materials and practicality. The design of the musical instrument is simple; both the playing method and the musical tones do not require a lot of memorization. The musical instrument was created to be lightweight and can be moved and stored quickly and conveniently.

Phase 3

From brainstorming and discussing with the group of elderly, music experts, geriatric specialists, product design experts, and technicians, they have successfully designed a musical instrument. The design process for the musical instrument is based on the user's needs, which the researcher got from the interviews about what should be considered in terms of design that considers the user as the main focus and the physical aspect that must be designed appropriately with the physiology of older people. The three musical instruments made from recycled materials were produced according to the pattern created, including a percussion instrument made from a tin container, a percussion instrument made from tiles (the tone bars attached to the base), and a percussion made from tiles (the tone bars can be disassembled). The next step is to test the musical instruments with older people and find ways to improve, promote, and develop innovation to become a standard.

Sample Group
(Experimenting with Musical Instruments)

The sample group used in this research included five elderly people whose names were listed in the register of Tha Pho sub-district, Mueang district, Phitsanulok province, by selecting a purposive sample according to the specified criteria. In this research, the sample subjects will be represented by the word 'volunteers' to protect and maintain the confidentiality of the research participants according to the ethical principles of human research.

Inclusion Criteria

The inclusion criteria were chosen according to the given task as the following:

1. Older people between the ages of 60 and 75 years.
2. The name must be listed in the register of Tha Pho sub-district, Mueang district, Phitsanulok province.
3. Be able to help themselves and perform musical activities.
4. Have the ability to read and write.

Research Tools

The tools used in this research consisted of an interview form to brainstorm opinions from elderly people, music experts, geriatric specialists, product design experts, technicians, and musical instrument producers. It allows volunteers to express their views on designing and developing musical instruments from recycled materials with the participation of the elderly group. The interview will include questions about the methods and design of musical instruments from recycled materials for older people to interview a group of elderly people, music experts, geriatric specialists, product design experts, technicians, and musical instrument producers. Further, it has passed the quality examination of interview questions by experts to consider the appropriateness of the interview questions.

Data Analysis

This study used quantitative analysis. The sample group participated in the brainstorming of ideas. It consisted of eight people from a team of researchers, designers, community philosophers, and gerontology, music, and materials science experts. Moreover, in-depth interviews were also conducted from the group of five older people in the community who talked and exchanged opinions. Comprehensive experience in the subject matter to be studied by analyzing data using concepts and theories about quality of life, physical relationship to musical

instruments, and psychological well-being, including documents related explicitly to older people. The researcher transcribed the interview to answer the research questions, and the results obtained from the data analysis are presented, along with a summary and descriptive discussion.

FINDINGS

From brainstorming ideas for designing and drafting musical instruments from recycled materials with a group of older people, music experts, geriatric specialists, product design experts, and technicians believe that creating musical instruments from recycled materials for older people is beneficial. The design aspect should consider the user as the main focus, emphasizing usability, touch, and lightweight. The material used is a large size suitable for the eyesight of older people, is also beautiful, and does not have sharp corners. In the physical aspect, the team pays attention to the anatomy of older people. It should be a floor-standing instrument, preventing the elder from lifting or carrying it too long. If it is a chair, it must be the right height, have a backrest and armrest, and be lightweight to promote the user's health. The materials selected to make the musical instrument correspond to the type of instrument. It should be a material that is available, safe, or at risk of injury when playing it. The characteristics must be similar to the materials used to build usual musical instruments, that is, shells, straws, bamboo, cans, pipes, pot lids, etc. The colors of the musical instruments should be bright and colorful to attract attention, as well as lightweight, strong, and portable. The sound should be comparable to the original musical instruments, using a sound equalizer or application to set the sound so that the sound level meets international standards. There should be a variety of musical instrument creations involving instruments that are the main melody, harmonies, and instruments used to accompany the rhythm so that they can be played as a group. There is an expectation that the user will get a musical instrument that is beautiful, usable, erases the image of recycled materials, is easy to play, and has a clear sound. It helps people to interact with others, and they can take turns playing. Some suggestions consider usage and safety as the primary focus, easy to use, and not too many tones.

CREATING MUSICAL INSTRUMENTS FROM RECYCLED MATERIALS AND TESTING THEM WITH AN ELDERLY GROUP

The results of creating and developing musical instruments from recycled materials with the elderly group found three musical instruments obtained from recycled materials: Tang Thong, Nuan Thong, and Nuan La Or. The instrument's characteristics are based on the results of brainstorming ideas from the group of elderly, music experts, geriatric specialists, product design experts, technicians, and musical instrument producers. The size of three musical instruments is suitable for the eyesight of older people, easy to use, and portable, and the materials used are from commonly found recycled materials. Tang Thong has developed from one-sided and two-sided drums (Klong Khaek and Rebana); one Tang Thong can be used to replace the sound of two two-sided drums. The other two musical instruments, Nuan Thong and Nuan La Or, were developed from steel alto xylophone using the C major scale, consisting of seven tones of the major scale used in Western style, which is strongly established among all people in the given area, although not reflecting traditional uses anymore. Through the choice of colours, the researcher was giving some personal inspiration and ideas to present the identity of Phitsanulok province in the Northern part of Thailand, especially red, blue, purple, and gold, which will reflect an emblematic traditionality through the design and development of musical instruments.

The three musical instruments that the researcher has designed and developed comprise materials and equipment, construction processes, and principles of using musical instruments are presented as follows:

Musical instrument (with illustrations)	Materials and equipment used	The process of creating musical instruments	Principles of use
TANG THONG 	1. Square tin container 2. Five sheets of plywood (8 mm) 3. Nut 4. Two inner tubes (60 cm x 1.5 cm) 5. Stickers (for coating) 6. Electric drill and drill bits 7. Angle grinder 8. Hammer 9. Screwdriver 10. Sandpaper no. 100, 80, 0 11. Jigsaw 12. Fret saw 13. Ruler/meter stick	1. Cut the plywood into squares the size of a square tin container 2. Cut four round pieces of plywood (Ø 9 cm), and drill holes inside the circles 2 cm from the edge 3. Coat the square tin container with a sticker 4. Spray paint 5. Take two inner tubes and wrap them around the top of the tin container (the area where the round plywood is) so that the inner tube is directly across the center of the circle of the lid; stretch the inner tube and tie it tightly	1. Strumming the rubber stripe to get the ting sound of the male drum. 2. Tap/hit the side of Tang Thong to get the tham/thang sound of the female drum 3. Tap on other parts of the Tang Thong; it will represent the sound of joh/jah 4. Tang Thong can be placed on the lap or the floor, which gives a louder sound
NUAN THONG 	1. Tile 2. Nuts and bolts (2 inches: 16 pieces, 1 inch: 12 pieces) 3. Rubber hose (36 cm) 4. 2 large bamboo tubes (40 cm) soak in the water for several months to prevent insects 5. Plywood 6. Electric drill and drill bits 7. Angle grinder 8. Hammer 9. Screwdriver 10. Sandpaper no. 100, 80, 0 11. Jigsaw 12. Fret saw 13. Ruler/meter stick **For making a bat** 1. Bamboo 2. Calico 3. Rope	1. Cut tiles using an angle grinder and grind them into eight different tone bars with the same width but the extra length 2. Drill holes in the tone bars, both top and bottom, and pair the new sound 3. Make a base using a bamboo stick cut in half and turned upside down. Then, attach the rubber hose cover to the base. 4. Try placing tone bars on the rubber hose. Then, secure it with nuts and bolts. 5. Make a bat using bamboo sharpened into a handle and wrapped with a calico alternating with 5-6 layers of rope. The last round uses colorful fabric.	1. Take a bat and hit it on the tile bars 2. Nuan La Or can be placed on the floor or lap

Musical instrument (with illustrations)	Materials and equipment used	The process of creating musical instruments	Principles of use
NUAN LA OR 	1. Plywood 2. Tile 3. Paint bucket used as a base and sound amplifier (Ø 25 cm) 4. Rubber hose (43 cm) 5. Color paints 6. Latex glue 7. Electric drill and drill bits 8. Angle grinder 9. Hammer 10. Screwdriver 11. Sandpaper no. 100, 80, 0 12. Jigsaw 13. Fret saw 14. Ruler/meter stick **For making a bat** 1. Bamboo 2. Calico 3. Rope	1. Cut tiles using an angle grinder and grind them into eight different tone bars with the same width but extra length 2. Apply glue to the lid of the paint bucket, then drill a hole in the center. 3. Cut the bottom of the bucket and cover with plywood so the tank has a height of 24 cm. 4. Cut the plywood into a trapezoidal box (30 cm wide, left side is 28 cm wide, length: 36 cm, height: 4 cm) and attach it to the lid of the bucket 5. Attach the rubber hose to the plywood around the plywood at the lid of the bucket 6. Place the tone bars in a plywood box at the lid of the bucket and arrange sizes from large to small 7. Make a bat using bamboo sharpened into a handle and wrapped with a calico alternating with five to six layers of rope. The last round uses colorful fabric.	1. Take a bat and hit it on the tile bars 2. Nuan Thong can be placed on a flat surface or table to prevent tone bars from falling from the base

Figure 1: Table of material studies, construction process, and principles of use as musical instruments from recycled materials compiled by the author of this study, 2023.

TANG THONG

It might be not surprising that most of the newly created musical instruments are to be played in a percussive way, as co-ordination is still functioning well in elderly people for a very long time and also needs some experience with overview-thinking that is generally given in those interested in music at this age.

A percussion instrument that has a rectangular shape with no corners is seen as ideal. The top base is consisting of rounded pieces of plywood. The musical instrument is made from a rectangular tin container. The top is covered with overlapping plywood pieces cut to the same size as the top container and drilled into overlapping circles to form a border. A motorcycle's inner tube is stretched tight around the top for flipping to get a sound that can replace male and female drums. Tapping or hitting the side of the Tang Thong will represent the sound of the tham/thang of the female drum, or strumming the rubber stripe to get the ting sound of the male drum. If

tapped on other parts of the Tang Thong, it will represent the sound of joh/jah. Tang Thong can be placed on the lap or the floor, which gives a louder sound. The colors of the instruments are red, blue, purple, and gold.

Figure 2 (left): Materials and equipment used in the process of creating a percussion instrument, called *TANG THONG* from recycled materials for the elderly. Figure 3 (right): The *TANG THONG* percussion instrument is made for the elderly from recycled materials. Photographs by the author, 2023.

NUAN THONG

Another striking musical instrument is this one (Figures 4 and 5). This musical instrument is made from tone bars attached to a base of tubes. The bar tiles are arranged in a row with eight sounds from low to high using the major scale as in Western music and the higher octave of the first bar. In case that a traditional tune is produced, the metallophon is possibly only using the basic tone and the fifth. It is attached to a bamboo base using nuts and bolts, supported with a rubber hose. The stick is made from five to six layers of fabric and yarn intertwined. Nuan Thong can be placed on the floor or a lap, using the stick to hit the tile bars. The colors of the instruments are red, blue, purple, and gold.

Figure 4 (left): The process of creating a percussion instrument, called *NUAN THONG*, for the elderly from recycled materials. Figure 5 (right): The base can be made of bamboo tubes or of plastic tubes, mainly it is for the elderly from recycled materials. Photographs by the author, 2023.

Figure 6: The 'Nuan Thong' percussion instrument is made from recycled materials for the elderly. Photograph by the author, 2023.

NUAN LA OR

The characteristics of these musical instruments are that they are made from tile or Nuan La Or, in which each bar of tiles is arranged in a row with eight sounds, from low to high. The tiles can be disassembled, stored, moved, and changed. The tiles are placed on plywood rails supported by a rubber hose. The base is made from a paint bucket. The bat is made from five to six layers of fabric and yarn intertwined. Nuan La Or can be placed on a flat surface and use the bat to hit the tile bars. A thin strip of rubber hose can be wrapped around the tile to prevent friction on the adjacent platter. The colors of the instruments are red, blue, purple, and gold.

Figure 7: The process of creating the percussion instrument Nuan La Or, from recycled materials for the elderly. Photograph by the author, 2023.

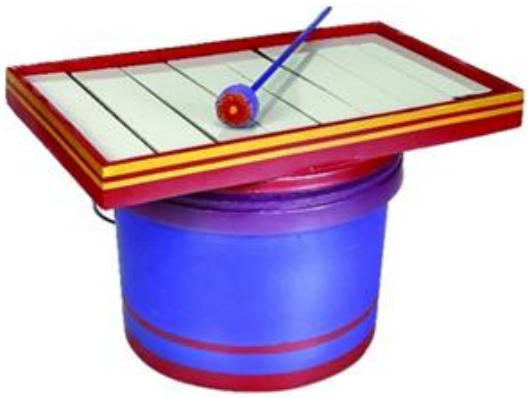

Figure 8: The 'Nuan La Or' percussion instrument is made from recycled materials for the elderly. Photograph by the author, 2023.

According to the experiment, the researcher used three musical instruments from recycled materials with a group of elderly to try out in practice, including a 'Tang Thong' made from a tin container, a 'Nuan Thong' made from tiles that cannot be disassembled, and 'Nuan La Or' made from tiles that be disassembled when it is not in use. These three musical instruments were used for group experiments and played with traditional Thai instruments in the classic Thai song 'Toey Khong'. This song uses a group of five main sounds (Pentatonic Scale), which is a song with a simple, uncomplicated melody (Kanchanapradit, 2013).

After trying out the instrument, the researcher received additional comments from the elderly group as follows: First, the musical instrument was to be played from a tin container or Tang Thong, which is colorful, beautiful, lightweight, suitable for the body of older people, and the sound is not too loud. Second, a musical instrument made from tiles (the tone bars attached to the base), or Nuan Thong, received additional comments from the elderly group that it was beautiful and strong, and its sound was beautiful. The loudness level of the musical instrument is appropriate for older people, who can hear clearly and not too loud. However, a symbol should indicate the tone on each tile bar. Third, for musical instruments made from tile (the tone bars can be disassembled) or Nuan La Or, the elders believe it is an excellent way to put paint buckets to good use, and beautiful as well as the sound.

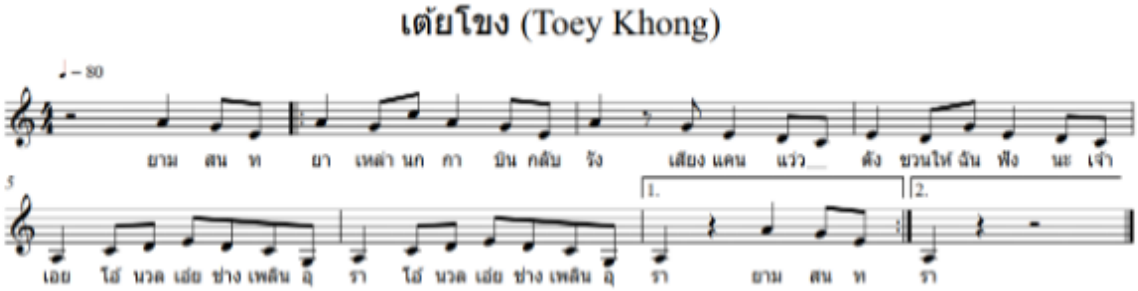

Figure 9: Toey Khong sheet music. Transcription by the author, 2023.

Nonetheless, there are suggestions, as well as the Nuan Thong, that there should be a symbol indicating the tone on the tile and that the size of the paint bucket should be adjusted to fit the body of older people. The tone bars should be fixed in place or a groove on the rubber hose to fit into the groove and not move when playing. Overall, all three musical instruments have simple techniques of use and beautiful appearance, presenting that recycled materials can be developed into musical instruments. It is also melodious and can be played in a group with other types of musical instruments and helps to strengthen the interaction of the group of players.

DISCUSSION

From brainstorming concepts for designing and outlining musical instruments from recycled materials with the elderly group, it was found that the elderly group music experts, geriatric specialists, product design experts, and technicians have opinions on designing musical instruments from recycled materials for the elderly. The ease of use should be considered a primary focus; it is lightweight and has no sharp corners that cause danger or risk of injury. The musical instrument should be beautiful, and the size should be large enough to suit the eyesight of older people. Moreover, the physical aspect that the creator should pay attention to is the physiology of the elderly. It should include many types of musical instruments to play as a group. Applications are used to set the sound to meet international standards by selecting recycled materials for making musical instruments, such as tin containers, paint buckets, bamboo, shells, etc. There is also the expectation that recycled materials can be transformed into interesting musical instruments. Further, there is an expectation that recycled materials can be transformed into interesting musical instruments, give a clear voice, and help with the state of mind. The other suggestion is that there are not too many tones and a way of playing that is not complicated, consistent with the innovative design thinking concept of Lewrick et al. (2018) that emphasizes analyzing problems by listening and trying to understand expectations and those involved for designing musical instruments elderly. It led to product design that directly meets the needs of users. Reprocessing recycled materials to make them useful helps the environment, economy, and society (Phontharaphong & Siripithakul, 2022; Sangrajrang et al, 2013).

The results of creating and developing musical instruments from recycled materials with the elderly group found three musical instruments obtained from recycled materials: Tang Thong, Nuan Thong, and Nuan La Or. The instruments' characteristics are based on the results of brainstorming ideas from the group of elderly, music experts, geriatric specialists, product design experts, technicians, and musical instrument producers. The size of three musical instruments is suitable for the eyesight of older people, easy to use, and portable, and the materials used are from commonly found recycled materials. Tang Thong has developed from one-sided and two-sided drums (Klong Khaek and Rebana); one Tang Thong can be used to replace the sound of 2 two-side drums by tapping or hitting the glass side, which will represent the tham/thang sound of the female two-sided drum. The player can also strum the rubber stripe at the top of Tang Thong to represent the ting sound of the male two-sided drum. If tapped on other parts of the Tang Thong, it will represent the sound of joh/jah. Moreover, the other two musical instruments, Nuan Thong and Nuan La Or, were developed from steel alto xylophone using the C major scale, consisting of seven tones mostly used and strongly established among the people of this region, although not anymore traditional. These three musical instruments made from recycled materials that the researcher has designed and developed are consistent with the work of Wongphanit (2003), using recycled materials to create value-added products by selecting types of recycled materials, planning and designing each step outside the box to create the uniqueness that practical and represent the community.

From the experiment of using musical instruments from recycled materials with the elderly group, it was found that the researcher brought three musical instruments from recycled materials, namely, Tang Thong, Nuan Thong, and Nuan La Or, for older people to play and experience together as a group. They played the original Thai song 'Toey Khong' with a simple melody. The researcher received additional comments from the elderly group about the first musical instrument, 'Tang Thong', which is colorful, beautiful, lightweight, suitable for the body of older people, and the sound is not too loud. Second, a musical instrument made from tiles (the tone bars attached to the base), or 'Nuan Thong', received additional comments from the elderly group that it was beautiful and strong, and the instrument's sound was beautiful. The loudness level of the musical instrument is appropriate for older people because they can hear clearly and not too loud. However, a symbol should indicate the tone on each tile bar. Third, in musical

instruments made from tile (the tone bars can be dissembled) or 'Nuan La Or', elderly people believe that it is an excellent way to put paint buckets to good use, and beautiful as well as the sound. Nonetheless, there are suggestions, as well as the Nuan Thong, that there should be a symbol indicating the tone on the tile bar and that the size of the paint bucket should be adjusted to fit the body of older people. The tone bars should be fixed in place or a groove on the rubber hose to fit into the groove and not move when playing. Overall, all three musical instruments have simple techniques of use and beautiful appearance, presenting that recycled materials can be developed into musical instruments. It is also melodious and can be played in a group with other types of musical instruments and helps to strengthen the interaction of the group of players. This is in line with Manipharak (2020); The method for adding value to recycling is the 3Rs, which consists of Reuse, Reduce, and Recycle, using recycled materials to make the most benefit using the art of design. Sorach (2019) also supports that this practice is a part of reducing the number of recycled materials from the household.

Conclusion and Suggestions

The study of musical instruments from recycled materials and the experiment was conducted with a group of five selected elderly. It was found that the musical instruments had different shapes, forms, and colors that made the elderly want to try and play these instruments. The musical instruments are easy to play and not complicated; not only will the people with experience playing a musical instrument be able to play it very well, but also, if you have a primary interest in playing them, you can practice and learn quickly from there. The musical instrument that was introduced to the experimenters considered that the sound must be suitable for the elderly, not too soft and not too loud when playing each time. Nonetheless, the sound must be similar to the sound of the original instrument. The creation of innovative musical instruments from recycled materials that are novel and created through considering opinions of senior citizens and groups of experts in various fields.

From the research results, the researcher has suggested the following:

If people are interested in using musical instruments from recycled materials for study or further development, it will be crucial to make them more convenient. A symbol should indicate the used tone on the 'Nuan Thong' tiles and on the 'Nuan La Or'.

The creator should select materials that are suitable in terms of the size of the instrument and do not require excessive trimming or modification because some materials are at risk of breaking, that is, plastic buckets, tiles, and other less often used items.

The person should make a groove on the Nuan La Or's rubber hose so that when the tone bars are placed, they will fit into the track, or a rubber stripe may be used to separate the tone bars. If the producer does not make a groove or secure the tone bars, they will move while playing and risk being broken soon.

Making musical instruments from recyclable materials for the elderly is a worthy effort to entertain those people in a useful way and to give them a place in society. This is the result and it is a result of great value.

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