Construction of a Chromatic Khaen Sound System: A Case Study of Mr. Chaiya Cha-Sa-Nguan, Tha Ruea Village, Na Wa District, Nakhon Phanom Province, Thailand

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Abstract
This article presents the results of the study about “construction of a Chromatic Khaen sound system: a case study of Mr. Chaiya Cha-Sa-Nguan, Tha Ruea Village, Tha Ruea Subdistrict, Na Wa District, Nakhon Phanom Province, Thailand. It also presents the producing process of a chromatic Khaen sound system using musicological methods. The researcher collected data from fieldwork at the research areas and then design a chromatic Khaen sound system and create a chromatic Khaen sound system. A physical structure appearance is similar to the original Khaen, but larger and heavier. It consists of twenty-two Luk Khaen (Khaen’s bamboo) arranged into the depressed area for blowing into two pairs, left and right, and each pair have eleven Luk Khaen. There are different sound systems and finger placement, but remains the identity of the traditional Khaen sound.

Mr. Chaiya Cha-Sa-Nguan or Chang Chaiya was born on January 24, 1973, is a Khaen maker at Tha Ruea Village, Tha Ruea Subdistrict, Na Wa District, Nakhon Phanom Province, Thailand, which is the area where the production and distribution of Isan folk music instruments are the largest in the country. Mr. Chaiya has expertise and experience in making Khaen for at least fifteen years. Moreover, he has an understanding of Western music systems. Mr. Chaiya is now well-known and accepted by both local and international Khaen players. There is a total of Khaen orders many throughout the year. He produces a Khaen that is loud, easy to blow, does not consume much air and he has developed its products all the time.

Keywords: Chromatic Khaen, Chromatic Bamboo Mouth Organ, Isan Music Instrument
Introduction

Khaen is a traditional Isan folk instrument in the type of wind blower that has been developed and passed down from generation to generation in all areas of the northeast of Thailand for a long time. Khaen is a type of wind blower made of small bamboo, called Luk Khaen (Bamboo mouth organ), with a long, cascading, arranged into the depressed area for blowing (Tao Khaen) that made of solid wood. A vibrator is made of silver or brass inserted into the socket to make a sound by closing and opening a finger at a small hole drilled next to the Khaen that is called some holes, each with one hole. The Khaen’s bamboos are attached to the Tao Khaen with the beeswax. There are many sizes of Khaen ranging from three to nine pairs, the most popular being Khaen Eight with seven sounds, but playing only five sounds. There are both solos played with Mo Lam, Isan harp, or Ponglang. It is popularly played in the Northeastern part of the country as general entertainment. The songs that are played are called in various patterns, such as Lai Soi, Lai Po Sai, Sudsanan, Lai Yai, Lai Noi, etc. (Piyaphan Saenthaweesuk, 2006: 20)

The researcher has the concept that to develop Khaen to be able to play twelve semitone notes, which will allow Khaen to play melodies and harmonize in more diverse forms, such as blues, jazz or contemporary music, etc., but Khaen remains the identity of the tone, accent, as well as the techniques of the traditional Khaen playing methods.

Research Objective

To produce a chromatic Khaen sound system.

Literature Review

Charoenchai Chonpairot (1997: 1-5) stated that there are two features of Khaen in the Mekong region. The first feature is the Tao Khaen (depressed area for blowing) in the middle of the Khaen protruding from the top and bottom of the Tao Khaen. They are mostly found in flat areas such as Khaen of Laos, Thailand, Vietnam, and the Hmong Tribe. The second feature is that the Toa Khaen is located at the bottom of the Luk Khaen and the vibrator is inside the Tao Khaen that the large ones are made from gourds or hardwoods. The Luk Khaen emerges from the Khaen only on one side. This feature of Khaen is found in China, such as the Chinese Khaen (Sheng).

Udom Buasri (1987: 73-85) stated that Khaen is a type of music that uses the mouth to suck and blow air in and out. Tao Khaen is in control of Luk Khaen which can be attached with the beeswax as a connector and prevent the wind blowing to leak out. The Khaen has the silver vibrator called "Khaen-Lin-Nguyen" and the golden vibrator called "Khaen-Lin-Thong".

Khaen sound system originally was just setting the ratio of cutting, punching the holes according to the original Khaen sound system. Later, when Khaen had to adapt to play kinds of music mixed with other kinds of instruments, there were improvements of the Khaen sound system, Khaen Six, Khaen Seven, Khaen Eight, Khaen Nine. Khaen's structure was convenient for playing songs that emphasized the double harmonization of sound and sound group. Khaen's music playing style is mostly in the form of music that is in the pentatonic sound level. Then it is developed in the diatonic sound level during the reign of King Rama V, the British geologists cooperated with the Vientiane Khaen maker produced during the year 1894 - 1896 (Sanong Klang-Phra-Sri, 2011)

From the study of the Body of Knowledge of Khaen, the researcher can conclude that the Khaen is a musical instrument with history, legend, since ancient times. It has a sound system from a few notes and increases in number accordingly. The Khaen playing is called the
melody of the song "patterns" such as short patterns, such as Lai Po Sai, Lai Sudsanan Lai Soi, and long patterns such as Lai Noi, Lai Yai, and Lai Se, etc.

Research Methodology
This research was qualitative research using two methods of collecting data, namely, Documentary Research that consists of printed documents including research reports, thesis, articles, books, and research studies on the history and development of Khaen and its fieldwork research that is data obtained from preliminary surveys, interviews, observations and participant observation in related activities.

Research scope
Key informant was Mr. Chaiya Cha-Sa-Nguan, born on 24 January 1973. He has expertise and experience in making Khaen for at least fifteen years. Moreover, he has an understanding of Western music systems. Mr. Chaiya is now well-known and accepted by both local and international Khaen players.

Research period
January 2015 to March 2019

Research Area
The researcher selected the area where the largest source of production and distribution of Isan folk instruments in the country is the Tha Ruea village, Tha Ruea Subdistrict, Na Wa District, Nakhon Phanom Province, Thailand. It is in the west direction of Nakhon Phanom Province, and geographic coordinates at 17°29′22″N 104°6′5″E. The village was established in the year 1904 by the first group of people immigrating from Amnat Charoen District, Ubon Ratchathani Province. The social environment of the Tha Ruea village has a simple lifestyle. The community is kind to one another in the form of relatives and there is an exchange of knowledge in the production of folk instruments. As for the production of Isan folk instruments, the Tha Ruea villagers produce Khaen (Bamboo mouth organ), votives, harps, and Ponglang according to market demand as a source of production and distribution of the largest Isan folk music in the country.

Research Results

Figure 1: Map of Na Wa District, Nakhon Phanom Province, Thailand
Source: https://en.wikipedia.org/wiki/Na_Wa_District

www.turkjphysiotherrehabil.org 28034
The researcher studied the fieldworks data about the processes and methods of making traditional Isan folk Khaen from a craftsman, Kan, Mr. Chaiya Cha-Sa-Nguan, Tha Ruea village, Tha Ruea Subdistrict, Na Wa District, Nakhon Phanom Province, after that to design the chromatic sound system through interviews and participant observations to produce the chromatic Khaen. It can be divided into two parts, namely the design of the chromatic sound system and the method of making the Khaen chromatic sound system.

1. **Design of chromatic sound system:** Design of counter-punching position and pipe placement position of the chromatic Khaen sound system has a total of twelve semitones with the positioning of the Luk Khaen in different positions to be convenient for finger placement at the Luk Khaen. The added semitone has the hole position for each sound that is 0.5 cm higher than the normal note, for tactile observation from the tip of the finger that is used to cover the Khaen counting hole as shown in the second figure.

![Figure 2: The position of counter drilling holes and the position of the chromatic Khaen tubes, both left (L) and right (R)](image)

**Table 1** Determines the length of the Khaen. (Measured from the bottom of the lower Khaen to the top of the Khaen)

<table>
<thead>
<tr>
<th>The Khaen</th>
<th>Left</th>
<th>The length of the Khaen</th>
<th>Sound</th>
</tr>
</thead>
<tbody>
<tr>
<td>L 1</td>
<td>90 cm</td>
<td>C4</td>
<td></td>
</tr>
<tr>
<td>L 2</td>
<td>90 cm</td>
<td>C#4</td>
<td></td>
</tr>
<tr>
<td>L 3</td>
<td>90 cm</td>
<td>B3</td>
<td></td>
</tr>
<tr>
<td>L 4</td>
<td>90 cm</td>
<td>Bb3</td>
<td></td>
</tr>
<tr>
<td>L 5</td>
<td>72 cm</td>
<td>D4</td>
<td></td>
</tr>
<tr>
<td>L 6</td>
<td>72 cm</td>
<td>E4</td>
<td></td>
</tr>
<tr>
<td>L 7</td>
<td>72 cm</td>
<td>F4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The Khaen</th>
<th>Right</th>
<th>The length of the Khaen</th>
<th>Sound</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 1</td>
<td>90 cm</td>
<td>A3</td>
<td></td>
</tr>
<tr>
<td>R 2</td>
<td>90 cm</td>
<td>C4</td>
<td></td>
</tr>
<tr>
<td>R 3</td>
<td>90 cm</td>
<td>G4</td>
<td></td>
</tr>
<tr>
<td>R 4</td>
<td>90 cm</td>
<td>G#4</td>
<td></td>
</tr>
<tr>
<td>R 5</td>
<td>72 cm</td>
<td>A4</td>
<td></td>
</tr>
<tr>
<td>R 6</td>
<td>72 cm</td>
<td>Bb4</td>
<td></td>
</tr>
<tr>
<td>R 7</td>
<td>72 cm</td>
<td>B4</td>
<td></td>
</tr>
</tbody>
</table>
Drilling the Khaen’s holes is very important in setting Khean’s volume. In the construction of the chromatic Khaen sound system, to drill the holes on the top of the Khaen by drilling the inside of the Khaen. The location of drilling holes in the upper notching of the Tao Khaen is shown in the second table.

**Table 2:** Upper notching size (measured from the top edge point of the upper notching to the lower edge point of the upper notching)

<table>
<thead>
<tr>
<th>The Left Khaen</th>
<th>Notching size</th>
<th>Sound</th>
<th>The Right Khaen</th>
<th>Notching size</th>
<th>Sound</th>
</tr>
</thead>
<tbody>
<tr>
<td>L 8</td>
<td>2 cm</td>
<td>C4</td>
<td>R 8</td>
<td>2 cm</td>
<td>A3</td>
</tr>
<tr>
<td>L 9</td>
<td>2 cm</td>
<td>C#4</td>
<td>R 9</td>
<td>2 cm</td>
<td>C4</td>
</tr>
<tr>
<td>L 10</td>
<td>2 cm</td>
<td>B3</td>
<td>R 10</td>
<td>2 cm</td>
<td>G4</td>
</tr>
<tr>
<td>L 11</td>
<td>2 cm</td>
<td>F#4</td>
<td>R 11</td>
<td>2 cm</td>
<td>Eb5</td>
</tr>
<tr>
<td>L 12</td>
<td>1.5 cm</td>
<td>Bb3</td>
<td>L 1</td>
<td>1.5 cm</td>
<td>Eb5</td>
</tr>
<tr>
<td>L 13</td>
<td>1.5 cm</td>
<td>D4</td>
<td>L 2</td>
<td>1.5 cm</td>
<td>B4</td>
</tr>
<tr>
<td>L 14</td>
<td>1.5 cm</td>
<td>E4</td>
<td>L 3</td>
<td>1.5 cm</td>
<td>Bb4</td>
</tr>
<tr>
<td>L 15</td>
<td>1.5 cm</td>
<td>F4</td>
<td>L 4</td>
<td>1.5 cm</td>
<td>B4</td>
</tr>
<tr>
<td>L 16</td>
<td>1.5 cm</td>
<td>F#4</td>
<td>L 5</td>
<td>1.5 cm</td>
<td>A4</td>
</tr>
<tr>
<td>L 17</td>
<td>1.5 cm</td>
<td>G4</td>
<td>L 6</td>
<td>1.5 cm</td>
<td>A4</td>
</tr>
<tr>
<td>L 18</td>
<td>1.5 cm</td>
<td>G#4</td>
<td>L 7</td>
<td>1.5 cm</td>
<td>A4</td>
</tr>
<tr>
<td>L 19</td>
<td>1.5 cm</td>
<td>D5</td>
<td>L 8</td>
<td>1.5 cm</td>
<td>A5</td>
</tr>
</tbody>
</table>

**Source:** Chumchon Suebwong

Drilling holes in the bottom of the Tao Khaen (depressed area for blowing) by drilling the inside of the Khaen is shown in the third table.

**Table 3** Bottom notching size (measured from the top edge point of the bottom notching hole to the bottom edge point of the bottom line)

<table>
<thead>
<tr>
<th>The Left Khaen</th>
<th>Notching size</th>
<th>Sound</th>
<th>The Right Khaen</th>
<th>Notching size</th>
<th>Sound</th>
</tr>
</thead>
<tbody>
<tr>
<td>L 1</td>
<td>1.8 cm</td>
<td>C4</td>
<td>R 1</td>
<td>2 cm</td>
<td>A3</td>
</tr>
<tr>
<td>L 2</td>
<td>1.8 cm</td>
<td>C#4</td>
<td>R 2</td>
<td>2 cm</td>
<td>C4</td>
</tr>
<tr>
<td>L 3</td>
<td>1.8 cm</td>
<td>B3</td>
<td>R 3</td>
<td>1.8 cm</td>
<td>G4</td>
</tr>
<tr>
<td>L 4</td>
<td>1.8 cm</td>
<td>Bb3</td>
<td>R 4</td>
<td>1.8 cm</td>
<td>G#4</td>
</tr>
<tr>
<td>L 5</td>
<td>1.8 cm</td>
<td>D4</td>
<td>R 5</td>
<td>1.8 cm</td>
<td>A4</td>
</tr>
<tr>
<td>L 6</td>
<td>1.8 cm</td>
<td>E4</td>
<td>R 6</td>
<td>2 cm</td>
<td>Bb4</td>
</tr>
<tr>
<td>L 7</td>
<td>1.5 cm</td>
<td>F4</td>
<td>R 7</td>
<td>2 cm</td>
<td>B4</td>
</tr>
<tr>
<td>L 8</td>
<td>1.7 cm</td>
<td>F#4</td>
<td>R 8</td>
<td>2 cm</td>
<td>D5</td>
</tr>
<tr>
<td>L 9</td>
<td>1.5 cm</td>
<td>G4</td>
<td>R 9</td>
<td>2 cm</td>
<td>Eb5</td>
</tr>
<tr>
<td>L 10</td>
<td>1.5 cm</td>
<td>F5</td>
<td>R 10</td>
<td>2 cm</td>
<td>E5</td>
</tr>
</tbody>
</table>
2. The process of construction of a chromatic Khaen sound system by Mr. Chaiya Cha-Sa-Nguan consists of four steps as follows:

2.1 Preparing the Khaen’s bamboos

2.1.1 The preparation of the Khaen’s bamboos and the selection of the Khaen’s bamboos should be the right size, the trunk is straight, not bent, about 1 year old, and then cut them to dry in the sun completely.

Figure 3: The position of the holes of the chromatic Khaen sound system, both left (L) and right (R)
Source: Chumchon Suebwong

2.1.2 Trimming Khaen’s bamboos: The selected bamboos are cut and trimmed to lengthen, cascading down to the size of the Khaen. When choosing the right size of Khaen’s bamboos, it is used to bend, trim and cut the wood by using a bamboo-splitting knife.

Figure 4: Sun-dried bamboos for selection for making Khaen
Source: Chumchon Suebwong
2.1.3 Straightening the Khaen’s bamboos using a monkey's hand, modified by making a fire and then bringing the Khaen’s bamboos into the fire. When the Khaen’s bamboos are soft, then use a hand to bend it straight.

Figure 5: Trimming Khaen’s bamboos  
Source: Chumchon Suebwong

2.1.4 Forging the Khaen’s bamboos: using the fully straightened bamboos to penetrate the joint of the bamboos by using the red hot iron pierce them. The size of the iron must be appropriate for the size and length of the Khaen’s bamboos.

Figure 6: Using a monkey's hand to straighten the Khaen’s bamboos  
Source: Chumchon Suebwong

2.1.5 Notching the Khaen’s vibrator: Drilling in the middle of the Khaen’s bamboo in a rectangular shape to fit the Khaen’s vibrator that will be pinned. The Khaen’s vibrator hole is located between the center hole of the two pairs. Just on different sides, the pairs hole
is on the inside, while the Khaen’s vibrator is on the outside, with the holes of the Khaen’s bamboos are inside the Tao Khaen. Therefore, the Khaen’s bamboo must be pierced at the same level.

2.2 Stages of making the Khaen’s vibrator

2.2.1 The forging of the Khaen’s vibrator is a thin metal sheet made of copper, brass, and silver, or an alloy of both types (silver mixed with copper) according to the ratio to make the Khaen’s vibrator of good quality which is techniques of each Khaen makers. When the Khaen’s vibrator is made into, the sheet metal is attached to the notch next to the pipe of Luk Khaen and then use lime to apply the groove to close the Khaen’s bamboo.

![Figure 8: The forging of the Khaen’s vibrator](source: Chumchon Suebwong)

2.2.2 Sanding of the Khaen’s vibrator: using bamboo’s skin polish the Khaen’s vibrator with a resolution and a suitable air vent.

![Figure 9: Sanding of the Khaen’s vibrator with bamboo skin (left) and bamboo skin for polishing the Khaen’s vibrator (right).](source: Chumchon Suebwong)

2.3 Inlaying the Khaen’s vibrator and making sounds

2.3.1 Inlaying the Khaen’s vibrator is bringing the Khaen’s vibrator to be embedded in the Khaen’s tube that is another detailed step. The bottom of the Khaen’s vibrator must be brought in first and then the tip of the tongue. This step can be used to scrape with the tip of a knife to set the sound of the Khaen to get the right volume as well.
2.3.2 Scraping of the Khaen’s vibrator: when the Khaen’s vibrator is already assembled with the Luk Khaen, the maker has to scrape the Khaen’s vibrator to adjust the sound to the desired level. Using the tip of a knife to scrape the Khaen’s vibrator smooth and close to the slot of the Khaen’s vibrator as much as possible, relying on the expertise of each Khaen technician.

![Figure 10: Inlaying the Khaen’s vibrator](source: Chumchon Suebwong)

2.3.3 Using lime or red mortar to paint the Khaen’s vibrator: after inserting the Khaen’s vibrator with the Khaen’s bamboo, the lime will be applied around the area to prevent wind leakage or prevent the wind from seeping. This can make the Khaen’s sound tight and bouncy, not wasting the wind while playing.

![Figure 11: Scraping of the Khaen’s vibrator](source: Chumchon Suebwong)

2.3.4 Setting up the Khaen’s sound with a digital tuner that is used to compare the sound with details about the reliable number. When the Khaen’s vibrator is installed with the
Luk Khaen. The Khaen maker must try to blow every Khaen. If any sound is out of tune, the tuner will need to be scraped to adjust the correct pitch.

![Image](image1.jpg)

**Figure 13:** Setting up the Khaen’s sound  
**Source:** Chumchon Suebwong

2.3.5 Notching the bamboo’s hole is an important step in making Khaen. There are two holes in Luk Khaen, one on the top of the Khaen’s bamboo and the other on the bottom of the Khaen’s bamboo. Notching the bamboo’s hole to blow and compare sounds to be lower than each other by drilling the holes shorter than each other.

![Image](image2.jpg)

**Figure 14:** Notching the bamboo’s hole  
**Source:** Chumchon Suebwong

2.4 Making Tao Khaen (depressed area for blowing)

2.4.1 Tao Khaen drilling and trimming: Tao Khaen is shaped like a breast, the part that encompasses all the Khaen’s bamboos which are popularly made from padauk root. Tao Khaen was peaked and sharpened to be smooth. At the end of the Tao Khaen, it is topped with granules like a nipple. In the middle of the Tao Khaen was pierced through a rectangular, wide front and descending cascades to suit the insertion of the Khaen’s bamboos that are of different sizes. The front section of the Tao Khaen is pierced for the mouthpiece to reach the middle part of the Tao Khaen to be the path of the wind to the Khaen’s vibrator.

![Image](image3.jpg)

**Figure 15:** Making Tao Khaen  
**Source:** Chumchon Suebwong
2.4.2 Inserting the Khaen’s bamboos into a Tao Khaen: there will be a crutch in the middle between the boards of the two Khaen to prevent the Khaen, to make the area more voice boxes, and there is wind collector. The insertion of the Khaen’s bamboos must be inserted in order of tone and position of the compared sound that packed down one pipe, one by one, adjust the short length of the Khaen’s bamboos to be straight that the Khaen’s vibrator is in the middle of the Tao Khaen.

![Image](image1.png)

**Figure 16:** Inserting the Khaen’s bamboos into a Tao Khaen  
*Source: Chumchon Suebwong*

2.4.3 Putting the beeswax into the hole and the gap between the Khaen’s bamboos and Tao Khaen to keep the wind from leaking out by using the sufficiently tough beeswax, not too hard not too soft. The maker uses the hands to close the holes. After that, the tip of a bamboo-splitting knife or a small stick may be used to press the beeswax firmly to the Khaen’s bamboos and Tao Khaen.

![Image](image2.png)

**Figure 17:** Putting the beeswax into the hole and the gap between the Khaen’s bamboos and Tao Khaen  
*Source: Chumchon Suebwong*

2.4.4 Drilling the counter holes (the holes above the Tao Khaen): It is a hole that is drilled into a small round hole for use with a finger to cover it to get the sound you want and turn it on when you don’t need it.

![Image](image3.png)

**Figure 18:** Drilling the counter holes  
*Source: Chumchon Suebwong*
2.4.5 The binding of the Khaen’s bamboos is the part that binds the Khaen’s bamboos together. The maker binds at the end of the Khaen’s bamboos and the bottom of the Khaen’s bamboos that popularly tie with Krua Ya Nang (Tiliacora Triandra), rattan, or rope.

Figure 19: The binding of the Khaen’s bamboos with Krua Ya Nang (Tiliacora Triandra)
Source: Chumchon Suebwong

Figure 20: The position of the international notes in the chromatic sound system
Source: Chumchon Suebwong

Figure 21: Khaen chromatic sound system
Source: Chumchon Suebwong

Conclusion and discussion
The Khaen has been developed for a long time and is considered a perfect musical instrument in itself. It can be played in the melody and harmonies in a variety of moods.
All craftsmen Khaen's crafting methods, materials, and equipment are similar and a little different. The important point is Khaen’s vibrator because it is the source of the sound.

The creation of the chromatic sound system is a further development of the original to increase the potential of Khaen to play more sounds. However, this should be considered in the application of the instrument, which is consistent with the concept of John Garzoli (2014:113) that Western and Isan sound systems are in harmony with each other. In harmony with western instruments, musicians must consider the cultural differences of the music and the choice to use it in the music.

The four major components of Khaen production are the Khaen’s bamboos, Khaen’s vibrator, Tao Khaen, and beeswax, which correspond to the academic work of Charoenchai Chonpairot (1998). At present, the materials that are components such as Khaen’s bamboos, beeswax, metal to make the Khaen’s vibrator are hard to find and the prices are quite expensive. These are the problems of the Khaen technicians, which is consistent with Chaisak Phumun (2000) who has studied the construction of Khaen for business: a case study of Ban Tha Ruea, Tha Ruea Sub-district, Na Wa District, Nakhon Phanom Province, found that the production of Khaen for business was an occupation that was passed down from the ancestors, and the construction for sale took place throughout the year.

At present, there are problems in the production of Khaen for business, namely material shortages, high prices of materials. Currently, most craftsmen mainly purchase materials from merchants from the Lao People’s Democratic Republic and the Khaen makers started to find alternative materials to use in making Khaen, such as using small aluminum pipes instead of the Khaen’s bamboos, etc.

Feedback
1. The chromatic Khaen sound system is a quite new issue. Some people accept and do not, so it needs to spend time in creation and dissemination.
2. It should promote and support the dissemination of the chromatic Khaen sound system to the people in the form of other characterization to be more international.
3. There should be a manual on how to blow a chromatic Khaen sound system.
4. There should be creative research on a chromatic Khaen sound system.

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