Bridging Thai music notation to Western music scores through innovative conversion and evaluation

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Abstract Research on bridging Thai music notation to Western music scores through innovative conversion and evaluation by developing a Thai music notation printing program through innovative research For converting Thai musical notation into an international musical score by researching documents and related research along with advice from music experts. After that, the program was tried and evaluated by three experts and 20 test users. The results of the research showed the creation of a program to Thai music notation to Western music note structure conversion called XxX Notation (Triple Note) by accessing the domain http://www.music.msu.ac.th/xxxnotation-v2, which is under the website of the College of Music, Mahasarakham University. Music can be saved online, reused, and edited. Able to export notes to paper through printers, PDF, Word, and Excel. Able to listen to the sound of printed notes. It is the sound of a large gong, which is an instrument in the main melody of Thai music. And can increase or decrease speed. To Thai music notation to Western music note structure conversion. Use Thai music notation input, convert the data to MusicXML, and display it as an international note. The results of the quality assessment of the Thai music notation printing program from 3 experts to evaluate the quality of the program in 4 aspects found that the program evaluation results were the highest quality with an average of 4.68, and the quality assessment results from 20 users were the highest quality with an average of 4.76.

Keywords: thai music program, thai music notation, folk music notation, musicXML, music note conversion

1. Introduction

In today's era, the technology of recording musical notation has developed and has become very important to influence musicians and music education (Julia et al 2018). It is characterized by an application format. Recording musical notation has many benefits. It is a recording to prevent forgetting songs or to transmit songs for future generations to inherit. Traditional Thai music is transmitted through a word-of-mouth instrument, which is word of mouth or singing in the rehearsal and teaching of the music teacher (Seeyo et al 2023). At present, Thai musical notation is recorded in a paper writing style and recorded in various programs, which requires the program's expertise in the work (Wisutthiphat 1992; Myers-Moro 1990; Boonkerd and Petkongthong 2016). And to Thai music notation to Western music note structure conversion, there is a strong understanding between international notation and Thai musical notation, which may prevent foreign Thai music players who do not understand the Thai alphabet from playing Thai musical notation. Therefore, Thai music cannot be as widespread as it should be. In addition, the conversion of such notes requires a music expert who can understand both characteristics of musical notation. The principle of conversion is complex and requires writing the result of the conversion of musical notation by hand, which results in slow results. It is not convenient for those who want to convert notes in bulk.

Musical notation is important in Western music because it serves composers, musicians, and music students (Pongsin Arunrat, 2000). Ancient civilizations in the eastern hemisphere, such as China and India, have a long history of recording musical notes, affecting art and culture across Asia (Pikulsri 1997). Thailand, on the other hand, has very recently embraced music notation, originally as a memory aid. Due to the dependence on direct instruction and memory in Thai music tradition, different academics developed their own symbols, resulting in group-specific norms (Khamfoi 2010).

With changing circumstances and time restrictions in the modern period, Thai music notation has grown in importance, becoming essential to teaching Thai music (Arunrat 2000). Furthermore, it plays an important function in music academia, acting as a medium for information transmission in research and academic publications and successfully sharing Thai music knowledge. The use of the international notation system provides a good opportunity for Thai music knowledge to be shared internationally, inviting international researchers to investigate and study this rich history.

During the initial stage of recording Thai music scores, there was a predominant reliance on international music notation styles, as there was a lack of recognized symbols for accurately representing musical notes. Subsequently, the Thai alphabet, also referred to as letter notation, was implemented as a method for documenting musical notes via Thai script. The notation system utilized in this study was developed through the integration of Lieutenant Colonel Phra Aphaiphonrob's methodology and the contributions made by Khun Phon Phaeng Charoenkarn (Sonyai 2018). Over time, it supplanted the use of international music notation and gained significant popularity. In contemporary times, it is observed that Thai music, alongside regional music from the northern, northeastern and southern regions of Thailand, frequently uses Thai letters for the purpose of music notation. The utilization of the notation method currently employed in Thai music is indicative of the resourcefulness demonstrated by Thai music educators.The global dissemination of Thai music plays a crucial role in facilitating a comprehensive examination of Thai music notation theory in conjunction with worldwide music notation practices. The dissimilarity between Thai and worldwide music may be attributed to several factors, including the distinctive Thai sound scale system, diverse performing skills, and unique music composition systems (Bhumitavara 2019).

Consequently, the researcher identified the issue, leading to the subsequent development of the software. The aim of this study was to tackle the challenge of transforming Thai music notation into a widely identifiable Western music note structure. In response to this problem, the researcher devised software with the objective of flawlessly accomplishing this conversion. The primary objective was to develop an online platform or web application that would streamline the conversion of Thai musical notation into a format that aligns with international notation standards. This platform not only provided a solution for the conversion of Thai music but also functioned as a means to access both Thai and worldwide music in a unified notation system.

2. Related Work

King Mongkut recorded Thai musical compositions used to accompany the trumpet ensemble that British military officers, including Captain Impay and Captain Knox, used during the ceremonial parading of soldiers during a later period of his reign. Subsequently, Luang Pradit Pairau, also known as Sorn Silpbaleng, devised a numerical system in the Thai language consisting of nine characters. Subsequently, the Royal Academy undertook the task of commissioning the Phra Jane Orchestra to produce a recording of Thai music utilizing the international notation system. Concurrently, the Fine Arts Department also embarked on the endeavor of recording Thai music using the international notation system, resulting in the publication of two distinct sets: the Cold Prelude and the Kwan Kit. During a subsequent era, the Fine Arts Department released a scholarly magazine that aimed to distribute Thai songs with an internationally recognized notation method (Khamfoi 2010; Arunrat 2000). Each issue of the journal focused on a single song, and afterwards, the department compiled and published volumes featuring songs received from the aforementioned journal. The musical compositions by Mr. Sudjai Sribenja known as Thai Song Scores 1, 2, and 3 are the subject of this discussion. The presentation involved the utilization of the international notation system to record Thai music, which exhibits a recording methodology that differs somewhat from that employed by the Fine Arts Department. In the Year of Kanchanakorn, Silpakorn undertook the task of reprinting the three volumes of Thai music notes. This was accomplished by recording international notes on a computer system. Subsequently, Kasetsart University published Thai music scores that were originally sourced from America. These scores were then disseminated along with the international notation system.

Sonyai (2018) examines the classification of rhythmic patterns in Thai music, specifically focusing on three distinct categories: common rhythm, ching beat, and beat of the slash. Every category fulfills a distinct function within the realm of musical performance. The examination of the symbolic attributes of music notation provides valuable insights into the organizational aspects of musical measures, whereby notes are strategically placed to convey rhythmic accents, descents, and elevations. The symbols "X" and "-" are utilized to express note values, indicating varying durations. The significance of these components in comprehending the rhythm and notation of Thai music is underscored by the summary (Figure 1.)
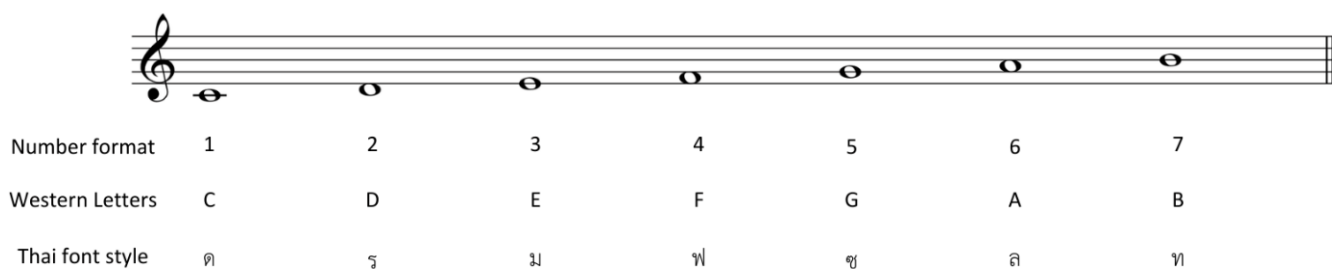

Number format	1	2	3	4	5	6	7
Western Letters	C	D	E	F	G	A	B
Thai font style	ด	ร	ม	ฟ	ซ	ล	ท

Figure 1 Symbols in Thai music notation.

The musical scores in Thai notation utilize seven letters to symbolize both low and high pitches. To indicate variations in pitch, dots below or specific characters like Pintu **(ฺด)** for lower notes and the top spot or Nikhit **(ดํ)** for higher notes are

employed. In cases of high-pitched notes, the top spot or Nikhit (ด่) is used. Note values are also indicated: for instance, (ด - - -) represents a note "ด" equivalent to 4 sub-strokes, (ด - -) represents a note "ด" equivalent to 3 sub-strokes, (ด -) represents a note "ด" equivalent to 2 sub-strokes, and (x) represents a note "ด" equal to 1 substroke.

This segment investigates the understandable symbols and universal recognition of Western music notation while focusing on the conversion of Thai music notation to essential aspects of Western notation. "The discussion focuses on crucial aspects of Western music notation translation, notably time (Kivijärvi 2019). Notes in Western music are represented as semi-oval circles on five lines, representing pitch and sound duration. Rest notes denote moments of quiet at a continuous pace. Ties, which are represented by curving lines connecting identical notes, extend note values according to time signatures. Note and rest values are affected by dot characteristics such as one and two dots. The lengths of notes and rests follow a proportional hierarchy, with each note value lasting twice as long as the next smaller one. Time signatures, which are fractional expressions of time, define the number of beats per bar and note values per beat (Phancharoen 2010). A typical time signature when translating Thai musical notation to Western notation is "2/4."

Kuo et al (2013) present a color music notation system that improves recognition and numbered musical notation for music beginners. It focuses on single melodies that are easy for beginners to read and play, increasing their confidence at the first step of music learning. The approach establishes a correlation between color music scores and the phenomenon of color and music synesthesia as experienced via human visual and auditory perception. It uses color codes for pitch, duration, range, and intensity and adopts the Itten color wheel and natural color system with 12 primary colors. This innovative system aims to help beginners read and play music quickly, accurately and confidently.

Symbols for recording numerous musical aspects, such as lyric titles, composer names, notes, rhythm ratios, pitch, dynamics, and other international notation symbols, are included in MusicXML files. When transmitting musical data across applications, this format assures that no symbols are lost. The MusicXML tool, developed by Good and Actor (2003), has gained widespread use in web-editing musical scores and sharing musical information between software platforms. While there may be some fees involved, the benefits of adopting MusicXML for online songwriter cooperation are substantial (Cunningham et al 2006).

Furthermore, Szwoch's (2008) research presents a mechanism for automated accuracy evaluation in optical music recognition (OMR) applications. This method contrasts real-world images with their MusicXML representations produced by an OMR system like OMR Guido. The method computes the difference between the tested and reference scores, taking into account characteristics such as note length and pitch accuracy. This strategy, which is included in OMR Guido, provides users with an automated method of assessing OMR correctness. Preliminary test results indicate that it is capable of detecting and correcting mistakes in OMR outputs.

The focus of a study by Michael Good (2001) was on MusicXML, an XML-based language that makes it easier to exchange information about music. The software was particularly designed to faithfully depict Western musical notation from the seventeenth century onward, including a wide range of musical genres, including classical and popular music. The system's adaptability enables the integration of early music and the assimilation of unconventional notation demands from the 20th and 21st centuries. It is crucial to acknowledge that the most effective way to portray non-Western musical notations is through the utilization of a distinct XML language.

The main goal of MusicXML is to improve compatibility across different musical programs, encompassing areas such as musical notation, performance, analysis, and retrieval tools. The primary focus of these programs is to ensure sufficiency rather than prioritizing optimization. Although MusicXML does not intend to supplant formats specifically developed for certain musical activities, its objective is to enhance the smooth flow of data across various software systems. The primary objective of this study is to guarantee compatibility with any computer-based Western notation music tool that utilizes a defined data format.

In their study, Suksaen and Srichettha (2016) developed a software application with the objective of transforming Thai musical notations into the standardized international music notation format through the utilization of MusicXML. Within the worldwide music community, there is a frequent requirement to convert Thai music notes into international notation. This occurs due to the fact that Thai musical notes are commonly expressed using Thai characters or numerical notations, but international music utilizes symbols placed on five lines. The process of converting musical notes requires specialized expertise and can be intricate, sometimes leading to manual conversions that are labor-intensive and inconvenient for those who have a need to convert a significant quantity of musical notes.

Therefore, the main objective of the study was to offer a theoretical framework and design an experimental protocol to ease the transformation of Thai musical notation into the internationally recognized music notation system. The application was dependent on the utilization of a specific XML document format referred to as MusicXML. In order to analyze the efficacy of the algorithm, a set of 10 Thai songs was chosen as test data. These songs were then evaluated by a panel of five Thai music professionals, who examined the correctness of the international music scores created from the original Thai music scores. The evaluation findings yielded overwhelmingly positive feedback, suggesting that the application demonstrates a high level of expertise in making precise translations.

3. Materials and Methods

The objective of this study is to design and implement a software application. The process of transforming Thai music notation into a western music note structure involves adapting the unique symbols and conventions used in Thai musical notation to align with the standardized system of musical notation commonly employed in Western music. This conversion allows for the accurate representation and interpretation of Thai musical compositions within the framework of Western music theory and practice. This study aims to apply Michael Good's theoretical framework to the development of a web application. The research approach will primarily utilize qualitative methods, complemented by quantitative approaches, using data analysis techniques centered on content analysis.

Step 1: Begin by studying the context of Thai musical notation from various sources, including documents and relevant research from both within and outside the country. Use content analysis to investigate the subject matter, which includes Thai music and Western musical scores. The program now used to make Thai music scores, MusicXML, and web apps will be utilized to collect data from various sources for analysis and program creation via an online format known as web applications.

Step 2: Develop and create a program to convert Thai musical notation into an international note structure. Implement a system for recording use data in a database and managing system information. Allow administrators (Admin) to enter notes using the Thai keyboard layout. This system should allow users to save, reuse, and alter music online. It should also be possible to export note data to formats such as PDF, Word, and Excel. A large band gong, a key instrument in the main theme of Thai music, should be able to produce a sound that matches the written note. Furthermore, the application should allow users to alter the playback speed to simplify the translation of Thai musical notation into an international note structure. This will include taking Thai music notation as input, translating it to MusicXML, and then further converting it to Western notes using JavaScript frameworks.

Step 3: Conduct a satisfaction survey for the Thai musical notation conversion program into an international note structure. Invite experts to examine the Conformity Assessment Form (IOC), matching it with the study objectives and assessment questions. Revise the form as needed for quality assurance, and then pick three experts using a specified method: one expert in Thai musical notation, one in computer music, and one in folk music notation. Collect data from 20 people who are interested in using the application and use their comments to rate their satisfaction with the music notation printing software. Finally, examine and report the summary results from the program satisfaction evaluation.

3. Results

3.1. Development of Thai music notation recording software XxX Notation (Triple X notation)

The XxX Notation program system has been designed as a web application, enabling users to simply access it online. Prior to commencing usage, it is unnecessary to install the software on one's own computer. This is due to the fact that the system usage data is stored in a database, system information is maintained by the administrator, and the input of Thai music notes into the program is facilitated by data conversion. The task at hand involves the conversion of notes into the MusicXML format, followed by the transmission of this data to Verovio, a web-based program designed for the purpose of displaying Western musical notation. As follows (Figure 2):
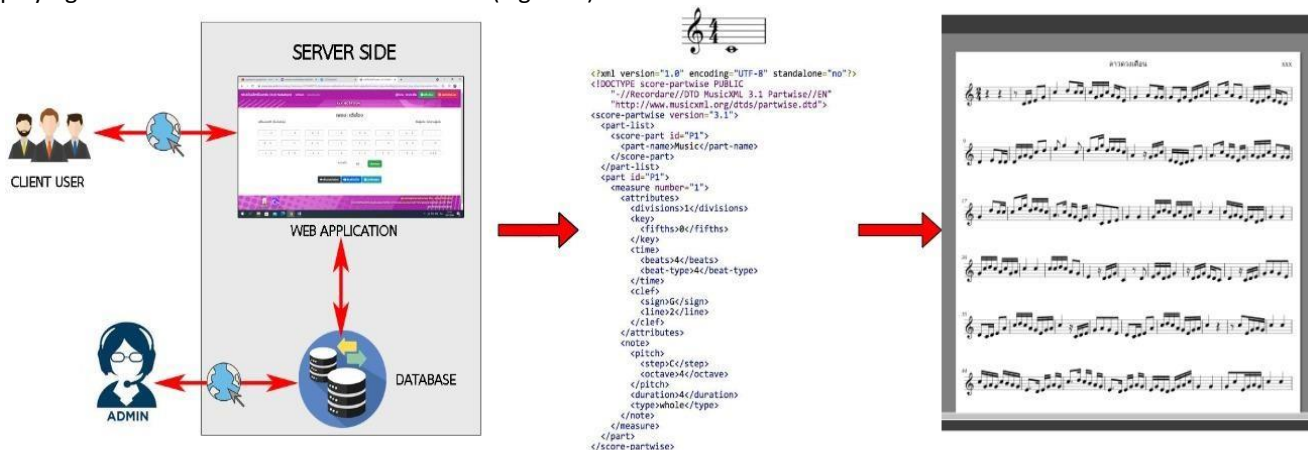

Figure 2 Program flow chart.

Accessing the Website https://music.msu.ac.th/xxxnotation-v2 It is under the domain of the College of Music, Mahasarakham University (Figure 3).
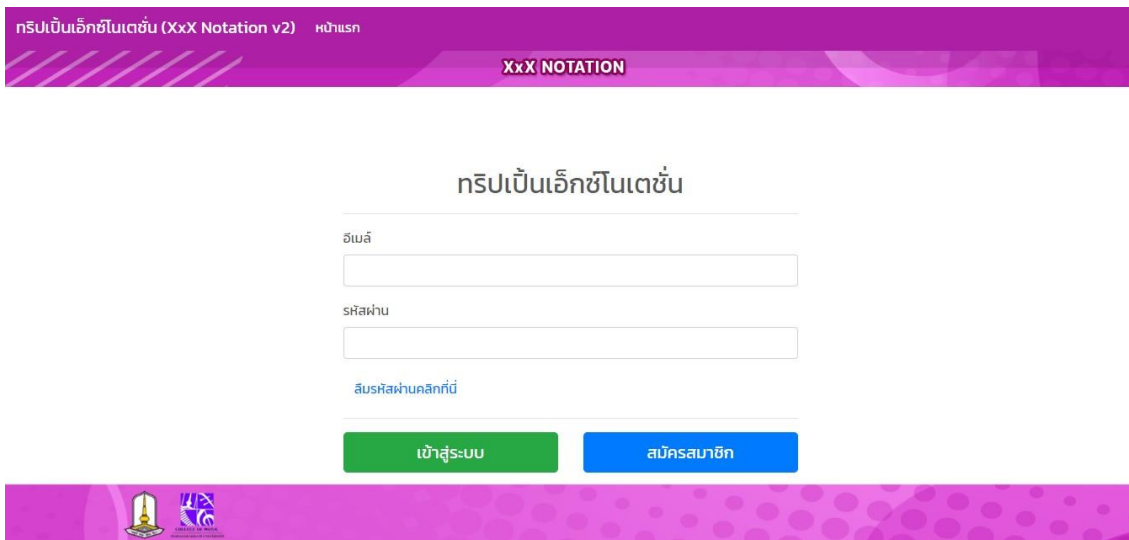
Figure 3 Homepage XxX Notation program.

The platform employs a membership framework that facilitates the acquisition of users' personal information and music notes. This is achieved through the process of user registration, which entails the completion of several information fields and subsequent login using the designated email username and password. In the event that a user experiences password forgetfulness, they have implemented a method of identity verification through the process of password reconfirmation. Taking note: A button is available to initiate the process of entering and generating a new note with the purpose of providing comprehensive information on a song. This information includes the song's title, the composer's name, the type of musical instrument involved, the method employed in playing the instrument, as well as several lines designated for textual content. The procedure for documenting Thai music notation and the design of the system prioritize user-friendliness through the utilization of the keyboard's letter keys on the computer. Certain letters are classified based on the attributes of Thai music notation, namely (Figure, 4, 5 and 6):
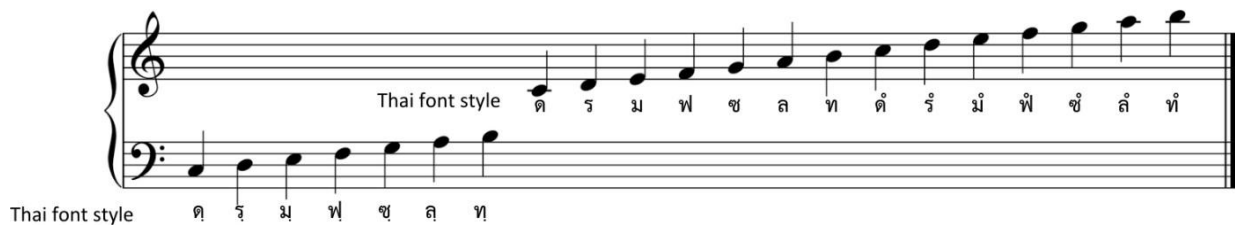

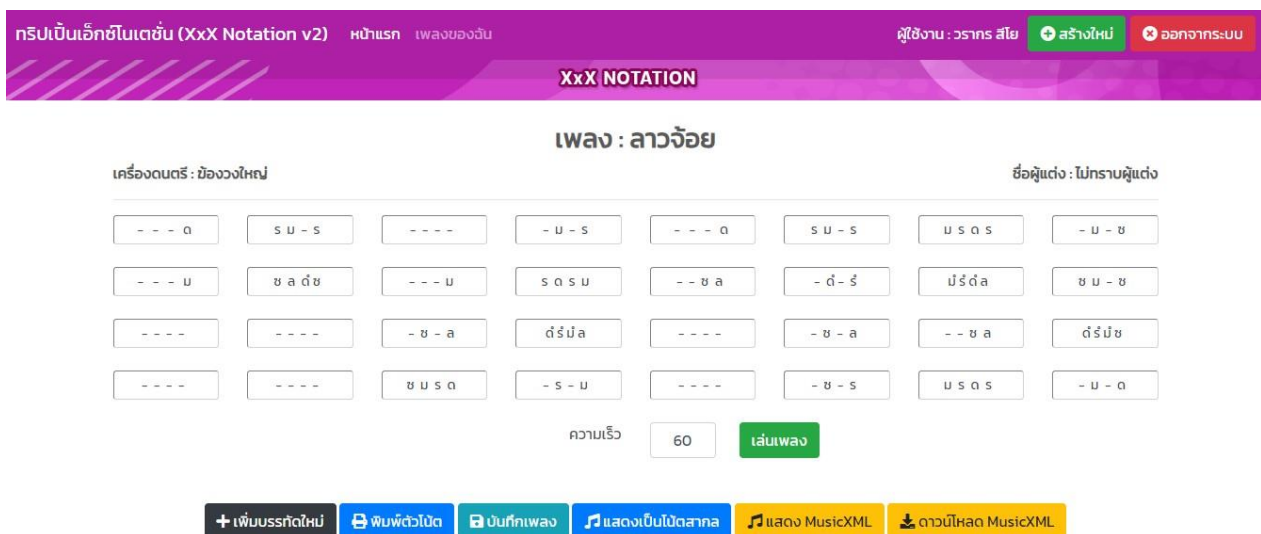**Figure 4** Symbols for music notes.

Figure 5 Write notes.

```
▼<score-partwise>
  ▼<identification>
    ▼<encoding>
        <software>MuseScore 1.2</software>
        <encoding-date>2012-09-12</encoding-date>
      </encoding>
    </identification>
  ▼<defaults>
    ▼<scaling>
        <millimeters>5.7</millimeters>
        <tenths>40</tenths>
      </scaling>
    ▼<page-layout>
        <page-height>2084.21</page-height>
        <page-width>1473.68</page-width>
      ▼<page-margins type="even">
          <left-margin>70.1754</left-margin>
          <right-margin>70.1754</right-margin>
          <top-margin>70.1754</top-margin>
          <bottom-margin>140.351</bottom-margin>
        </page-margins>
      ▼<page-margins type="odd">
          <left-margin>70.1754</left-margin>
          <right-margin>70.1754</right-margin>
          <top-margin>70.1754</top-margin>
          <bottom-margin>140.351</bottom-margin>
```

Figure 6 Rendering as MusicXML file.

Converting Thai music notation to the Western note system is widely recognized and accepted in the fields of education and music performance. Conversion requires the investigation and comparison of note values and rhythms. Specifically, the fourth note serves as a noticeable beat, whereas the sub-beat corresponds to the sixteenth note inside the rhythm (Figure 7).
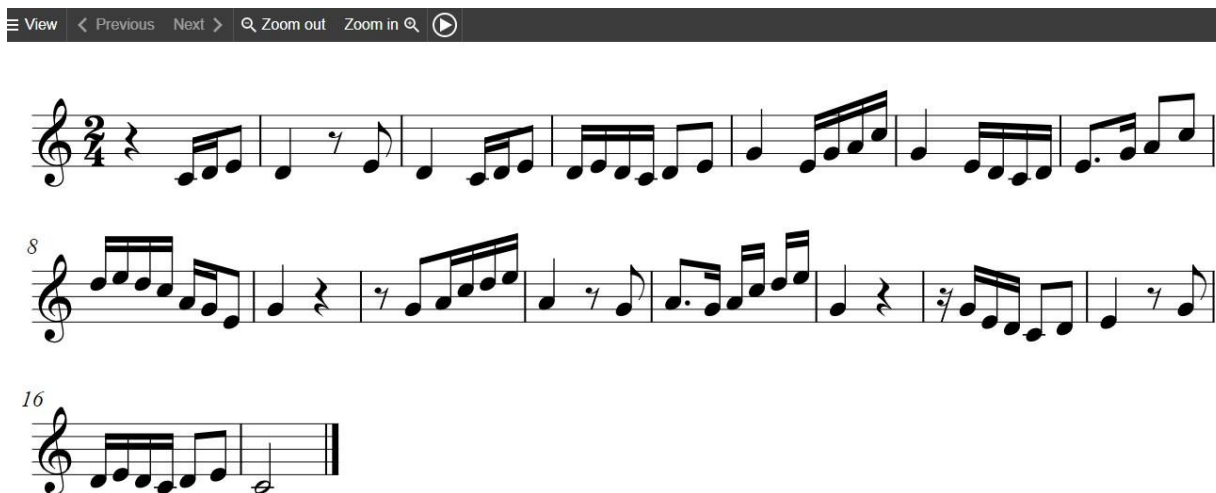

Figure 7 Rendering as Western notes.

3.2. Quality assessment results of software XxX Notation

Quality assessment results of Thai music notation recording software from three experts were used to assess the quality of the program in four aspects. The program assessment results are at the highest quality with a mean of 4.72, which is divided into aspects as follows: program accessibility is at the highest quality with a mean of 4.67; notation recording performance is at the highest quality with a mean of 4.62; sound performance is at the highest quality with an average of 4.72; and satisfaction in use is at the highest quality with a mean of 4.87.

The results of the quality assessment of Thai music notation software from twenty users assessed the quality of the program in four aspects. The assessment results of the program are of the highest quality with a mean of 4.76, which is divided into aspects as follows: program accessibility is of the highest quality with a mean of 4.89; notation recording performance is at the highest quality with a mean of 4.76; sound performance is at the highest quality with an average of 4.60; and satisfaction in use is at the highest quality with a mean of 4.80 (Table 1).

Table 1 Overview of program quality assessment results in terms of program accessibility.

Assessment items	Experts		Users	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Program accessibility	4.67	0.47	4.89	0.20
Notation Recording performance	4.62	0.40	4.76	0.52
Sound performance	4.72	0.31	4.60	0.69
Satisfaction in use	4.87	0.19	4.80	0.51
Total	4.72	0.34	4.76	0.48

4. Discussion

This research involves the development of a program to convert Thai musical notation into an international note structure by developing a web application that can be used in an online format for users to access more conveniently. There is no need to install the program on the computer before starting to use it, and the system usage data is stored in a database for ease of use today. In typing notes, Thai letters corresponding to Thai musical notation are used. Able to issue data in document format and PDF, Word, and Excel files for a variety of applications. It is efficient to listen to the sound of printed notes, namely the sound of the big band gong, which is an instrument in the main melody of Thai music and can increase and decrease speed. To convert Thai musical notation into an international note structure. Using Thai music notation input, convert data to MusicXML and convert display data into international notation, which is relevant and consistent with Suksaen and Srichettha (2016) developed a program to convert Thai musical notation into the structure of international notation using Music XL. The objective of this research is to propose a conceptual framework and develop a test program. In converting Thai musical notation to international musical score structure, using an XML document in a musical format called Music XL, The use of 10 Thai songs, evaluated by five Thai music experts on the issue of the accuracy of the structure of international musical notation converted from Thai musical notation, produced results at a very high level. It is useful to convert Thai musical notation into the structure of international notes. And it also corresponds to Good and Actor (2003), who introduced MusicXML as a universal translator for software compatible with standard Western musical notation. and also corresponds to Watanabe et al (2006), who have studied Music XML, which represents a musical score in XML and is able to display it and play back the corresponding music using a Web browser, and implemented and evaluated the proposed schemes.

The application provides a user-friendly interface that facilitates the printing of diverse Thai music scores due to the similarity of the note entry technique. Furthermore, it improves the precision of the conversion process from Thai musical notations to the international standard, thereby enabling the worldwide distribution of Thai music. This is consistent with the research conducted by Cunningham et al (2006) on the utilization of the MusicXML application for altering music scores over the internet. MusicXML is generally recognized as the prevailing worldwide standard for the exchange of musical data across software applications, and it is particularly well-suited for internet-based usage, notwithstanding the associated expenses for its utilization. Online collaboration is a highly advantageous tool for songwriters, offering several benefits.

The efficacy and applicability of the established software for the conversion of Thai music notes into international notation in the field of music education are significant. The utilization of diverse musical notations is streamlined, fostering innovation in music creation and pedagogy. This finding is consistent with the study conducted by Julia et al. (2018), which showed that the utilization of computer music notation, such as the program Sibelius, may greatly augment the processes of music production and instruction. This is achieved by facilitating swifter writing, facilitating smoother cooperation, and permitting instantaneous playing and assessment of musical works. Both strategies effectively enhance creativity and efficiency in music-related endeavors.

This research asked about the satisfaction of using the program by assessing the quality of 3 experts to evaluate the quality of the program in 4 aspects. The result of the evaluation of the program was the highest quality with an average of 4.68, and the evaluation of the quality of the program was from 20 users to evaluate the quality of the program in 4 aspects. It can be used and further developed.

5. Conclusions

XxX notation recording software has a simple technique that requires the user understanding of basic knowledge and understanding of Thai music notation to use it well and the user can bring this program to apply recording applications of other folk music notes because the notes are similar.

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Ethical considerations

Not applicable.

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