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APPLIED E-LEARNING OF KOLINTANG MUSICAL INSTRUMENTS CASE STUDY: UNIVERSITY OF DE LA SALLE MANADO

Liza Wikarsa[1], Debby Paseru[2], and Vianry Teguh Pangemanan[3]
Informatics Engineering, University of De La Salle, Manado, Indonesia
[1] lwikarsa@unikadelasalle.ac.id, [2] dpaseru@unikadelasalle.ac.id, [3] vx.pangemanan@gmail.com

ABSTRACT

Kolintang (Indonesian's xylophones) is popular nationwide as the traditional music instruments from Minahasa, a regency in North Sulawesi. It is usually played in ancestor worshipping rituals as it was believed that Kolintang had a close relationship with the traditional belief of North Sulawesi's natives and as their culture. Currently, there are several Kolintang applications developed that run either on Windows or Android operating system. They also use different types of controllers like a web camera, touch screen, and keyboard. Unfortunately, these applications are mostly intended for advanced users who have knowledge and skills in playing the Kolintang instruments. In addition, there remains a general lack of research on how to play the five instruments of Kolintang. Thus, this research will develop an e-learning application for the Kolintang musical instruments that are best suited the needs of novice and advanced users. An evaluation framework is developed to assess the quality and efficiency of learning objects of this application on the selected users by incorporating the Unified Theory of Acceptance and Use of Technology (UTAUT). Four criteria identified in this framework that are learning goal alignment, presentation design, interaction usability, and accessibility. The findings revealed that this e-learning application can help both novice and advance users to play the five instruments of Kolintang with ease and smoothness. The learning process can be done at the individual's choice of pace and time.

Key words: E-learning, Kolintang, Multimedia, North Sulawesi

I. Introduction

Kolintang (Indonesian xylophones) is popular nationwide as the traditional music instruments from Minahasa, a regency in North Sulawesi. It is usually played in ancestor worshipping rituals as it was believed that Kolintang had a close relationship with the traditional belief of North Sulawesi's natives and as their culture. According to Kaseke, the name of Kolintang came from the sound: TING (high pitch note) and TANG (moderate pitch note), TONG (low pitch note). In the local language, the invitation "Let us do some TING TANG TONG" is: "mangemo kumolintang" [1]. Hence, the name of the instrument is called Kolintang. Kolintang belongs to the pitched percussion category. As an idiophonic instrument, the source of Kolintang's source is from its bars that vibrate when being hit. Kolintang consists of five different instruments, namely bass, cello, tenor, alto, and melody that must be played together.

Recently, there were several Kolintang applications developed, namely Aplikasi Alat Musik Tradisional Kolintang Dengan Menggunakan Webcam Sebagai Sensor Deteksi Gerakan [2] dan Aplikasi Alat Musik Kolintang Berbasis Android [3], Aplikasi Kolintang Virtual Berbasis Android [4], Virtual Kolintang by Elago Tech, and others. Despite these developments, playing the Kolintang instruments is still challenging due to their different techniques, tools, and type of songs to play. For instance, the number of sticks used, type of sticks, and the number of simultaneously hitting notes are different for each instrument of the Kolintang.

It was further noticed that the developed applications are not particularly intended for novice users who have limited skills and knowledge on how to play the instruments correctly. There also remains a general lack of research in developing an e-learning application for the Kolintang musical instruments that can preserve the culture heritage of Minahasa to wider audiences regardless their skills and knowledge about these instruments.

E-learning is basically defined as the self-paced or real-time delivery of a learning, training, or education program through various electronic [5] [6]. Nurjayanti adds that the adoption of e-learning is widespread to address diverse goals that engage learners to experience the learning process at their own convenience with ease and efficiency [7]. To enhance the delivery of the learning program in an e-learning application, one must incorporate multimedia elements like texts, pictures, sounds, animations, and others. Multimedia elements are essential to promote more effective design that enriches the learning experiences.

The participants of this study are students, lecturers, and staff at University of De La Salle Manado, Indonesia. This university already has a student activity club that provides facilities and practices for students to play Kolintang. This club is under the mentoring of the appointed lecturer who has the knowledge, skills, and experiences in playing the Kolintang instruments. In addition, this student activity club has taken parts in local Kolintang competitions for several years. There is also an increasing interest in Kolintang by students, lecturers, and staff at this university.

Hence, there is an opportunity to develop an e-learning application of Kolintang musical instruments that can provide basic skills and knowledge on how to play each instrument of Kolintang for novice users. This application can also be used by advanced users with various options to choose from, including the operating systems, the types of controllers, and the Kolintang instruments.

An evaluation framework for this application will be derived from the Unified Theory of Acceptance and Use of Technology (UTAUT). This theory provides a useful tool to carefully assess the likelihood of success of the introduction of new technologies, in this case is the e-learning application of Kolintang musical instruments. Criteria identified in this study include learning goal alignment, presentation design, interaction usability, and accessibility.

The formulated research question is "how to develop an e-learning application of Kolintang musical instruments that provides ease of learning process for users?". In this regard, the research objectives are as follows: (1) To introduce and preserve the Kolintang musical instruments that has a close relationship with the traditional belief of North Sulawesi's natives and as their culture. (2) To develop an e-learning application of Kolintang with a multimedia-assisted environment that promotes learning interest, learner engagement, and efficiency without being limited by physical constraints.

II. Literature Review

A. Kolintang

According to Kaseke, the standard of Kolintang orchestra is seven players, with instrument compositions of two (2) melody Kolintang, 2 alto Kolintang, 1 tenor Kolintang, 1 cello Kolintang, and 1 bass Kolintang [1] [8].

Figure-1. Kolintang's Bars [1]

Each Kolintang has its own instrumental name as shown in the following table:

Table-1. The Kolintang Instruments in Minahasa's Language [9]

No.	Kolintang Instruments	Minahasa's Language
1	Melody	Ina
	a. Melody I	Ina esa
	b. Melody II	Ina rua
	c. Melody III	Ina taweng
2	Cello	Cella
3	Tenor	Karua
	a. Tenor I	Karua
	b. Tenor II	Karua rua
4	Alto	Uner
	a. Alto I	Uner
	b. Alto II	Uner rua
	c. Alto III	Katelu
5	Bass	Loway

Tools used to hit the Kolintang bars are called stick that must suit the instruments played. For high pitch instruments, we must use a stick that has a hard surface, for example melody Kolintang does not use a rubber cover on its head. The lower the bar notes to hit, it required soft sticks with tick rubber covers on their heads. The thickest rubber cover is used for the bass Kolintang stick. For one instrument, the player can use sticks that have different thickness.

Figure-2. Kolintang Sticks [1]

B. Multimedia-Based Kolintang Applications

There are several Kolintang applications developed in the last three years. In 2013, Angdresey created Aplikasi Alat Musik Tradisional Kolintang Dengan Menggunakan Webcam Sebagai Sensor Deteksi Gerakan that runs on Android [2]. This application provides five instruments Kolintang where the player can only play one instrument on Android at a time. It has history of Kolintang, lyrics and sound settings.

In 2014, there were four unpublished thesis about the developments of Kolintang applications that all run on Android. Firstly,Aplikasi Kolintang Virtual Berbasis Android using Java and XML done by Sukma [4]. Secondly, Multimedia Interaktif Alat Musik Tradisional Kolintang using Adobe Flash and Cockos Reaper for sound samples was developed by Norman [10]. It has the history of Kolintang using animation, visualization of Kolintang and its sticks using 3D that can be viewed 360^0, tutorial on how to play Kolintang by providing a sampled song. Thirdly, Wijaksana developed Aplikasi Android Virtual Instrumen Kolintang Minahasa that has animated Kolintang bars when got hit [11]. Lastly, Rewur did his thesis on the development of Ap likasi Alat Musik Kolintang Berbasis Android that also provides five Kolintang instruments along with the history of Kolintang, type of Kolintang instruments, and video of Kolintang orchestra [3].

C. User Interaction and Virtual Musical Instruments

A system can be classified as an instrument when there is “a feedback between the output of the virtual device and the user in real time” [12]. Stofringsdal points out that instrument input is the excitation process that includes the parameter controller and interface [13]. On the other hand, instrument output is the sound radiation characteristics. A general system of a performer actuating over a virtual musical instrument can be in the figure below.

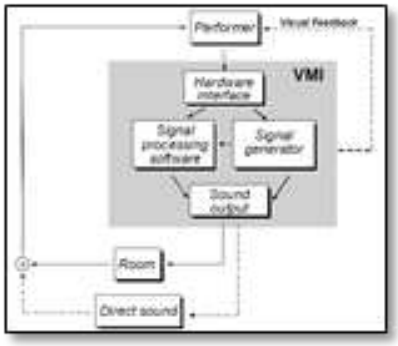

Figure-3. User Interaction and Virtual Musical Instrument [12]

As seen in the figure above, it is noticeable that physical and visual interactions play important role to provide feedback system between the player and the instrument. Digital media developments have abilities to possibly control every parameter that modifies sound with ease and efficiency

III. Research Method

A. Research Sample

The participants in this research were 75 students, 15 lecturers, and 10 staff from five faculties at University of De La Salle Manado. From 100 questionnaires were distributed to the selected participants, all questionnaires were filled in completely. Descriptive data from 100 participants include name, email, gender, age, status of the participant, and study program.

B. Variables and Indicators

This study used UTAUT to assess the uptake and use of the e-learning application by looking at several variables as shown in the figure below.

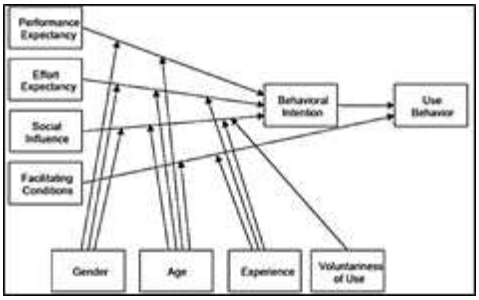

Figure-4. UTAUT Model [14]

Udjulawa *et al*. explain that UTAUT "combines successful features of the eight leading technology acceptance theory into a single theory that are Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Motivational Model (MM), Theory of Planned Behavior (TPB), Combined TAM and TPB, Model of PC Utilization (MPTU), Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT)" [20].

According to Venkatesh *et al*., performance expectancy (PE) is defined as the degree to which using a technology will provide benefits to users in performing certain activities. This is also known as perceived usefulness [19]. Meanwhile, effort expectancy (EE) is the degree of ease associated with the use of technology. Social influence (SI) is the extent to which users perceive that important others (e.g., family and friends) believe they should use a particular technology; and *facilitating conditions* (FC) refer to users' perceptions of the resources and support available to perform an activity. Furthermore, the diagram above shows that PE, EE, and SI have direct effects on behavioral intention, which along with FC have direct effects on use behavior. This model also includes four moderating variables such as age, gender, experience, and voluntariness of use.

This study further added four other indicators into this UTAUT model that are learning goal alignment, presentation design, interaction usability, and accessibility.

Table-2. Definition of Indicators Used in the Evaluation Framework

Learning goal alignment	The design of application content must meet the learning goals in relation to learner's activities by paying close attention to learner's specificity and perception.
Presentation design	Suitability, visibility, audiology, coherence, image display, colors and graphical elements related to the learning goals.
Interaction usability	The ease of use, clarity, and learn-ability of the contents/materials presented in the application.
Accessibility	Ability to access the content of the application by the individual's choice of pace and time.

C. Measurements

Data processing was conducted on this research comes from the participants' answers to questions. Test-retest reliability is performed by administering the same test twice over a period of time to the selected research sample [14]. The scores from the first and second tests can then be correlated in order to evaluate the test for consistency over time. The first test is given to the participants before they use the e-learning application and the second test is done after they use the application. Formative validity is used as an outcome assessment tool to provide information that can help to improve the content of the e-learning application [15].

Research participants are asked to select the response closest to their opinion that ranges from 'very good' to 'poor' with a neural category in the middle. Each question and answer is given alternate scores respectively as follows:

Table-3. Scoring

Score	Strength of
1	Very good
2	Good
3	Moderate
4	Fair
5	Poor

As these options are ordered, the codes will be entered into SPSS. This study will also use Cronbach's Alpha to determine internal consistency of the instrument. It is regarded as "a function of the number of test items and the

average inter-correlation among the items" [16] [17]. The following table will enlist the range values of Cronbach's Alpha.

Table-4. Cronbach's Alpha [16]

Cronbach's Alpha	Internal Consistency
a ≥ 0.9	Excellent
0.7 ≤ a < 0.9	Good
0.6 ≤ a < 0.7	Acceptable
0.5 ≤ a < 0.6	Poor
< 0.5	Unacceptable

The formulae of Cronbach's Alpha is [16]:

$$\alpha = \frac{\mathrm{N}.\bar{\mathrm{c}}}{\bar{\mathrm{v}} + (\mathrm{N}-1).\bar{\mathrm{c}}}$$

α : alpha
N : the number of items
$\bar{\mathrm{c}}$: the average inter-item covariance among the items
$\bar{\mathrm{v}}$: the average variance

Data analysis uses descriptive statistics that consist of mean and percentage to provide a simple summary of the data gathered from the sample as well as the observations that have been made for this research [18].

D. Evaluation Framework

This study attempted to incorporate the criteria into the UTAUT and thus used it as the evaluation framework to measure the quality of content and information provided in the application as well as measure the acceptance and use of the applications. These constructs will be further moderated by age, gender, and experience.

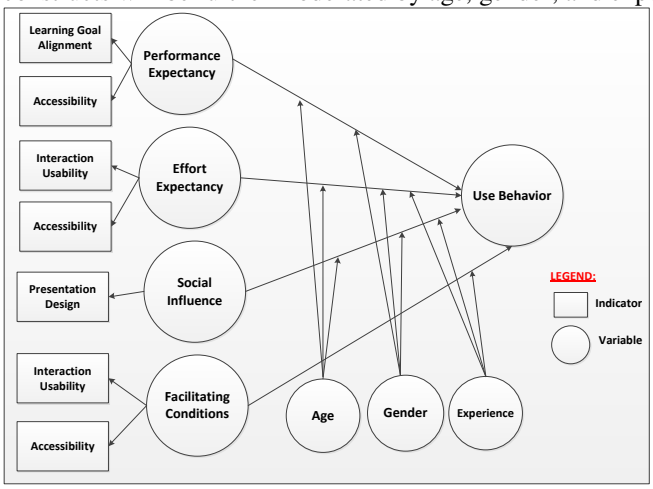

Figure-5. Evaluation Framework

In this research, it omits the behavior intention variable from the evaluation framework. PE, EE, SI, and FC will have direct effects on the use behavior. Alongside this, each variable will be assessed by age, gender, and experience as shown in the figure above.

IV. Design and Implementation

A. Requirement specifications

List of requirement specifications for developing an e-learning application of Kolintang musical instruments is as follows:

1. To enable users, both novice and advance, to have access to knowledge and information about the Kolintang instruments.
2. To provide assistance for the novice users to learn the instruments by outlining instructions in the application.
3. For advanced users, there are more options provided in terms of operating systems, controllers, types of instruments, and others.
4. Users can play together simultaneously online where they are also able to see and hear the plays of others online.
5. To provide features like the history of Kolintang, type of Kolintang instruments, lyrics, video demo of playing Kolintang instruments, chatting, and setting

B. Technology for the application development
Supporting software for this application are as follows:

Table-5. Software Required For Application Development

Programming	Adobe Flash Professional CS6, Java Eclipse, Android SDK, ADT-21.1.0
Image Editing	Adobe Photoshop Professional CS3
Animation	Adobe Flash Professional CS
Modelling	Microsoft Office Visio 2007

C. Implementation of application
The following will depict the application interfaces

Figure-6. Main Menu

Figure-7. Mode Selections

Figure-8. Instrument Selections

Figure-9. Controllers

Figure-10. Song Selections

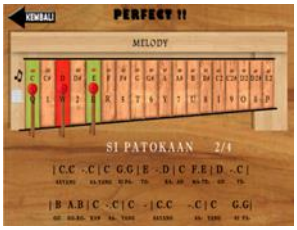

Figure-11. Melody Kolintang Played Using Keyboard

This application is divided into two different modes that are novice and advance. For the novice mode, the user needs to do the following steps:

1. Select the song to play.
2. Select the instrument.
3. The application will display the bars from the selected instrument along with the song notes and lyrics.
4. The user needs to hit the highlighted bars to produce the sound accordingly.
5. The application will automatically highlight the notes and lyrics according to the tempo of the song.
6. After the song is finished, it will display the number of bars hit correctly. When the user met the required notes, he/she can move to the next level of the learning activity.
7. The user is also given other options like selecting different songs, changing mode, or selecting other menus.
8. The next level is more difficult as the user has to play the song without having any assistance. The application will not provide the highlighted bars to hit. Instead, the user has to hit the bars by following the highlighted notes and lyrics

For advanced users, the application provides more functionalities to enhance the playing experience as follows:

1. The web camera is used to playing the Bass Kolintang only. The touch screen is for playing the Kolintang instruments on Android. The keyboard is used to playing the instruments by multiple players simultaneously online.
2. Select one of the five Kolintang instruments to play that are melody, bass, alto, tenor, and cello.
3. When using the web camera to play the Bass Kolintang, the distance between the player and the web camera is ideally 3 meters in order to have a better light sensitivity.
4. The player can play with others online by selecting the desired instrument. This player can also view the plays of others and hear the sounds produced by others from his/her computer.
5. There are several features included in this application such as record and play, chatting, video demo, lyrics, introduction to Kolintang, and more

V. Application Testing on Evaluation Models

Testing was performed on this application using the following computer specifications.

Table-6. Computer Specifications For Testing

Processor	Core i3 2.27 Ghz
RAM	2 GB
Operating System	Windows 7 32-bits
	Android 4.0
Web camera	VGA web came (1.3 mega pixels)

Assessing the quality of the materials provided in this application is considered to be vital. The internal consistency of the instrument using the Cronbach's Alpha was 0.659 which is acceptable based on the range values of Cronbach's Alpha as shown in table 4.

The findings showed that the design of the application contents has met the learning goals whereby users are able to learn and practice the Kolintang instruments at their own pace and conveniences since there are no physical limitations as to where this activity can take place. There is a significant improvement in the knowledge, skills, and experiences of users in playing the Kolintang instruments from moderate to good as can be seen in the figure 13.

Reliability Statistics

Cronbach's Alpha	N of Items
.659	20

Figure-12. Internal Consistency

	N	Minimum	Maximum	Mean	Std. Deviation
Previous_Learning	100	1	5	3.54	.892
Post_Learning_Goal	100	1	3	1.81	.748
Valid N (listwise)	100				

Figure-13. Previous and Post Learning of the Application

	N	Minimum	Maximum	Mean	Std. Deviation
Performance_Expectancy	100	1	4	2.27	.664
Valid N (listwise)	100				

Figure-14. Performance Expectancy

		N	Minimum	Maximum	Mean	Std. Deviation
Effort_Expectancy		100	1	3	1.52	.627
Valid N (listwise)		100				

Figure-15. Effort Expectancy

		Social_Influence			
		Very good	Good	Moderate	Total
Status	Student	42	30	3	75
	Lecturer	1	11	3	15
	Staff	4	6	0	10
Total		47	47	6	100

Figure-16. Social Influence

		Facilitating_Conditions				
		Good	Moderate	Fair	Poor	Total
Status	Student	15	16	41	3	75
	Lecturer	1	0	11	3	15
	Staff	0	0	4	6	10
Total		16	16	56	12	100

Figure-17. Facilitating Conditions

The contents were designed for both novice and advanced users whose different levels of knowledge and experiences in playing the instruments. This certainly increases the performance expectancy of this application that provides benefits to users in performing the specified activities, regardless the age and gender of the users. The mean of the performance expectancy is 2.27 which is considered to be good as presented in the figure 14.

The ease of use, clarity, and learn-ability of the contents presented in the application are considerably high as pointed out by most users of this application. This application basically blends self-paced e-learning and face-to-face learning to improve knowledge and performance of users. Users with limited knowledge, skills, and experiences in playing the Kolintang instruments can learn and practice by following the instructions at their own convenience. On the other hand, those students who are in the Kolintang student activity club can further enhance their techniques of playing by selecting the advance mode in the application. The appointed lecturer for this club can use the application to demonstrate his teaching face-to-face. Therefore, the effort expectancy of this application is also regarded to be high (mean 1.52) due to the easiness of the use of the application by the participants.

The presentation design of the contents is found to be suitable for the targeted users who have ages ranging from 18 years old to 65 years old. Gender and status of users have no impacts on how the application is used. The participants have no difficulties in learning the contents as the structure and visualization of graphical elements are related to the learning goals. Multimedia elements like text, images, animations, sounds, and video are used to enhancing the presentation design that further promotes the learning process for users. Many participants agreed that the uptake and use of this application can enrich the learning experience of an user due to the suitability, visibility, and coherence of the presentation design of the application contents.

This application provides necessary supports for users to learn and practice various Kolintang instruments without having to buy these costly instruments. Instructions on how to play each instrument are also included amongst features to help users with the learning process.

VI. Conclusion and Recommendations

The following conclusions were presented with reference to the research questions:

1. The new developed Kolintang application can help preserve the Kolintang by virtualizing the way it is played.
2. The application has provided varying options for both novice and advanced users to ease the learning process, including the playing modes, operating systems, controllers, type of instruments, and others.
3. The multimedia-assisted environment in this application promotes learning interest, learner engagement, and efficiency without being limited by physical constraints.
4. After the use of this application, there is a significant improvement in the knowledge, skills, and experiences of user in playing the Kolintang instruments.

The following recommendations are made for further research in this particular area of interest:

1. For the Android's version, it is highly recommended that the application can be played by multiple players simultaneously so that it can show a live Kolintang musical performance to a wider range of audience.

2. There is a need to add more octaves to the Bass Kolintang for the web camera. If possible, it is strongly urged that all the Kolintang instruments can be played using web cameras as well.
3. It is suggested to include options to choose type of Kolintang woods for each instrument due to the differences in timbre that can enrich the sound experience.
4. To create a computer-based model of analysis and simulation on different timbres produced by each Kolintang instrument.
5. To create an application that can automatically translate notes into respective sounds based on the selected instruments.
6. It is better to include the rhythmic movements and moveable rhythms that cover gestural aspects of performed rhythm which are required for live performances

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