An Interactive Mobile Application for Learning Music Effectively

S.C. Ng, Andrew K. Lui, and W.S. Lo

The Open University of Hong Kong,
30 Good Shepherd Street, Ho Man Tin, Kowloon, Hong Kong SAR, China
scng@ouhk.edu.hk

Abstract. This paper introduces a mobile application that allows users learn music in a funny and effective way so as to arouse students' interests towards music, and provide a convenient means to students' learning and playing music through the mobile devices. The mobile application enables users to know their learning progress. Students can learn music effectively through game-based quizzes and exercises. The mobile application provides an elementary level e-learning platform for music learners. It serves as a stepping stone for them to further develop their interests in this field. The application is divided into three parts: fundamental musical theory, educational games, and practical use of musical instruments. The musical activities includes introducing different musical instruments, reading scores, listening to different notes, writing and recognizing treble clef, calculating the tempo of a song and playing notes from a keyboard with the sounds of different instruments.

Keywords: mobile learning, applications of mobile devices, learning music.

1 Introduction

Music is a form of art. It plays an important role in the development of a child's brain. Recent research found that music affects the growth of a child's brain in four ways: academic, physical, emotional and spiritual affairs. It is no doubt that music should be included in a balanced education [1-2]. Research concerning the preferences of music activity for pre-school children suggests that children are spontaneous to enjoy musical activities in a supportive environment [3]. By learning in different environments, like schools and home, it strengthens children's concentration and enjoyment in music [4]. In reality, not every individual child can have a proper training in music and musical instrument due to the expensive educational cost. In addition, the current learning method in a classroom may not be interactive to arouse the children's interests in music.

As learning with a smartphone is totally different from learning in the classroom, a new aspect of the study has come into shape, called mobile learning. Mobile device applications (i.e. apps) can be treated as a kind of study aids where

J. Lam et al. (Eds.): ICT 2013, CCIS 407, pp. 148–157, 2013.

students can learn music through the device in an interesting and interactive way at anytime and anywhere [5-6]. The mobile applications allow students gain access to different resources, which can play a supplementary role in the education part [7]. For those who do not have proper training in music, they can start their own learning journey using the mobile application at their own pace. Learning music is not only for children. This claim is supported by the research conducted by Wristen that adult students seek quality, which includes passion for music and knowledge of music [8].

There are a number of mobile applications for learning music in the market, like Music School for Toddlers[9], Music Tutor Sight Read Lite [10] and Piano [11]. Music School for Toddlers provides the sound of five musical instruments such as piano, guitar, drums, percussion and xylophone. Music Tutor Sight Read Lite teaches how to read and write staff. Piano provides a piano keyboard for users to play. These applications only provide one or two focus functions. They do not include complementary music courses for learning music effectively and interactively.

This paper introduces a mobile application that allows users learn music in a funny and interactive way. It provides a convenient means to students' learning and playing music through the mobile devices. The mobile application enables users to have their own learning journey in music. Users can learn music in an interesting way through game-based quizzes and exercises.

The mobile application provides an elementary level e-learning platform for music learners. It serves as a stepping stone for them to further develop their interests in this field. The application is divided into three parts: fundamental musical theory, educational games, and practical use of musical instruments. The musical activities includes introducing different musical instruments, reading scores, listening to different notes, writing and recognizing treble clef, calculating the tempo of a song and playing notes from a keyboard with the sounds of different instruments.

2 Design and Methodology of the Mobile Application

This mobile application is divided into three parts: "Start to Learn", "Music games" and "Musical Instruments". The first part ("Start to Learn") is to learn some basic knowledge in music. The second part ("Music games") includes game-based revisions and quizzes. The contents of the questions are based on the knowledge from "Start to Learn". The third part ("Musical Instruments") is to allow users encounter different musical instruments such as violin, flute, trumpet and piano. The functions provided in the application can be found in Figure 1.

The design and methodology of each part of the application will be discussed in this section in details.

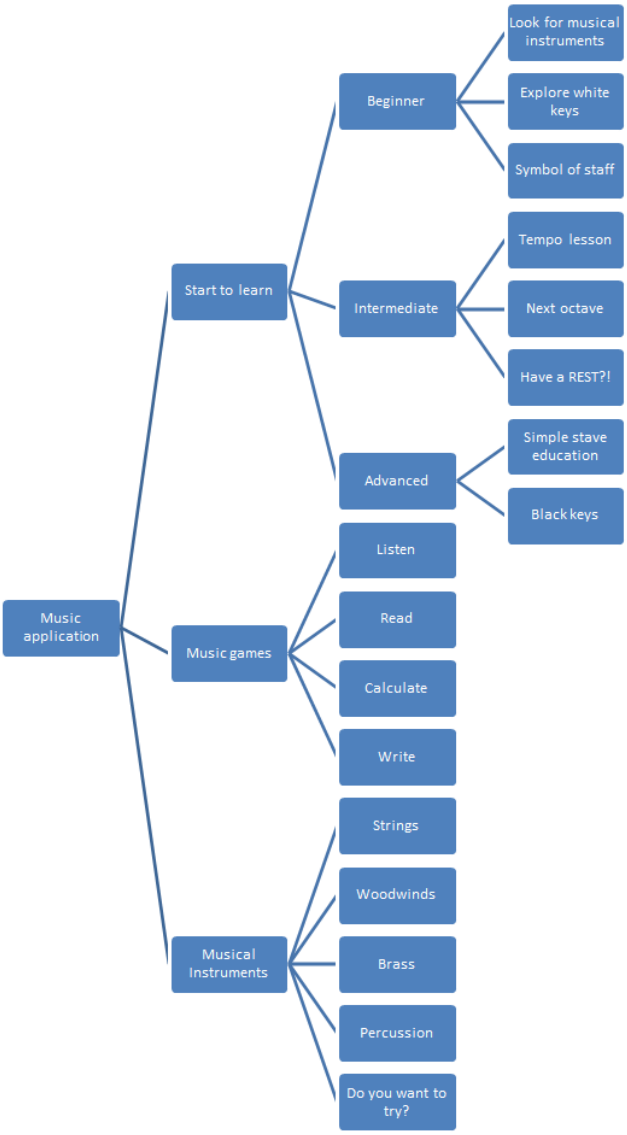

Fig. 1. Functions provided in the mobile application

2.1 Start to Learn

For the first part "Start to learn", the learning journey is divided into three stages - beginner, intermediate and advanced. Users can learn different musical instruments and the positions of different notes on a keyboard (Figure 2).

Fig. 2. The piano keyboard

There are different audio formats to be used in the application, such as midi, mp3 and ogg. After comparing these formats, it was found that the ogg format gives the best performance, the provided sound can be played in a gapless way. The comparison of using different file format can be found in Table 1.

Table 1. Comparison of file formats used in the application

	.midi	**.mp3**	**.ogg**
Error occurs	None	Frequently	None
No. of times that the song can be played	Played once	Played many times, an exception throw	Played many times
Speed of performance	Average	Slow	Fast

For the midi format, the sound of the notes can just play once even if you touch the keyboard many times, there will be no response afterwards. For the mp3 format, the application runs slowly, it easily gets an error with frequent touches of the keyboard, and it has a slower response. For the ogg format, it gives the best performance among the three formats without error and quick response. Therefore, the ogg format is used as sound source for this application.

Musical instruments are classified into strings, woodwind, brass and percussion. Users can then learn how to read staff, calculate the tempo and listen to the sound of the musical notes immediately. Once the users click on the staff image, the application will show users how to draw a treble clef. Users can follow the arrow to learn the ways to draw a treble clef (Figure 3).

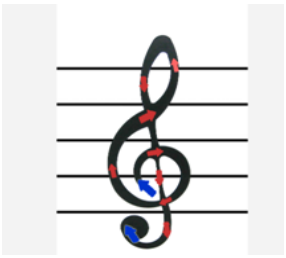

Fig. 3. Writing of a treble clef

Users can have a "Tempo Lesson". The sound and the tempo of that musical note will be played once the users pressed the selected button (Figure 4).

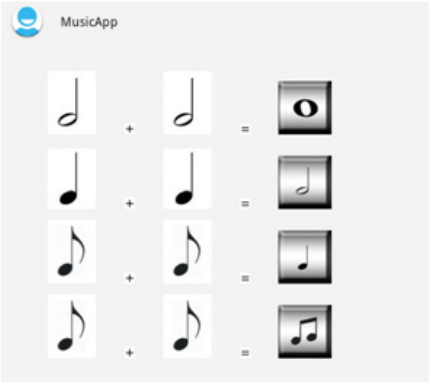

Fig. 4. The Tempo lesson

2.2 Music Games

In the second part of the application ("Music games"), there are different games and exercises to reinforce what they have learnt. The games are divided into reading notes, listening to the notes, writing the treble clef and calculating the tempo.

For the reading game shown in Figure 5, users need to read through a staff including the musical notes which generated randomly and recognize the note (e.g. Middle C). Seven buttons as the name of notes for event handling are included as users' input.

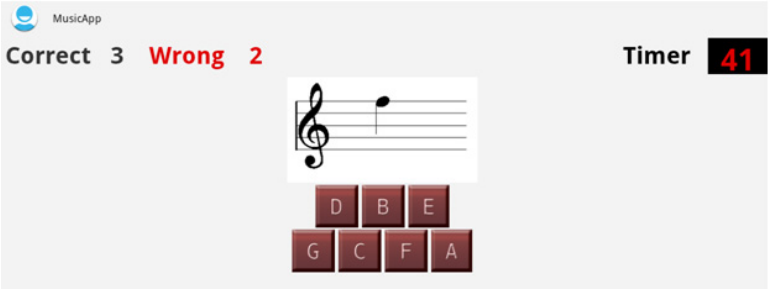

Fig. 5. The Reading game

For the writing game (Figure 6), users need to draw the treble clef. This part used the Android gesture builder. The way of drawing the treble clef is initially drawn and stored at the development stage. By comparing the users' input (i.e. gesture) from the tablet with the one initially developed, it can be checked the accuracy of the users' drawing.

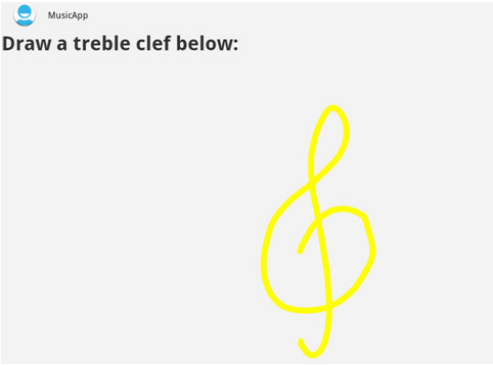

Fig. 6. The Writing game

The listening game shown in Figure 7 is about the sound of a particular musical note, which will be played and the users need to listen carefully. The sound will be generated randomly through the program. Sound is not like text. If the users miss the sound, they will miss the information. Once the users cannot listen to the question clearly, there is a repeat button for users to play the sound again.

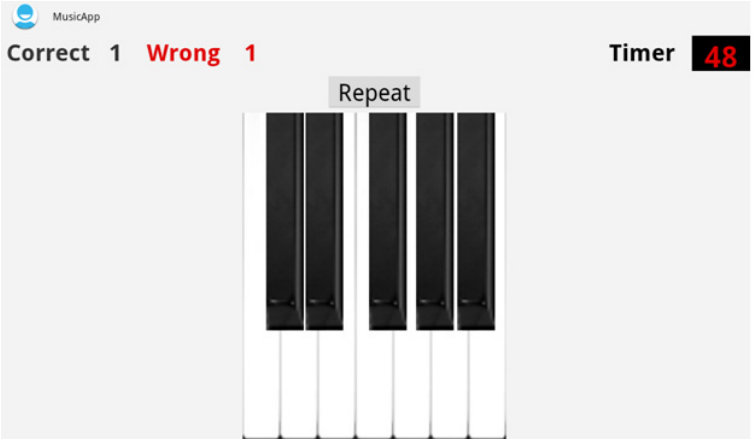

Fig. 7. The Listening game

For the calculation game shown in Figure 8, those questions which are drawn as images. It will generate randomly. There are four answers for users to choose. Those answers appear as images too. Drag and drop feature is used. Users need to drag and drop the answer image to an area in order to answer the questions. The screen size of tablet will be obtained. The x, y-coordinates of the answer image and x, y-coordinates of the answer area are compared to check for the correctness. If the users do not put the answers into the answer area, the answers will restore to the original x, y-coordinates position. Once the x, y-coordinates of both are matched, the answer image is needed to check if user selects a correct answer image. If yes, one mark will be added. If not, one mark will be subtracted at the end of the game.

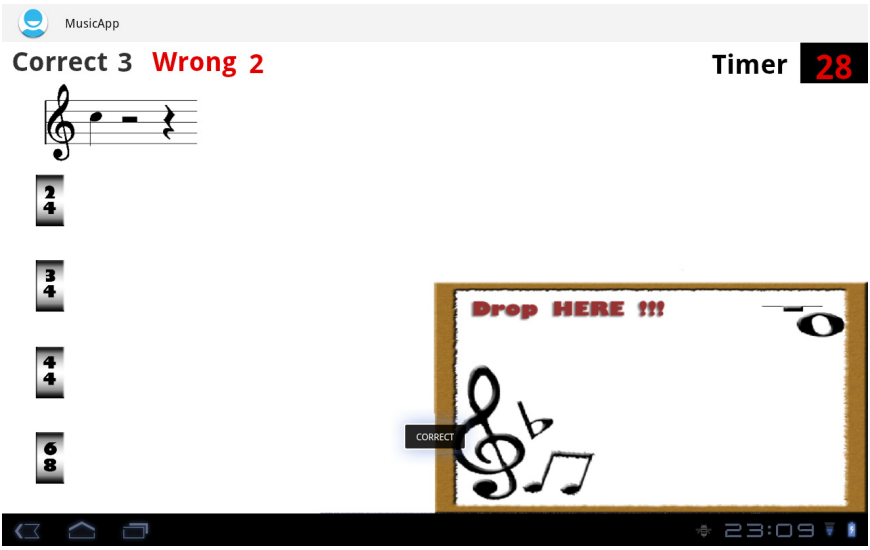

Fig. 8. The Calculating game

Users need to answer the game-based test to achieve higher marks. The marks will be stored and accumulated. Users can check for their total marks after finished playing the game in an alert dialog. The chronometer is used for counting down in the reading, listening and calculating game. The time allowed is set to one minute for each game.

2.3 Musical Instruments

In this part, users can have entertainment through playing the musical instrument, like the piano. The piano music keyboard had used absolute layout. But, there is a problem that the keyboard varies in different sizes of screen. The problem is solved by using the relative layout. The Piano keyboard is thus fixed. Besides, the piano music keyboard is added with the sound of different pitches. There are totally three octaves. The sound source of music is obtained from Overture4.0 in midi format. However, the MediaPlayer in the Android OS cannot play the midi format smoothly. By converting the midi format into ogg format, the problem is solved.

The sound effects with respect to different musical instruments are added. A page of all musical instruments will be displayed for selection. They are sorted according to different type of musical instruments. Once the image button of that particular music instrument is pressed, a piece of music performed by that musical instrument will be played. When the user touches the button again, the music is paused and the image is changed slightly. This is to recognize that the musical instrument is pressed. Figure 9 shows the piano keyboard with the selection of the sound of different instruments.

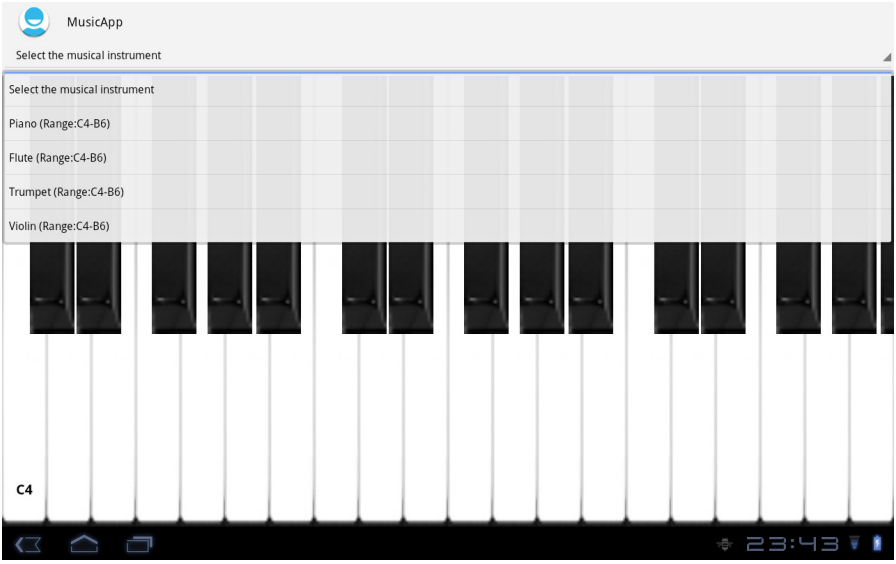

Fig. 9. Piano keyboard with different instruments

3 Results and Discussion

In order to test the effectiveness of this mobile application, an evaluation was carried out for 29 different users. Four of them are technical staff from the Educational Technology and Publishing Unit (ETPU), The Open University of Hong Kong. Users need to learn music using the application within a week. After that, users are required to fill in a questionnaire and give feedbacks. In the questionnaire, there are 11 questions listed in Table 2. Users can choose the marks in 5 (Strongly agree) and 1 (Strongly disagree). Another part in the questionnaire is the overall rating of the application (out of 10). Users can also write comments on the application on the questionnaire.

Table 2. List of questions in the questionnaire

1. The application layout is clear.
2. I learn more about the music instruments.
3. The games are attractive.
4. I think the application helps to enhance my music knowledge.
5. The application makes me easier to understand the music concepts.
6. I enjoy playing the application.
7. The application is attractive.
8. The application is useful.
9. The application is colourful.
10. The application motivated me to learn music.
11. I love the application.

The results of the questionnaire will be shown as below in Figure 10. Most of the users enjoy using this application, the average mark is 3.92 out of 5.

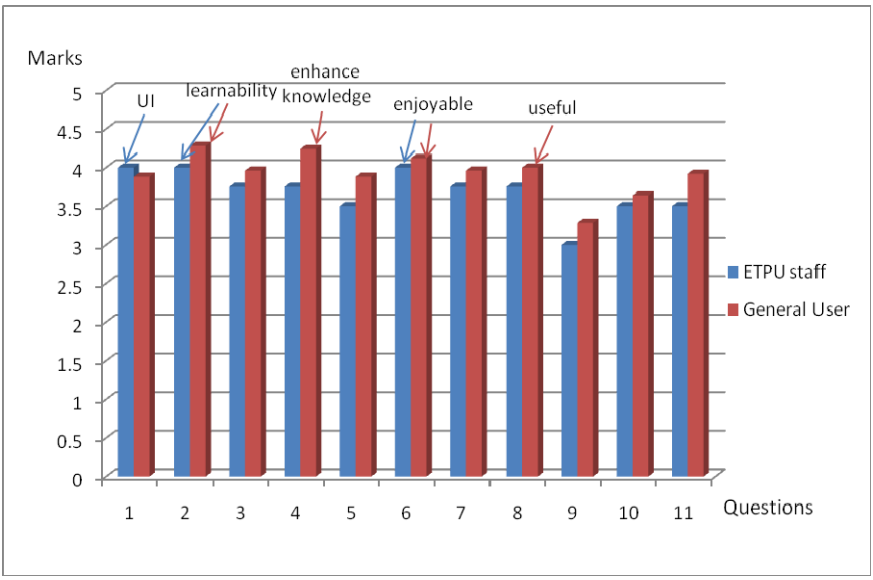

Fig. 10. Summary of evaluation results

Other comments from users include:

- "I want a colourful background."
- "The game generated by the app can be improved by adding 1 second waiting time between the player's input and the next tone generated."
- "The interface can be more colorful, it can attract more children to download the app."
- "Easy to learn and play, very good for music beginner."
- "It is ok if more colorful and clear instructions are included."
- "UI layout needs to be consistent. Good to have many graphical icons"
- 'Should have consistent design of UI for similar functions."
- "The presentation is clear. It got lots of content in different areas. It would provide great help to those who would like to learn music as a beginner."

From the above comments, it can be concluded that the application is not colourful enough. Other comments such as adding waiting time of the listening game have been incorporated into the new version of the application.

4 Conclusions

As compared with the existing applications in the Android market, this mobile application provides an all-in-one feature for users to learn music in an effective way. The application can arouse users' interest towards music. Users can learn, play, and

practice music through the application. This fulfills the needs of the learners to learn at their own pace. Sounds of other musical instruments such as violin, flute and trumpet are provided for users to enrich the application. The application has been evaluated by a group of different users including teachers, potential students and technical application developers. They all enjoyed the learning experience with this mobile application and they agreed that the application can effectively enhance their musical knowledge.

In the future, more researches should be carried out to understand the difficulties in learning music in a deep way. It can include a much higher learning level and implement a game-based revision. The games can be defined in stages as well. In addition to the treble clef, the bass clef can also be taught. More graphics can be included in this application.

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