

# Design of a game-based learning environment for basic rhythmic patterns in music

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## ABSTRACT

Rhythm is the basic learning content in music teaching. A game-based learning environment with basic rhythm is constructed in this paper by using 3D virtual world environment. The virtual island with the theme of “Music Playground” is designed to allow learners to learn basic music theory knowledge such as musical notes, time values, beats, staves, etc. Further understand the concept and classification of rhythm type and the importance of rhythm for music learning through game experience.

**Keywords:** 3D virtual world, rhythmic pattern of music, game-based learning

## 1. INTRODUCTION

### 1.1 Research background

Rhythm is the main component that makes up music<sup>1</sup>. For music courses in primary and secondary schools, rhythm teaching is an important part of it, and it is also an important foundation for students to learn music theory<sup>2</sup>. On the one hand, it can improve students' learning enthusiasm, cultivate students' independent creation ability and imagination, and enhance the sense of music rhythm by building a game-based learning environment for basic rhythmic patterns in music. On the other hand, it also adds more possibilities for the exploration of the virtual world in the field of music education.

3D virtual world environment has the main characteristics of situational, creative, immersive, interactive and diverse<sup>3</sup>. In the virtual world, users can create a virtual world of their own according to their own preferences through functions such as avatar design, construction tools, terrain layout, and script editing<sup>4</sup>, and interact with the surrounding environment through avatars<sup>5</sup>.

### 1.2 Design concept and goal

“Game-based learning” refers to the use of game-based approaches in the learning process, including the teaching methods used by teachers and the learning styles used by students in independent learning<sup>6</sup>, so that students can acquire knowledge, skills and attitudes in an enjoyable learning experience<sup>7</sup>. In an art subject such as Music, the focus is on enriching the students' emotional experience<sup>8</sup>. This paper combines the theory of “game-based learning” with basic rhythmic patterns using a 3D virtual world platform, allowing learners to control the interaction of avatars through the mouse and keyboard and to play different functional areas in two virtual islands to master the knowledge of basic rhythmic patterns in music and to enhance their own sense of rhythm.

## 2. LEARNING ENVIRONMENT DESIGN AND IMPLEMENTATION

### 2.1 Design strategies and build ideas

The thesis aims to build a gamified learning environment in 3D virtual world to teach basic rhythmic patterns in music. The theme is “Music Playground”, and two islands with 256 meters by 256-meter virtual land area are built, named as “Rhythm Playground” and “Dotted notes Square” respectively.

The learning environment for the basic rhythmic patterns is designed and built in three ways. One direction is to combine the theme of ‘Musical Playground’ with the construction of nine iconic playgrounds corresponding to the ten basic

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rhythmic patterns, and to place a knowledge bar near each playground so that learners can master the names, symbols and meanings of the ten basic rhythmic patterns as they explore the playground. The second direction is to divide the playground into five functional areas: The Castle of Music Theory, Rhythm game, Ear Training Wooden House, Let's dance together and Road of Piano. Each functional area uses different forms of interaction, allowing learners to further experience rhythmic patterns in various ways. The last direction is to take into account the holistic nature of the virtual environment and to beautify the learning environment with other architectural areas, which also allow for the integration of rhythmic patterns from life. The learning environment design and construction idea diagram is shown in Figure 1:

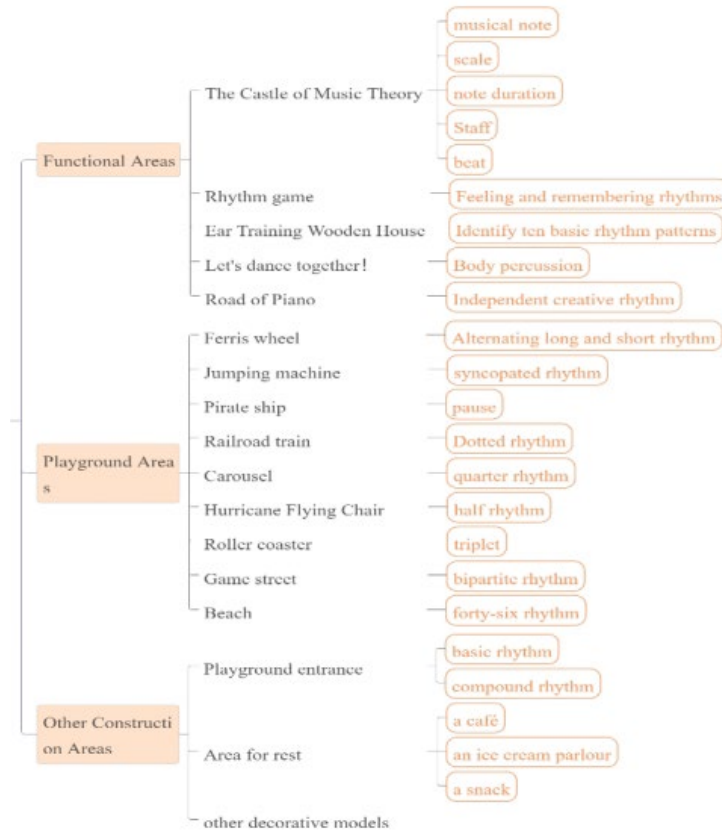


Figure 1. Learning environment design and construction ideas diagram.

## 2.2 Competency training and achievement of results

The organic integration of the game-based learning environment with the rhythmic content of the music is a key consideration in scenario design. Different scenarios and interactions need to be considered in the design process, for the development of learners' knowledge levels and the degree of competence training. The three directions of implementation are divided into five levels, with the aim of allowing learners to develop their knowledge from a beginner's level with no knowledge of music theory to an introductory level with a basic knowledge of music, as well as being familiar with the meaning of the ten basic rhythmic patterns and having a certain level of perception and creativity with rhythm through exploring and exploring the virtual environment. The design strategy and competency training diagram is shown in Figure 2:

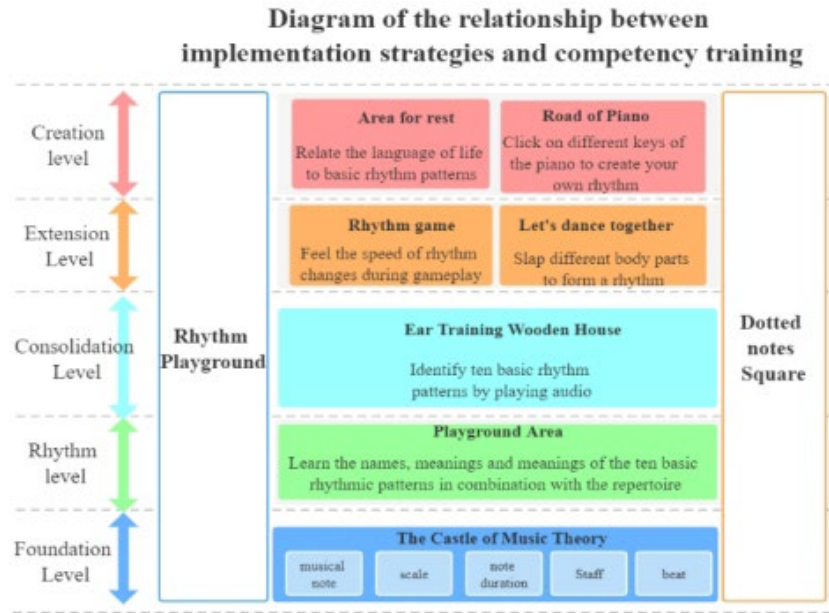


Figure 2. Diagram of the relationship between implementation strategies and competency training.

2.2.1 Foundation Level. Rhythm is the pulse of music, which determines the style and emotional expression of the work<sup>9</sup>. For a beginner, a basic knowledge of music theory is also required before learning rhythmic patterns. The Castle of Music Theory is a basic level implementation of the scene and contains the basics of music in terms of notes, scales, time values, beats and pentatonic, as shown in Figure 3. This functional area is intended to give the user a solid foundation before further practising basic rhythmic patterns through the game experience.



Figure 3. The castle of music theory.



Figure 4. Play video.

Inside Le Li Castle, a learning environment is set up in the form of art exhibitions. The specific implementation methods are divided into three categories:

- (1) One is to change the surface texture of the projected screen to a video that can be played, as shown in Figure 4.
- (2) The other type is to click on the photo frame, and the corresponding knowledge point will pop up in the upper right corner of the screen.
- (3) The last category is to click on the hemispherical transparent glass cover, the glass cover will become transparent, and the chat box will display the note or sound level name under the glass cover while making a sound.

2.2.2 Rhythm Level. The rhythm layer of competence training takes place in the rides area, which features nine infrastructures (Figures 5 and 6): Ferris wheel, Jumping machine, Pirate ship, Railroad train, Carousel, Hurricane Flying

Chair, Roller coaster, game street and beach. When building the models, the rides in the virtual scenes are referenced to the realistic shape of the facilities in reality, and on this basis they are combined with musical elements.



Figure 5. Carousel.



Figure 6. Hurricane flying chair.

According to the plan, a knowledge bar is placed in front of each ride, which is marked with the form of the rhythm pattern, the name, the beat time value in the track and the representative track. Learners can learn the corresponding rhythm pattern knowledge when they go to different areas during the roaming process on the island.

2.2.3 Consolidation Level. The design of the “Ear Training Wooden House” is in the form of a small farmhouse, with the central building being a two-storey dry-pen house with a lower floor mainly used for animal breeding and an upper floor for human habitation. Ten objects with different rhythmic patterns of sound are set up, and by triggering different objects in the area, the rhythmic pattern of the sound emitted by the object is determined.

As shown in Figure 7, in the process of visiting the small courtyard, Click the nine objects, and a dialog box will appear in the upper right corner of the screen to send a message to the designated user. A total of five buttons are set, one can play audio after clicking, one can stop playing after clicking, and the remaining three are rhythm patterns, one of which can be matched with audio as the correct answer.

This level is a further consolidation of the learning of basic rhythmic patterns, where learners can identify the different rhythmic patterns through the audio playback after understanding the types and meanings of the basic rhythmic patterns.

2.2.4 Extension Level. As well as playing beats and enjoying the repertoire, the development of a sense of rhythm in music can also begin by using other forms of interaction. The extension layer is a playful experience that allows students to further broaden their knowledge of rhythmic learning through the use of two functional areas.

(1) Rhythm game has two tracks, both of which have the same overall shape, as shown in Figure 8. Four parking spaces have been set up at the start of each track with four cars parked. The feature area is designed to build a parkour game in three dimensions, with a chat box popping up with notes as the learner sits in the car.



Figure 7. Ear training wooden house.



Figure 8. Rhythm game.

We can control the direction of the vehicle to hit the note by pressing the up, down, left, and right keys on the keyboard. When hitting the correct rhythm note, we will be prompted to add ten points. When hitting the wrong rhythm, we will be

prompted to deduct ten points. At the same time, the car will make a sound when hitting the note. When the finish line is reached, the game score will be announced. When the avatar leaves the vehicle for 2 seconds, the car automatically returns to the parking space at the starting point. At the same time, avoiding the note will affect the driving. When the note is hit, it will translate up 5 meters and return to the original coordinates after 15 seconds. This requires learners to pay attention to different rhythms while experiencing a racing game.

(2) The “Let’s dance together” section was created to highlight the role of body percussion in facilitating rhythm learning. As shown in Figure 9, the movement of the body parts is controlled through the keyboard, where different keys correspond to different notes, and when the notes are clicked to form the corresponding rhythmic pattern, the character shows the corresponding body movements. By allowing the avatars in the virtual world to perform vocal rhythms to the music, students learn to listen to music from a body percussion perspective<sup>10</sup>, develop their sense of rhythm and consolidate their learning of basic rhythmic patterns<sup>11</sup>.











Body Percussion				
				
<b>Q</b>	<b>W</b>	<b>E</b>	<b>R</b>	<b>T</b>
				
<b>Y</b>	<b>U</b>	<b>I</b>	<b>O</b>	<b>P</b>

Figure 9. Posture correspondence table.

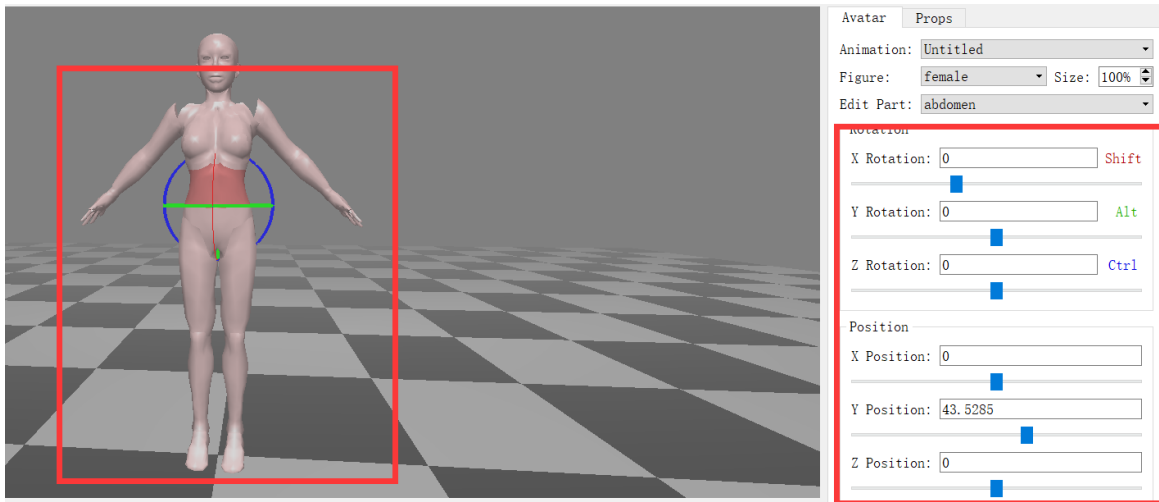


Figure 10. Action page of the Qavimator editor.

The tool used for animation is qavimator in Figure 10, which is a BVH character animation editor. We can select the gender of the character, and then adjust the three-dimensional angle by clicking on the corresponding body part of the character, and we can also adjust the position coordinates of the character.

2.2.5 Creation Level. The self-created area is a piano path, which is the equivalent of moving the eighty-eight black and white keys on the piano to this path. As shown in Figure 11, when the avatar clicks on the keys it can make a corresponding sound, and when the avatar steps on them, the keys glow. The main role of Piano Road is to be used for students to realise their own compositions, where users click on different keys in the virtual world to create their own rhythms for a piece of music. Rhythm creation is a process that consolidates basic music theory while constantly stimulating the students’ imagination.



Figure 11. Piano road.



Figure 12. Rhythmic patterns in life.

As shown in Figure 12, there are also three rest areas on the island, a café, an ice cream parlour and a snack stand near the jumping machine and the pirate ship. When exploring the rest areas, users will find a note placed on the table by the author. The notes contain a number of songs or sayings that are often expressed in our lives. The phrases are divided according to rhythmic patterns and beats, with the addition of a short score, which nicely explores the basic rhythmic patterns embedded in life.

### 3. SUMMARY

The paper follows three directions: the main functional area, the play facility area and the other architectural areas, and is divided into five levels: basic, rhythmic, consolidation, extension and creation levels for the corresponding competence training. In the construction of the gamified learning environment for the basic rhythmic patterns in music, two virtual islands are built in a structured and hierarchical way, taking into account the knowledge level and age of the learners and in accordance with the implementation strategy. A variety of interactive methods were also incorporated through script editing to allow learners to remain highly motivated to learn music theory. A fun learning context is created to experience the different functional areas of the game, to enhance the “sense of movement” and “sense of play experience” in the virtual world, and to stimulate learners’ sense of rhythm, imagination and creativity.

At the same time, the way in which the user learning effects are evaluated in the thesis needs to be improved to facilitate a better integration of the virtual world with the musical rhythm.

### REFERENCES

- [1] Li, M. H., “Course education research,” *Research on the Teaching of Rhythm in Music Class* 25, 157 (2017).
- [2] Liu, Q. X., [The Importance of Rhythm in Music Creation], Chongqing Normal University, (2018).
- [3] Wei, Y. G., [3D Virtual World Design and Production], Electronic Industry Press, Beijing, 1-11 (2015)
- [4] Wei, Y. G., [3D Virtual World Innovation Strategy], Beijing Normal University Press, Beijing, 243-246 (2018).
- [5] Hendaoui, A., Limayem, M. and Thompson, C. W., “3D social virtual worlds: Research issues and challenges,” *IEEE Internet Computing* 12(1), 88-92 (2008).
- [6] Yao, A. P., [Research on Primary School English Game Teaching in Gamified Learning Theory: Based on the Perspective of Teachers’ Practice], (Shanghai Normal University), (2020).
- [7] Ahrens, D., “Sciences serious games—A new perspective on workbased learning,” *Procedia-Social and Behavioral* 204, 277-281 (2015).
- [8] Li, B. Y., [Research on Design and Application of Flipped Classroom Model Based on Gamification Learning Theory—A Case of Grade Seven History Course], Hebei Normal University, Master’s Thesis, (2020).
- [9] Wu, J., “On the importance of rhythm in music teaching,” *Literature Life (Next Trimonthly Publication)* 10, (2013).
- [10] Li, X. Q., “How to improve the quality of music vocal teaching in primary schools under quality education,” *Chinese and Foreign Communication* 27, 324 (2020).
- [11] Liao, M. Y., et al, “The effects of gesture and movement training on the intonation of children’s singing in vocal warm-up session”, *International Journal of Music Education*, (2016).