

# Designing of a study game of the mathematics probability in middle school based on Unity3D

Li Wang \*

Department of education science and technology, Shanxi Datong University, Datong, China

\*wangli523971@126.com

**Keywords:** Game; Modeling; Unity3D

**Abstract.** The emergence of educational games has greatly changed the students' learning style, so that students can combine learning and entertainment, so as to improve the learning interest and efficiency. The article uses 3ds Max as the model design tool to build three-dimensional game scene and props, takes Unity3D as the development platform, uses JavaScript to program, designs the three dimensional study game of the mathematics probability in middle school.

## Introduction

Educational game has a very strong challenge, interesting and interactive, not only can make the students to consolidate the knowledge, expand the knowledge, but also improve the students' imagination, stimulate students' strong desire for knowledge and students' learning motivation, help students form a correct outlook on life and values <sup>[1]</sup>. At present, the main object of the Chinese educational game is preschool children, most of the educational games are 2D, and the 3D education games for middle school students are very few.

This paper takes the mathematics probability in middle school as the study subject, and the probability questions are divided into two parts, the geometric probability and the classical probability, the order is from easy to difficult. In this paper, 3ds Max is used as the model design tool to build 3D game scene and props, Unity3D is used as a platform for game development, JavaScript is used as a programming language to design and develop the game. Let the students experience the game exciting at the same time, to learn and consolidate the knowledge of probability by answering the questions, so that learning is no longer boring, and make students love learning, happy learning, and improve the efficiency of learning.

## Game development tools

3ds Max is software which is developed by Autodesk Company of the United States. It is software which is used for 3D animation. It has a low requirement for computer configuration. It has a very powerful modeling, animation, rendering capabilities. It has a very large number of users, and has been widely used in many fields <sup>[2]</sup>.

Unity3D is a very good game engine. It is easy to use, can be cross platform, especially suitable for individual or small team to develop games. At present, Unity3D in China has reached 90% of the mobile game market share, is the most popular game engine in China <sup>[3]</sup>.

JavaScript is the official programming language of Unity3D, has the advantages of cross platform, easy to operate, easy to use.

## Game development process

First, according to the specific learning objectives designs learning content and game play; and then uses the 3ds Max to build the model and give the material; then put the file into the Unity3D to develop the game, including animation settings, collision detection, layout lighting, add special effects, add music, set up the man-machine interaction; Finally, the system is optimized, which is exported to executable file.

## Game design and implementation

**Game design ideas.** This game belongs to the puzzle game of the secret chamber, the whole structure of the game scene as shown in Fig. 1. This big secret chamber is made of small secret chambers. Fig. 1 shows the position where the player enters the game. When the player enters the game, if he wants to leave the chamber, it is necessary to open the door. When the player goes to the door, he will trigger a trigger, which will pop up a question about mathematical probability in middle school. The first question is quite simple, who learned probability in middle school can solve it, so when the first answer is wrong, there will be the scene of failed the game to tell the game player first go to learn mathematics probability content, and then play the game again. When the first question is answered correctly, the door of the chamber is automatically opened and the player continues to move through the door. Players can go through the hallway to get into second chambers. Different from the first chamber is, from the beginning of the second room, each chamber has a main door and a side door. When the player into the second chamber's main door, it will pop up the second probability problem, the problem is more difficult than the first question. When this question is answered correctly, the main door will automatically open. If the answer is wrong, the side door will open. Side door will also have some mathematical probability problems; these problems are decomposition problems of the problem in the main door. Decomposition questions help game player progressive learning and understanding problems in the main door. The time limit for the game is 25 minutes; the individual problem has no time limit. This setting gives game player a relatively free space. The whole game scene consists of six main roads and six side roads, until the player to open the last chamber door; the game will end, and show the scene of "victory".

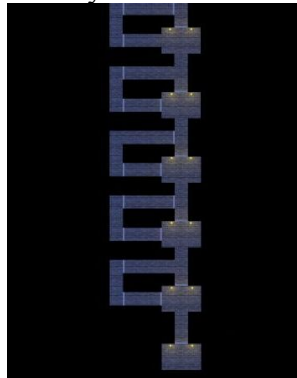


Fig. 1. Top view of the game scene

## Modeling of game scenes and props

**Set up the modeling unit.** In order to let the 3ds Max production of the size of the model is consistent with the actual needs; need to set up the 3ds Max unit<sup>[4]</sup>, the system unit and the display unit are set to centimeter.

**Model the secret chamber.** The method of "polygon modeling" is used in the modeling of the secret chamber. The chamber is divided into two parts, halls and corridors. The whole chamber is composed of several halls and corridors. The hall and the corridor are modeled as initial forms of the "standard base" of the "rectangular body". Need to use the "door" to separate the hall and the corridor in the game. The door of the chamber is modeled by "ProBoolean". The production hall and corridor are laid a good position as shown in Fig. 2, then gives them the "differential set" of the "ProBoolean". After the operation, the effect is shown in Fig. 3. Then take the "rectangular" as the initial body to create the "door" in the empty position as shown in Fig. 3.

Then follow the above method to create other halls, corridors and doors. And then use the "additional" command in the "polygon modeling" combines all the halls, corridors and doors together, and the whole chamber is modeled. The final effect is shown in Fig. 1.

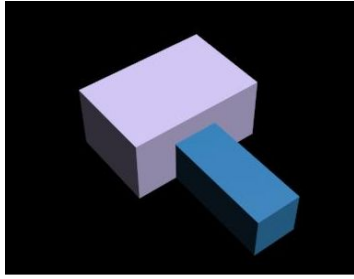


Fig. 2. Box1 and box2 display mode

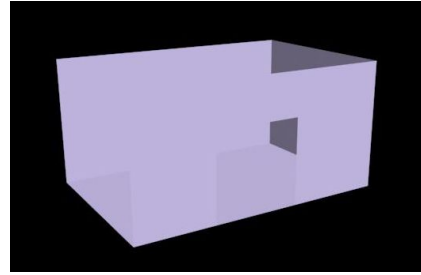


Fig. 3. The outline of the door

**Prop modeling.** In order to create a tense, strange atmosphere, both sides of the hall need to establish some braziers. The brazier production is divided into the brazier and the support production.

The production process for the brazier: Use the "cylinder" as the initial shape and convert it to "edit polygon object". Select the top of the cylinder to enlarge it, and then select "insert" to insert a new surface. Choose the new surface, use the "extrusion", puts the new face down. Using the "cutting" command, a new point will be formed by cutting the opposite vertices of the new surface. Into the "point" subset of the "edit polygon object", using the "select and move" command, this point is slightly pulled.

The fabrication process of the bracket is as follows: Use the "the rectangular body" as the initial shape and convert it to "edit polygon object". To enter the "point" subset, select the "select and move" command, and drop down the middle of the four points, Pull the bottom four points out, and then delete the missing bottom surfaces, and a bracket leg is finished. Then use the "copy" tool to replicate other three legs, put the four legs neatly and combine them. Finally, according to Fig. 4, put the four bracket legs and the brazier together.



Fig. 4. The brazier

### **Produce maps and import models**

Collect pictures of the chamber's wall and brazier, and use Photoshop to modify them. Import the modified picture into 3ds Max, add them to the inner walls and braziers in the game scene. After the whole scene is designed, it will be imported into Unity3D for game design.

### **Game design and implementation**

**Set braziers' light.** Build a point light in Unity3D and modify its related properties, adjust the color to the same color as the flame.

**Produce animations.** The game needs to design the automatic open the door. Use key frames to set up.

**Produce special effects.** The special effects used in the game are "fire", using the particle system to make them in Unity3D. Create a particle system in the grid hierarchy and modify the related properties, add material to the fire, making it more real.

**Design human computer interaction.** Using own characters in Unity3D. Put the characters model that has been imported into the game scene, you can through the keyboard W, S, A, D keys to control the character to move up, down, left, and right.

**Music added.** In order to make the game more attractive to players, need to add background music for the game. Select the main camera, click on the "components", click "Source Audio" under the "Audio" option, and drag the added background music to the main camera. Click the "loop" option in the view panel, adding background music is completed.

In order to create a tense atmosphere, you need to add to the heartbeat of game characters, methods ibid.

In order to make the game can give people a better sense of reality; you need to add the sound of "open door". To complete the addition of the sound, you need to write the code. When you add a sound with the previous method, you need to add the following code to the door.

```
If(doorIsOpen==true)
{Door.audio.PlayOneShot(doorOpenSound);}
```

**Collision and trigger setting.** In order to avoid the emergence of the characters through the wall, you need to add the game collision. In order to people approach the door, the game will automatically pop up a probability problem, need to add the trigger. The game involves the follow collisions: people with ground collisions, people with doors collisions, and people with braziers collision, they are added in the same way. Set the trigger method is: put a "null" in front of each door, add "Box collision" for the "null", in the view panel of space objects, mark the "IS Trigger", and then write the corresponding code.

## Optimization and release of the system

In order to improve the operating speed of the system, we can use the "light texture mapping" technology to render the lighting effects to the scene to achieve the purpose of optimizing the system [5]. After the completion of the system optimization, the entire game can be released as an executable file for students to use. At the beginning of the game scene is shown in Fig. 5, The answer scene is shown in Fig. 6.



Fig. 5. The scene at the beginning of the game

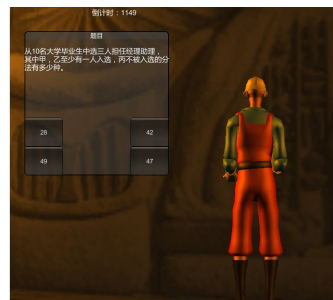


Fig. 6. The scene of the answer

## Conclusion

This paper designs and implements the mathematics probability in middle school education game, which is designed to help students improve their learning interest and learning efficiency. Due to the time of the relationship, the design also can be optimized. Such as: (1) can add some obstacles or organs in the game, make the game more interesting; (2) when the game scene is switched, add some animation to make the game more beautiful.

## References

- [1] Q .Wang, Y.Q. Zhao, The application of educational games in primary school mathematics teaching, J. Software Guide. 20013.12(3):3-8.
- [2] Y .Fan, M. Yang and W.C. Sun, 3ds Max three dimensional animation production base and operating instructions, Beijing: Tsinghua University Press, 2010.
- [3] Y.S. Xuan, Unity3D game development, Beijing: People's Posts and Telecommunications Press, 2012:91-13.
- [4] Li Wang, Researching of the three-dimensional virtual simulation campus scene's construction technology, J. The Open Cybernetics & Systemic Journal. 2015(Volume 9)1056-1057.
- [5] Li Wang, Construction of the three-dimensional virtual campus scene's Problems and Solutions, J. The Open Cybernetics & Systemic Journal. 2015(Volume 9)1132-1133.