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The feasibility of computer games in learning theory based subjects

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Abstract

In the era of rapid development of science and technology where there has been an extensive development of computer games, The scope of this thesis is discussing the research on a computer game called “Treasure Hunt“, and it will establish whether a computer game is helpful and has any advantage in learning as opposed to other traditional teaching methods. The aim of this document is to let players interested in the history of Chinese currency learn more about it, and also to check the memory of the players through the real results of the survey we have conducted. The thesis is also describing how to analyze and evaluate the result by the game and surveys to see if computer games can be considered as a helpful teaching aid. The game is a 3D single player game. The main platform of game is creating in Unity3D .According to the survey results, the entertaining and teaching effectiveness of the game education is working very well. Thus the author can conclude: computer games can be really helpful in education.

Keywords: Game-based Learning, Digital education game, Unity3D.

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1. Introduction

Since 1970, over forty years ago, when educational games first came into classroom education applications, many argue they work very well and have a place among other educational teaching methods, while as others have voiced more critical reservations about game-based learning, and are advocating the return to more traditional teaching methods. The developments of educational media have promoted the advancement of digital education. This situation contributes to the interest of educators and developers. Our research question is about whether digital games can be used to assist students in learning history and culture of different places, or whether other teaching methods are preferred, and we will also discuss how the digital education can become a more useful educational tool. In this study, we have created a digital game about Chinese currency and its history, and we have also conducted post-production and tests, in order to allow users to evaluate our game and give feedback and opinions on it, to determine how they like it as a way of learning, and what aspects they like or dislike about the game as a way of learning.

1.1 Research Problem

We are going to explore whether the feasibility of digital games in learning theory based subjects can produce positive effects in teaching processes by implementing a game based on the Unity3D engine. It will be interesting to find out if an educational game can be helpful in learning, and learn more about how it is perceived by its users.

2 Background

The education technology can be argued is the most important technology in the current world. In our research, we use digital game education to explore the digital education. In digital game education, we discuss three main concepts: E-learning, Game-Based-learning and Serious Games.

E-learning is a way to acquire knowledge and promote learning by using electronic devices. Currently this approach to learning relies on networks and computers. In order to use it more conveniently, a wider variety of devices will be developed in the future that can be used for e-learning. Examples of such devices include wireless devices and smart phones. We can choose the courses we are interested in or that we must learn in a specific school program when we are using E-learning. E-learning may be combined with synchronous and asynchronous access visits. It is also possible to make geographical distribution based on different time limits. [1] The process of developing E-Learning is based on the purpose of training. In this kind of application students can learn through a network anytime and anywhere. It is an important way to learn in the Internet era.

The development directions of Game-Based-Learning are the same as in E-Learning. GBL has three important components: the participatory, educational and classroom games. GBL can activate students' sense of competition to stimulate their enthusiasm for learning and learning ability by using a competitive game. Normally, educational games have a story as a clue and lead the users to learning and exploring. Most educational games have score criteria's; game score is determined by the degree of knowledge. [3] Game-Based-Learning is an important application of serious games. It combines both advantages, which means it is easier to implement training objectives.

Serious games are practical applications that combine entertainment applications and a game; it also improves the effect of the application and the user's experience. Serious games can be considered digital games. These games have the purpose of teaching knowledge and providing professional training. Due to the concept of the "game" has been expanded; the term "serious game" is no longer used. Serious games which were established in the 1980s have been widely used in military, medical, industrial, education, scientific research, training, and many other fields. [4] The game we have created belongs to Digital Game-Based Learning.

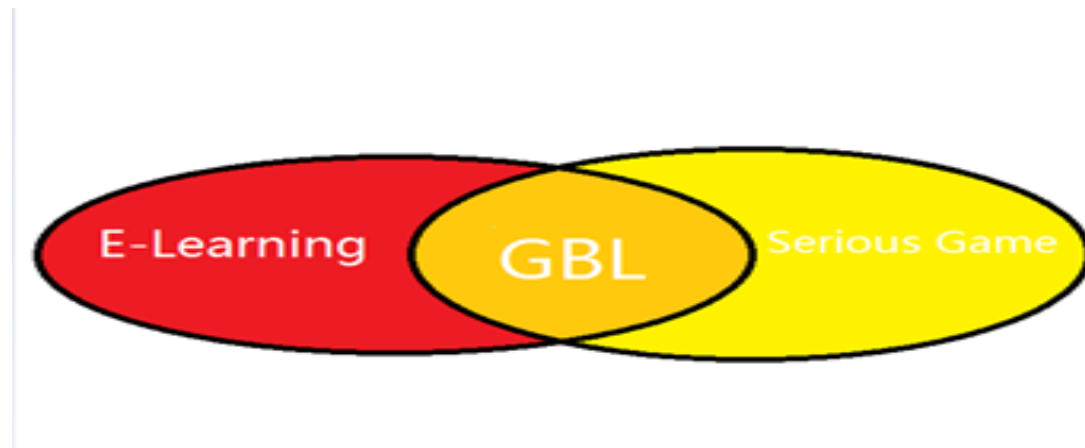


Figure 1: The relationship between E-learning, Serious Game and Game Based Learning.

2.1 Components of Digital Game Based Learning (DGBL)

Marc Prensky described the development of Digital Game-Based-Learning technology as representing the beginning of a new era and the end of the 20th century. [5] The activities of digital game based learning have limitations. Now only simple tasks can be solved by this technical approach. People want to develop it to gain more complete intricate problem solving skills. [6] Here are some necessary components required for effective digital game-based learning:

1. To engage at a high level, students must keep learning.
2. For a strong game-based learning program there must be good rules and goals.
3. Teachers must be sure about the outcome of the game, and provide feedback immediately.
4. It needs to have an interactive role to make the users interactive with themselves and others. [7]

2.2 Main Approach to Create a Digital Education Game (DEG)

Educational game design is a very broad topic, and it involves a lot of different ways and methods. Generally speaking any application that mixes elements of video games and educational effects can be seen as game-based-learning. The main method of creation can be divided into three categories:

1. The use of multimedia teaching present teaching content.
2. Transformation of existing games for educational purposes.
3. Designing the kind of game that has a relative balance between the entertainment and educational aspects. [10]

2.3 How to Evaluate Digital Educational Games?

How to assess the usefulness of games in learning is a controversial problem. Now it is difficult to give an assessment of fixed criteria. Because different games have

different features with different aims and often developed for a specific target group of users. Games can be assessed by looking at factors such as psychological feelings, games enlightening, level of entertainment, how the story or plot of the game works, and other various directions. One established valuation method is based on “activity theory”. There are four main ways to evaluate games by this method: game experience; learning experience; level of adaptively; and usability. Game experience refers to the user’s feeling and emotions during the time the game is played. Game experience determines whether the game is fun enough and if it is easy to understand for the users. “Learning experience” is about the game educational effect and attempts to evaluate if and how users have gained knowledge by playing the game. This is an important element in of testing the usefulness of educational games. It determines whether a particular video game is can be qualified as an educational game. Adaptively refers to whether the game tempo or the game speed gives the player enough satisfaction and feedback. “Usability” refers to how user-friendly the game is, and looks at the game's operability and imagery and other factors which are evaluated. [16] In this research we will use game target and the as the certain method to evaluate the teaching result of the DEG. The “activity theory” will used for evaluating the game.

2.4 The Benefit of Digital Education Game Based Learning

Griffiths says video games and digital games are important tools for education research. Digital games have great diversity, which means they can lead students to grow up from different environments, and encourage students to explore different areas of knowledge. [7] On the other hand, video games can train student skill in computer operation, which is indispensable in the 21st century. [8] A good game can help students learning by practice and reflect on the errors being made when playing the game. Goal-oriented students are able to learn by exploring, based on their interest and curiosity which thereby is facilitating and enhancing their learning skills. [9]

2.5 The Limitation of Digital Education in Game Based Learning

There is another word which is "edutainment ". It has been widely used when discussing game-based-learning. This is education and entertainment combined with advances technologies on many different platforms such as smart phones and tablets. It has been widely accepted and it is a very effective help for learning. [18] For everyone, it is a problem to choose a suitable digital education game. Because of this, it is hard to ensure that the teaching purpose of the game can achieve the learning goals that have been set. It is useful using digital education game at home, because children can easily pick up supplemental extracurricular knowledge in the entertainment. If a school wants use digital education instead of more traditional educational methods, the equipment and the post-maintenance will require an investment in the technology which can be quite substantial. Furthermore, it can be argued that it is difficult controlling the time of using computers without any supervision, especially among groups of young children. There have been a lot of

computer-induced diseases because of using computers for too long time such as: myopia, humpback and exposure to radiation. These aspects have caused some threat for the safety and health of humans using these devices. [7]

2.6 Case Studies of Digital Education in Game-based Learning

Many researchers have carried out research on digital games education. James Pail Gee has discussed video games in learning and literacy in his book. In order to write the book, he played three types of video games. By playing the games he gained understanding of how games directly affect the speed of thinking through the game. Players must learn and think about strategies and methods to pass the game. It means the game will guide the players to learn. He played the "Time Machine" game eight hours, which established the attraction of humans for playing this kind of games. [11]

New multiplayer gaming platforms provide a common network for thousands of players to play, which has lead to an increase of competitive and interactive games. [12] In 2003, Sony produced an online role-playing game named "EverQuest". According to records there are 430,000 players that have joined the game already. [13] Marc Prensky mentions two key concepts in his book: digital natives and digital immigrants. He says that digital natives refer to the generation growing up in the digital environment, they can use different digital media at same time. Digital immigrants refer to the generation growing up before the digital era; they are adapting and learning the digital media. The difference between them is that one is living in the digital media world unintentionally, while the other is trying incorporate digital media into their lives.

Compared with traditional educational methods, digital game-based education is more appropriate in today's society. [14] Santeri Koivisto created a digital educational game named "MinecraftEdu". He and his team require users to process game education by using their game play instruction. This method is a new child-driven pedagogy, this game does not provide a series of tasks and tools you can use. They hope to create a new ideology, to make a more democratic classroom. At present, more than 2,000 schools using their education games for educating students. [15]

2.7 Introduction about Unity 3D

For choosing a suitable creating tool, we had to compare and analyze similar software. There are E-Adventure candidate and Cocos2d-x. E-adventure is a game development tool developed by e-UCM for creating educational adventure games. It can be deployed on Windows and Mac OS X, but it only can be used to develop 2D games, therefore it cannot be considered to a suitable tool for the game. Cocos2d-x is a possible comparable game development engine with unity, except that it has developed by a developer community. Developers can also develop an editor for their

own projects easily. Visual editor is the weak part of Cocos2D-x. Cocos2d-x is more difficult than Unity3D for the starters. Comparing Unity and Cocos2d-x, Unity is more familiar to us, because we have two months in undergraduate courses of Unity, therefore we decided on using Unity as the most appropriate choice.

Unity3D is a game engine that was developed by Unity Technologies, and it was founded in Denmark. It has powerful cross-platform development properties. Component-based development makes the development process more interesting. Another significant feature is that once it is developed it can be easily be used on Windows , Mac, iOS, Android, Wii, PS3 and other platforms. It can easily be implemented whether it is computer games, online games, mobile games or console games. Unity3D makes the game development high-quality.

Unity3D has highly optimized rendering channels that can be used to develop 2D/3D games. The internal encapsulated of DirectX and OpenGL graphics rendering library also contains some commonly used rendering components and scripts and screen effects that are very nice. .It supports three scripting languages: JavaScript, c # and Boo. In Unity the game project is composed by a number of scenarios; different scenarios can be implemented in different game effects. Unity3D does not only integrate Nvidia PhysX physics engine, it encapsulates physical components that are frequently used in the game, such as collision bodies and connectors. [17]

In Unity visual editor, developers can clearly see the level of the game and the whole hierarchy of the project to ensure the game achieves the desired effect. Developers can buy resources (codes, models, etc.) that can develop by others in the resource store for efficient repeated application. This engine contains a Profiler analyzer; developers can analyze the efficiency of the performance of the CPU and the GPU at different stages in the editor or device connection. [17]

A complete unity3d program is a combination of a number of scenes. Each scene has to be created using multiple game objects based on the game needs, and each object can have multiple components. The script component which inherits from MonoBehaviour executes initialization, updates and other operations. The contents exhibited in the scene are controlled by the camera.

Scene: Scene is the basic unit of Unity3D. Any Unity program is a combination of several scenes. The program skips between these scenes through the script.

Game Object: Organization in the scene accordance with the scene graph form became the actual function object by adding specific components.

Components: Components can be: Mesh, Light, Camera, Particle, Collider, Cloth, Joint, Audio, Animation and script.

The based theory of Unity3D is object-oriented design. [17]

3 Method

3.1 Research Strategy

This study was done by creating a digital game that tests whether the teaching through the digital game based learning has a positive effect on teaching. The objective of this study is to implement a video game about China's currency, and then conduct our research based on the use of this game. To assess our games, an intuitive user experience is the most important part. In this paper, the main research strategy is the theoretical framework, data collection, game structure, inspection and evaluation of the game. We have attempted to create a rational structure for the game by learning the scientific literature, and then collecting resources that may be used in the game production. When game implementation was completed we needed to select users randomly to process the game demos and evaluation. After all this was completed, we were able to process the data according to the survey results and make a conclusion.

The needed knowledge can be found by studying academic literature and by reading scientific papers about digital game based learning. The limitation and advantages of digital game based learning is widely discussed, and there is a debate to what extent it is helpful in the learning process and how it affects the outcome of study results. The method to create digital education games will also be used in this paper. All data were collected in the IEEE library and on Google Scholar.

3.2 Data Collection

Before the implantation of the game, the sufficient amount of historical data about the monetary history of China would need to be obtained through various reliable sources.

3.3 Creating a Digital Education Game

3.3.1 Background of the Game

In order to achieve the purpose of publicity of Chinese currency, and prove the efficiency of DEG, we created a role-playing game. The background story of the game was a lost archaeologist, strayed into the labyrinth cave. In order to escape, he must find the Chinese money and then display it in chronological order. The purpose is to make users remember related knowledge by playing the game.

3.3.2 Creating Tool

We used unity3D to design the game. Using this software, developers can automatically generate the game in different version. For example: web version, Android version and Apple version. Moreover, this software contains powerful resources for game design. Developers do not have to do drawing and rendering,

because many of the data has been built as models in this software already. They can be used fluidly. This developer tool makes game creation much easier.

3.4 Test Conditions

The quality and effectiveness of DEG will come through by assessment tests after game completion. The game will be evaluated in the following manner:

1. To assess the content for the game a test method that from the literature review will be used. The game content will be evaluated in these fields:
 1. Game experience
 2. Learning experience
 3. Adaptively and Usability. [16]
2. Participants of the test must answer some basic questions about themselves in order to strengthen the accuracy of the analysis process. 40 people took part of the interviews and were surveyed to collect the valuable information. Those people who were involved in the test were divided into two groups for the memory test. The first group with 20 people played the game we made. The second group also with 20 different people will read a paper .Give them the same time to remember, and the same knowledge to learn. After that they need to answer the same test problem. The correct rate will be used for comparative analysis.
3. Test participant were picked randomly. For testing the game will take place in a café in a shopping mall, because there is WIFI available. Participants answered the questionnaire in two ways. The first way was by submitting answers into our computer; the second method was that we sent a Google website link of the questionnaire by email. By sending the link, participants could answer the questionnaire later at home at their own convenience. But most participants answered by using our computer after playing the game or reading the questionnaire paper. No matter in which way they conducted the test, all the people follow the rules for this research. We asked the participants if they had time to take part of our game test. If they had time, we let them play the game in two minutes and then answer our questionnaire on the internet. For the reading group, we asked random people on the street. The required reading list is very short, so they can finish the reading in two minutes, and then ask the same questionnaire on paper. We tried our best to make all the tests to be done on the same period of time.

4. Implementation of Game

4.1 Introduction of the Game “Treasure Hunt”

The objective of creating this game is using Unity3D to create a 3D education game regarding Chinese currency Culture with a simple operation. This game is based on old Chinese coins that from six different dynasties. The player acts as an archaeologist who must collect the old coins during limited period of time. The background story and the rule of the game will be displayed by five background pictures.

4.2 Game Specification

Name:	Treasure Hunt
Type:	3D PUZ (3D casual puzzle game, Role-playing adventure.
Game model:	Single-player video game.
Game Platform:	PC (Windows)
Background:	One day an archaeologist in China is in a cave by coincidence, there is something flashing inside the cave. Looking carefully, there are ancient Chinese coins. There are six currencies from different dynastic. The archaeologist must take them all out of the cave in 120 seconds.
Rules:	Player should collect six currencies in 120 seconds.
Operation:	Key Keyboard levels of control.
Objective:	Help player remember the right dynastic order of the six currencies

See Appendix A for the implementation

5. Result

5.1 Result of the Memory Test

40 people were interviewed and spent their time to complete the survey. The 40 participants who did the test were divided into two groups for the memory test. The first group with 20 people played the game we made. The second group of 20 people read the paper containing the same factual information as the game. They were given the same time to remember and memories the facts about the coins. After that they answered the same test. [Appendix B] Then we compared the answered and analyzed them.

5.1.1 The information about tester

We wanted to find out some personal details about the test participants in order to make the analysis more accurate and detailed. There were 21 male and 19 female

participants. The gender groups of the test participants were almost equal. The youngest was 17 years old, and the oldest was 70 years old, the average age of the test participants was around 30. They answered the survey by a questionnaire on our Google web page. [Appendix C]

5.1.2 Result of the Questionnaire

55% of the participants were interested to learn about Chinese currency. 60% of the participants read books sometimes, and 13% read books very often. 8% of participants never read books. It seems most people do not have enough time read books or do not enjoy reading books. When they answered the question “Are you using a Smartphone or tablet?” and “do you enjoy playing games on the smart phones or computer?” 90% of the participants said they are using a Smartphone or tablet, and 73% enjoy playing games by their smart phones or tablets. 75% of the participants have used games and educational software for learning in their studies. This indicates that people are increasingly moving towards a digital life style, which is interesting for the scope of our research. 85% of participants found the game/educational software based learning method effective.

There were seven questions for the memory test, which were: “Which is the correct chronological order of the currency? (Oldest currency first)”. The following figure 19 summarizes the accuracy from the two groups in each question and the total percentage of the accuracy. Except for question 7, the questions are about the correct order of the six currencies. The game group received a higher total percentage of accuracy with a test score of 88.6%, compared to the reading group who scored 77.1%.

	Reading Group (Group A)		Game Group (Group B)	
	Correct	Wrong	Correct	Wrong
Question 1	16	4	18	2
Question 2	19	1	19	1
Question 3	11	9	16	4
Question 4	13	7	18	2
Question 5	15	5	15	5
Question 6	14	6	18	2
Question 7	20	0	20	0
Accuracy	77.1%		88.6%	

Figure 2: Memory test answer from all testers

For question 4 “Which is the Tang dynasty currency?” The Tang dynasty was the first image showed to all test participants, but for the reading group there were seven

people that forgot and answered incorrectly. But for the game group there are only two people that answered incorrectly. Thus, the game seems to be more helpful in the process of memorizing facts about Chinese currency to the game player as they remember better compared to reading group of test participants.

5.2 Result of the game implementation

When the players went through the game with the following pictures. The game objective and game rules will be displayed to the players by using text.

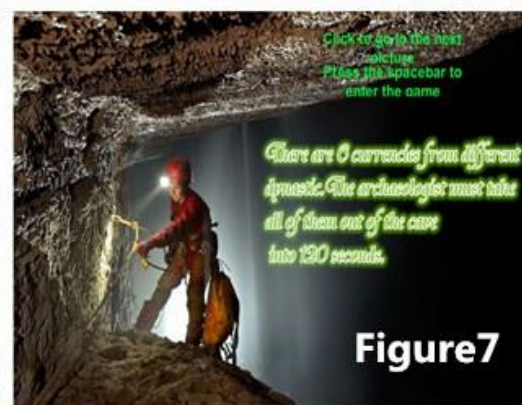


Figure 3: Main Menu.

Figure 4: “Treasure Hunt” the name of the game.

Figure 5: Background story of the game.

Figure 6: Background story of the game.

Figure 7: The game goal and rules.

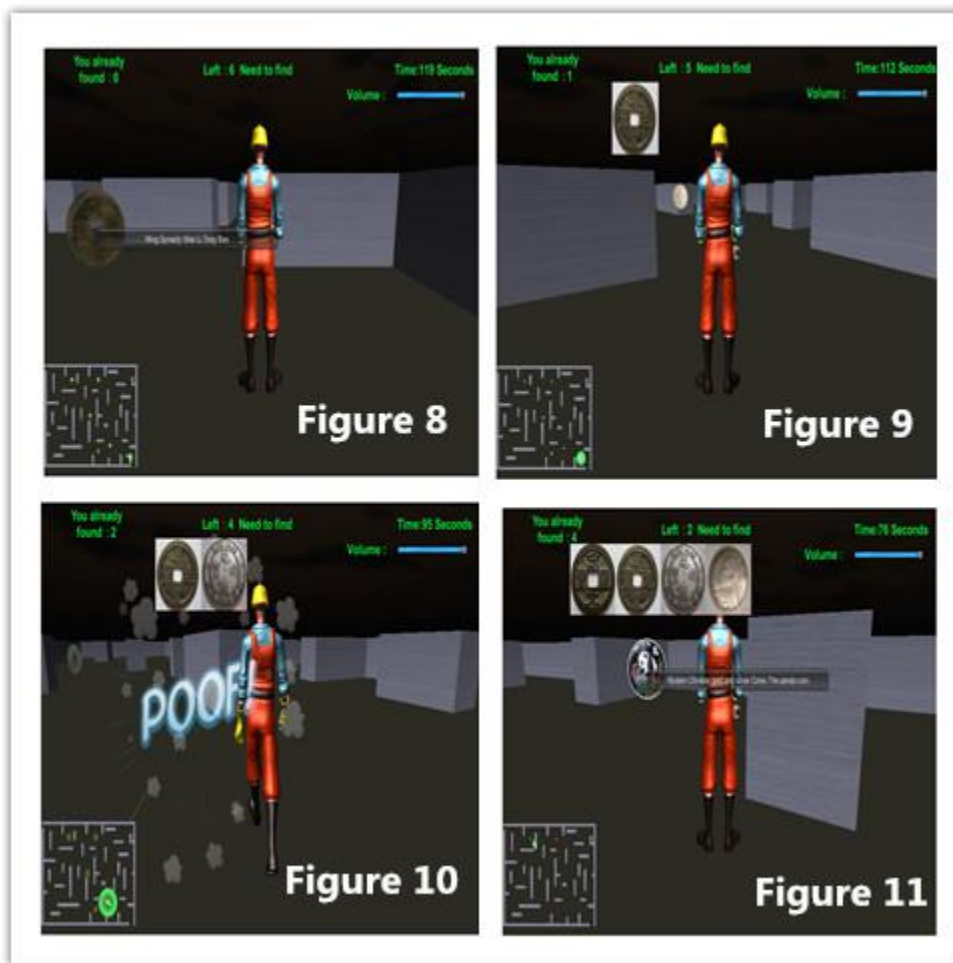


Figure 8: When the player gets into the game, the time counter will start.

Figure 9: When the player gets one of the 3Dcoins the image will show on the scene in the correct order. It helps the player to study the images more closely and memories them. The account of the already collected coins and the remaining coins will be updated at the same time.

Figure 10: Scene Sample.

Figure 11: The information of the coins will show when the player is within range of collecting them.



Figure 12: The player finishes the game in 120 seconds. All the coins and the information of the coins will be shown in the correct order.

Figure 13: The player did not complete the game within 120 seconds. Then they can play the game again. But the coins the player collected from the last time will still show on the scene in order to assist the player to remember the correct currency order more easily.

5.3 The following questions are connected to the method of “Activity Theory”

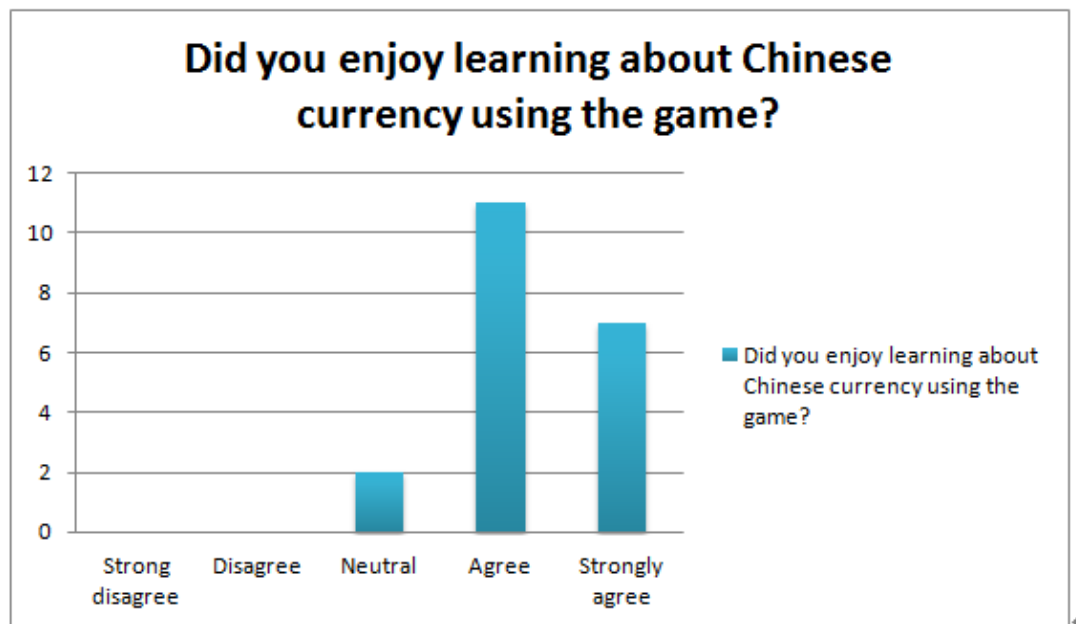


Figure 14: “Did you enjoy learning about Chinese currency using the game?”

This question is related to the concept of “Game experience” [16]. There are five levels for the tester to answer. They respectively are “Strong disagree, Disagree, Neutral, Agree, Strongly agree”. According to the figure 2 of the answer for the question if the user enjoys learning about Chinese currency using the game? It is interesting to note that 11 people agreed with it and 7 people strongly agreed. Nobody said they are not interested in learning. It means most people enjoy learning about Chinese currency using the game.

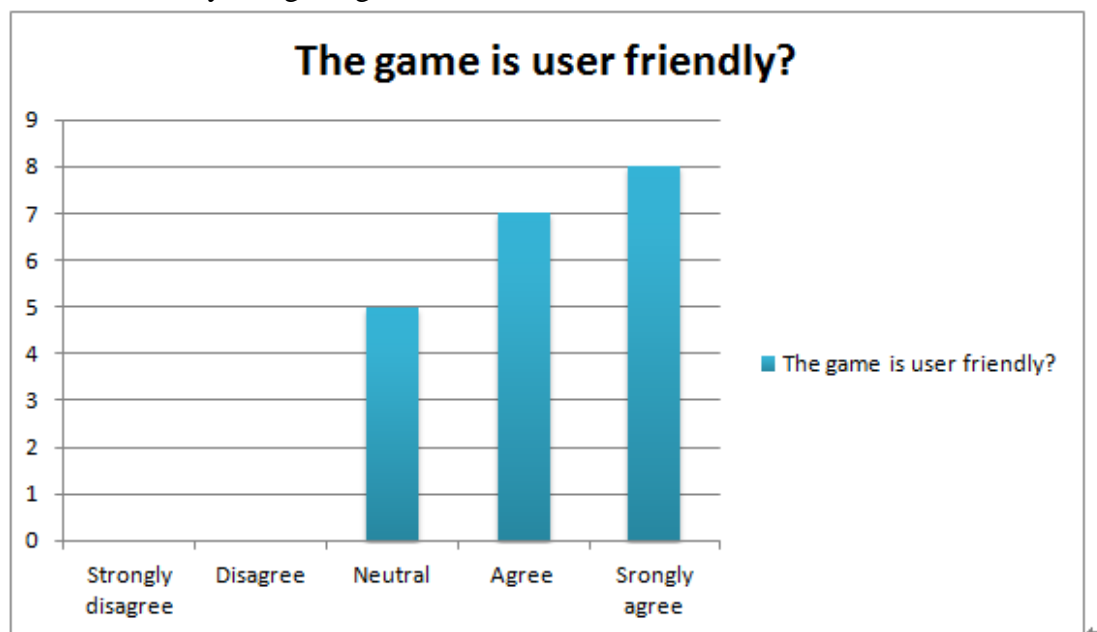


Figure 15: The game is user friendly?

This question is creating in aspect of “Usability” [16].

Follow the result of the figure 21. 8 participants strongly agree, 7 persons agreed and 5 persons were neutral about the question if the game is user friendly. It means 15 out of 20 people think this game it is easy to play.

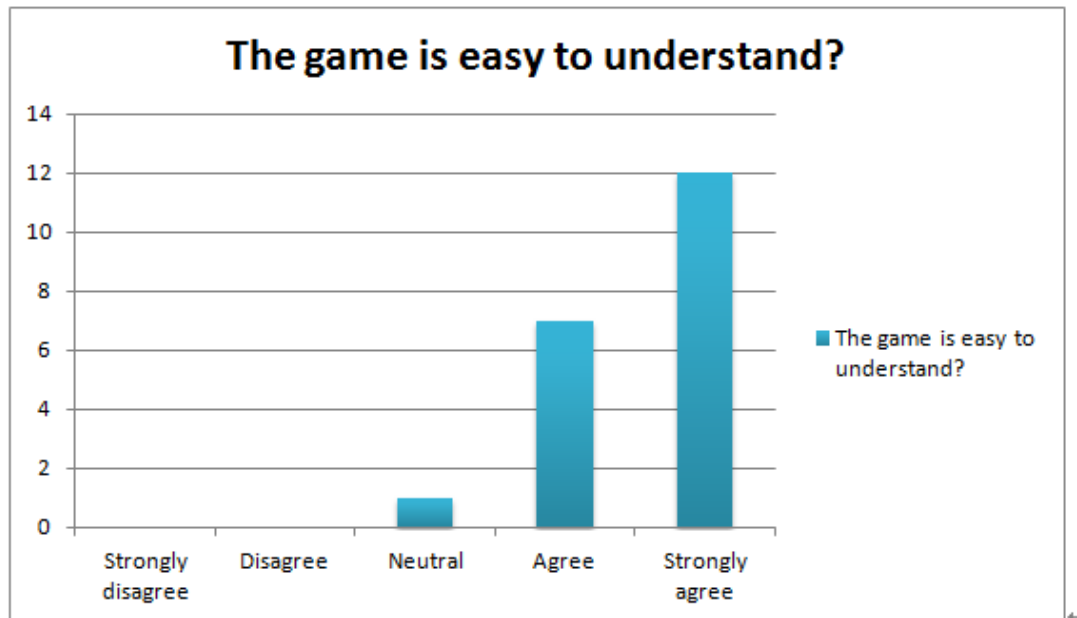


Figure 16: The game is easy to understand?

This question was created as an aspect of “Game experience” [16].

By the figure we can see that most participants strongly agree that the game is easy to understand and only 1 person was neutral. “Strongly agree” and “agree” make up for 95% of people. Thus, the game is really easy to understand for players.

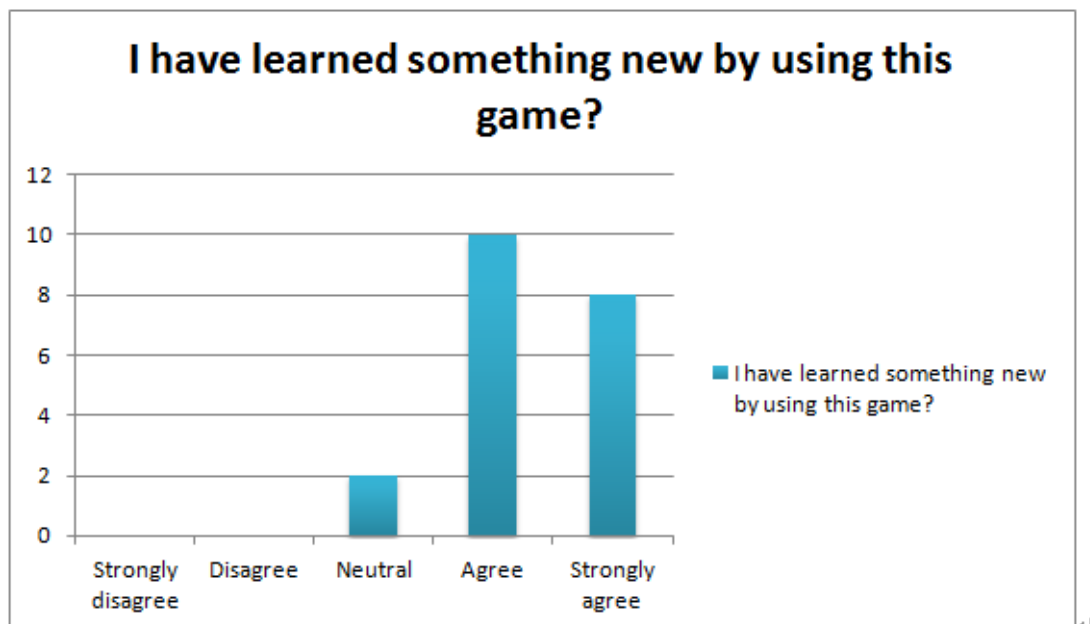


Figure 17: I have learned something new by using this game.

This question was created as an aspect of “Learning experience” [16].

According to the results of the above bar chart, most people agreed and 8 persons

strongly agreed and 2 were neutral. This question was intended to find out to what extent players could learn new things by using the game which is essential for this research filed. Almost all people that completed the test learned some new things by the game.

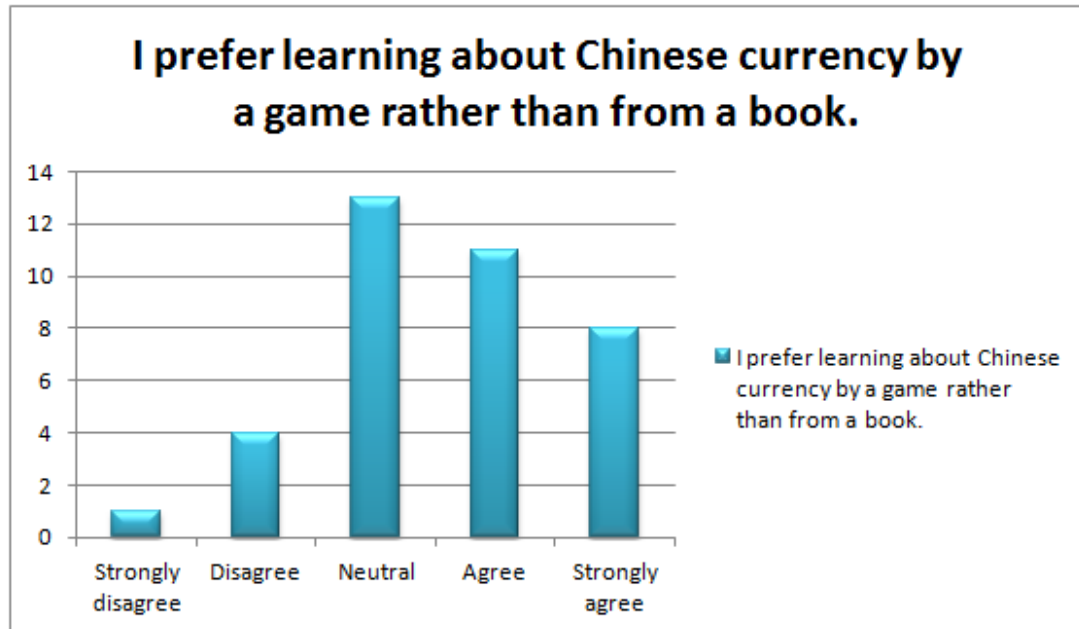


Figure 18: I prefer learning about Chinese currency by a game rather than from a book.

This question was created as an aspect of “Adaptively” [16]. From the bar chart above we can see that most people keep neutral. Because they think that both ways of learning could help them learning about Chinese currency. There were 11 people who agreed and 8 people who strongly agreed that learning about Chinese currency by a game rather then read from books is a better method. But 4 people disagreed and 1 person strongly disagreed that learning from the game is better than learning from a book. Those people prefer reading books in order to learn about Chinese currency.

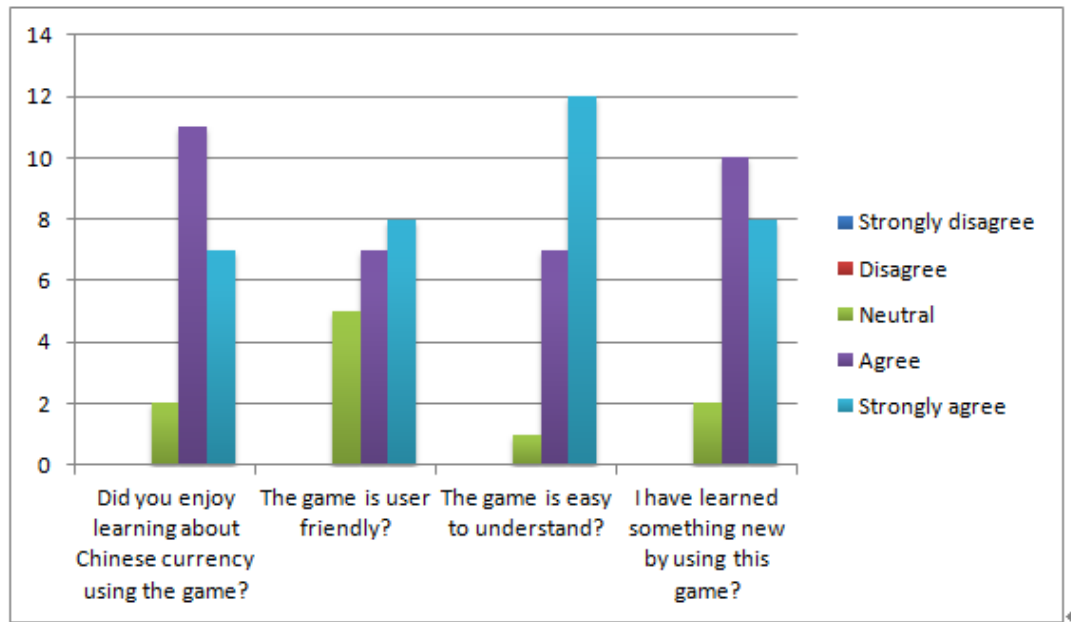


Figure 19: comprehensive problems bar chart.

By this image we could see that most people strongly agree that they think the game is easy to understand. It means the game could help people become interested in learning about Chinese currency, even if this area of knowledge is difficult to learn. But by this game, it is easier making people understand and easier to learn and memories facts. The second high bar chart shows that people are agreeing with that they are enjoying learning about Chinese currency using the game. The third high bar chart shows that people have learned something new by using this game. There are two colors missing which is dark blue and red. It means there is nobody who disagreed or strongly disagreed. So we can say this game not only made people interested but it also helped people learning something about Chinese currency. Even though the Chinese currency is a difficult to become interested in and it is a difficult scope to learn.

6. Discussion

6.1 About the Memory Test Method

In the survey, in order to improve the accuracy of the experiment, we took a one to one approach to conduct the test. The test is about remembering the order of China's Currency; people of Chinese origin have certain advantages, so they were not allowed to participate in the test. For this kind of research consider about the age of the tester and the study ability from difference age levels of tester. That could affect the final test result, which means there could be a high risk if all the tester age is not balanced. But we don't have enough time to find hundreds of people do our test. Instead we randomly pick up 40 people participation this research. Beside if we divide those 40 people into many groups by age then the group sample is too small to be an analysis. Thus may come out a wrong way for the research direction. Basic this problem condition must be involved more people in to the test and divide them into a big group to analyze the result. According to gender, educational level and age, they were divided into two balanced groups to perform the memory tests. 20 respondents (Group A) took the test by reading a paper, the other 20 participants (Group B) played the game. The limit for all of them was two minutes. It is difficult finding two groups of people that are perfectly balanced to reflect society or an entire population, but we feel we achieved a good mix of participants of different nationalities and age groups and educational levels as educational games are made for everyone. We randomly selected 40 people and divided them into two experiments groups (A and B). After the memory test was completed, we let some testers of group A play and assess the game. We also let group B read the paper, and let them choose which learning style they preferred. Although this takes a lot of time, we could ensure that the experimental results and findings are correct. This assessment includes three surveys, one is a memory test, the second is the game assessment, and the third is with regard to the game is a better method of learning compared to traditional methods like reading. To compare the results from the three surveys, in the memory test, the game education group achieved a better result than the reading group. When we conducted the interviews, we found out that the game group said they were particularly focused on the game while playing, but the reading group had problems memorizing and concentrating to the same extent, so some testers believed that game education is better for children with a short attention span, because it can help them concentrate and focus on something without too many distractions in their mind. However, some testers believed that learning by reading is more convenient, because they can repeat the learning and memories things their own way and organize the facts according to their own mind, but the game does not facilitate this. To play the educational game successfully, some strategy is required, which can become boring if played numerous times, so some believe this is a disadvantage of learning by games. About the game assessment: the game did well in the game adaptively, but the usability of the game needs to be improved. In the third test, the tester compared the informational paper with facts of the Chinese currency and the currency game. More than half of the test

participants think that when learning about Chinese currency the GBL is more appropriate than traditional educational methods like reading from a paper. But 30% of the test participants believe that traditional learning is better. The advantages of game education are that it makes the student more focused. Our test results show that those using the game to learn about Chinese currency scored higher than those reading the same information on a paper, this is a signal that demonstrates the strong recognition of the acknowledgement and support for game education.

6.2 About the Game Evaluation Framework

The game evaluation criteria “Activity theory” has been referred in chapter three. The evaluation criteria mean that a game is assessed using four different aspects. According to the four aspects: if it is easy to understand the game, if it is possible to learn something by the game, if it is user friendly, and if it is fun enough. These four issues are very easy to understand for testers, therefore with the help of this theory, it helps making the game assessment more comprehensive.

6.3 About the Unity 3D

Unity is today's most popular game development tool. It is easy to create such as 3D video games, architectural visualization, real-time 3D animation and other types of interactive content integrated multi-platform game development platform, is a fully integrated professional game engine. In Chinese currency education, the teaching efficiency of the game education is higher than in traditional education. The usage of computer games can produce positive effects in teaching processes by implementing a game based on Unity3D engine.

6.4 About the Game

The digital education game can be used to teaching different area knowledge. It can be application in daily life. However, some digital education games already used in skills training for example: driving school. In another hand Digital education game can also be used to learn theoretical facts. The game in this thesis is created for the theoretical facts teaching. Thus testers could learn the order of the Chinese currency.

In the discussion part of the game, we would like to address the disadvantages and advantages of the game, and how people responded on the open question in the questionnaire. There are two open questions in the questionnaire for both groups. One question was: “Which parts of the course did you find the most useful in learning about currency? And Why?” Most people thought that the most useful part was that the game was not only fun to play but also educational at same time. And when they collected the coins in the correct order, it helped them memories. Another question was: “Do you prefer learning about currency by reading books or by using an educational game? And Why?” Obviously, most people preferred learning by playing

an educational game. Because games are often updated with more recent knowledge, and it is faster and easier to absorb the information than reading a book, especially areas that may be considered boring. Educational games can help people becoming interested in a wide area of subjects and enjoying the learning process. Games can help players focusing on something for a prolonged time, but when people are reading books, the mind is often in another place. It seems the majority of people generally are interested in learn new knowledge through an education game in a shorter period of time as opposed to reading. The disadvantage of the game is that the images of the coins are not that clear, and the words of coins name are not big enough for player to read. The advantage of the game is that it is very easy to play and understand, and it helps people learning new knowledge at same time they are enjoying the game aspect.

7. Conclusion

7.1 About the Survey Results

According to the survey results, it is concluded that the educational games are more efficient than learning from more traditional teaching methods like reading books. During the memory test the correct score of the game playing group was higher than the reading group by around 10 percent.

7.2 Conclusion of the Method

The test result of the evaluation was based on the questionnaire for both groups of people for the memory test. One group answered the questions after playing the game. The other group answered the questions after they had read the paper. All answers were collected, and from all those 40 test participants we made the chart bar showing a comparison and evaluation of the results.

For the memory test question 1, question 3, question 4 and question 6, the game group scored higher than the reading group. Among the dynasties, the Ming dynasty, Tang dynasty and Qing dynasty currencies images are similar, so some participants had problems with that. Thus the total percentage of accuracy of the game group is higher than the reading group according to the methods we have used to analyze the evaluation results. The game group could memories more and learns more about Chinese currency.

For the questions “Did you enjoy learning about Chinese currency using the game?” 11 people agreed and 7 people strongly agreed, which means most people enjoyed learning about Chinese currency using the game. This question was asked as an aspect of “Game experience”. The result of evaluating the question: “The game is user friendly?” shows directly that all participants felt this educational game is helpful in

teaching. When it comes to the story of this game, almost all people thought it was easy to understand. However, there are five participants who remained neutral to this question, but no player disagreed or strongly disagreed. For the question, “I have learned something new by using this game.” most people agreed, and 8 persons strongly agreed, and only two were neutral. Somehow, it is important for this research to conclude that almost all the people learned some new things by using this game. This question was asked as an aspect of “Learning experience”. The statement which the participants could agree or disagree with: “I prefer learning about Chinese currency by a game rather than from a book.” left most participants neutral, probably because they believed that both ways could help them learning about Chinese currency. This question was created as an aspect of “Adaptively”.

An efficient evaluating framework about “learning experience”, “usability” and “game experience” was good in these aspects. However, with regards to the “adaptively” aspect, the game is not good enough, and must be further improved.

7.3 Final Research Conclusion

According to the survey results, the entertaining and teaching effectiveness of the game education is working very well. Thus we can conclude: yes, it is feasible of computer education games in learning theory based subjects.

8. Acknowledgements

Finally we have been able to finish our final thesis by going through several months of efforts. We would like to take this opportunity to thank all the teachers to express appreciation and respect for their patience. We have gained a lot of knowledge that we had never learned if it was not for the game application requirements during the process of writing the thesis. We have also learned the impact of game based learning in education. We would especially like to thank Carina Pettersson who is our supervisor for the final thesis. Under her guidance we have learned to have a clear direction and goal, she has provided us with valuable suggestions for this thesis and helped us improve our logical thinking ability. For example, she has taught us how to find resources, ask questions and address problems in an academic and professional way. We also like to thank Torsten Jonsson who is our examiner and help us make our thesis more objectivity and more pertinence. Three years of university life has resulted in this final graduation project, but what we have received is far from just this, we have learned a new way of thinking, and the graduation will be the evidence of our achievement and learning ability facilitated by the great teaching staff. In the end, we would like thank the all authors of the resources we have used. We have read a lot of literature in the process of writing the thesis so that our research is more objective and impartial. Besides, we also want to thank all the 40 participants who helped us answer our questionnaire. They gave us so much valuable information for the research.

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Appendix A:

Creating the Game

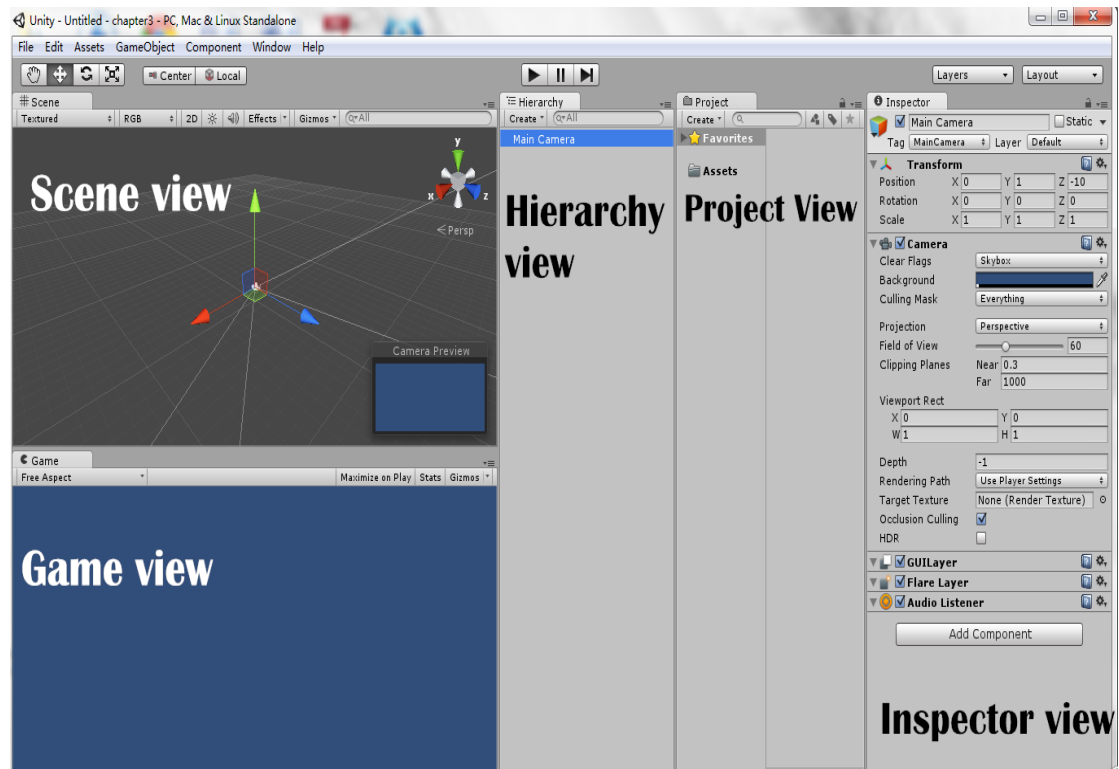


Figure 2: the screen shots of Unity3D

After starting Unity, select the 'File' in the navigation menu after that select "New Project". Set the save path and project name of the game project according to the prompts.

In Unity editor contains five Views. "Scene" View, "Game" View, "Hierarchy" View, "Project" View and "Inspector" View .In Project, the main storage all resource files for current game, such as games and maps and other sound files. In the Hierarchy can create some models, which will be used in the game ,such the Coins that contain in this game, but these models only have a single 3D grid, if you need to add the texture, you need to assign the texture file from Project to this model itself. Inspector is a special views, it is mainly used to description the render and parameters of a game object or game components. Scene View is used to edit the entire game world, the location and size of the model which created in the Hierarchy can change in Scene. Game show the final release of results of the game, it is must be sure to create a camera object in the Hierarchy, otherwise Game view will be dark.

Achieving the Game Framework

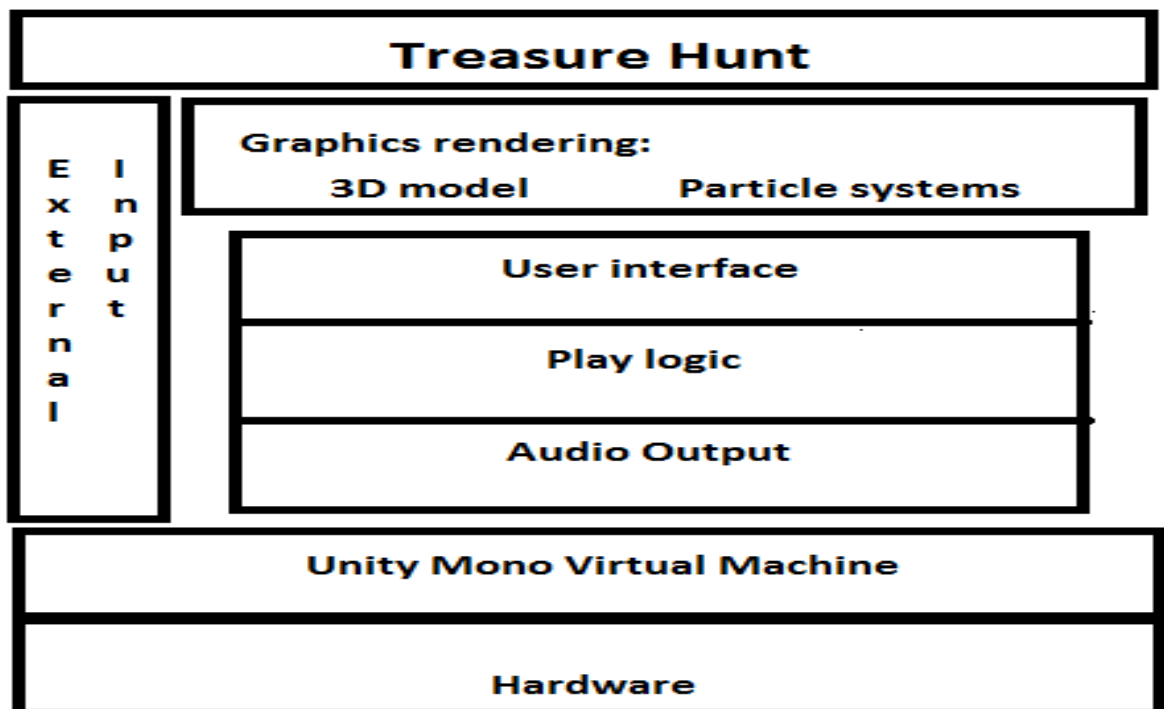


Figure 3: Game framework

At first, we needed to create some model in the Hierarchy. We need a plane, a maze, six currencies, one person and two cameras (one for the whole game the other for the person in mazes.). Adjust their size and location to the appropriate location in the Scene. Addition to currencies system comes with all the other models that we do not need to re-create. All the currency pictures are finds online. For use the currency in the game we need to bake them as a 3D model make them can be used in unity 3D. The process of Baking is unrelated with this thesis do not do a detailed explanation.

Images from the Game

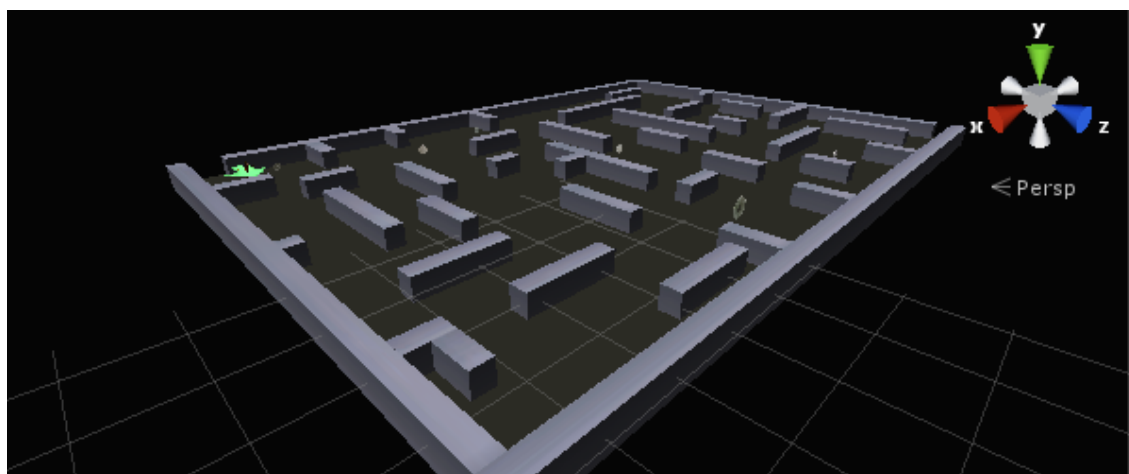


Figure 4: Scene of the maze and plan.

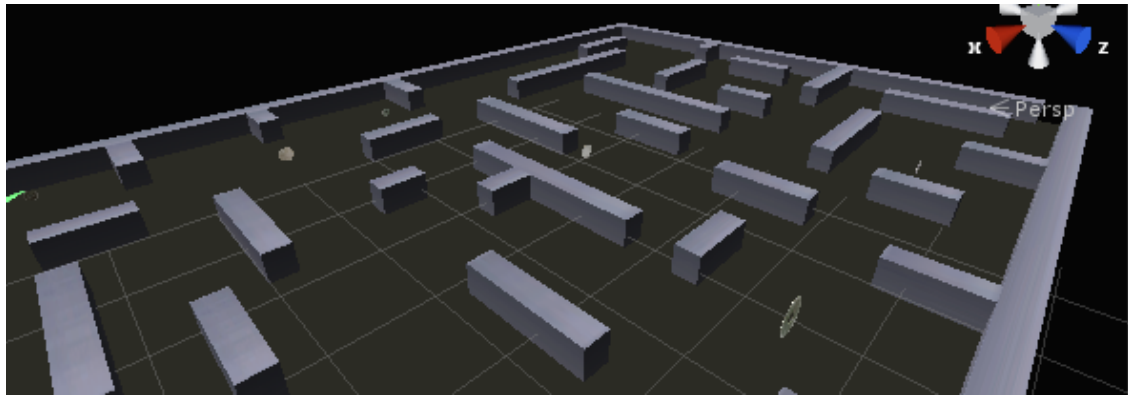


Figure 5: Scene of the coins location.



Figure 6: Scene of the Person in maze.

Game function implementation

We have five classes to achieve our game function:

GameStart: In this script we define the game startup screen. The startup composition by five pictures, click on the picture to go to the next picture press the space bar to enter the game. We use this five picture show the rules.

Huobi: In this script we define the currencies rotation and added a pat make the currency have luminescent effect. People close to the currency in a range of currencies will appear illustrate text. When the characters collide currencies the currency will disappears, the number of find currencies plus one.

Man: In this script is defined the rules of the game, the characters must eat six currencies in 120 seconds .When the task complete will pop “Exit” and “Retry” , if the player failure to complete

pass through the player can choose to “Retry” or “Exit” the game . The definition of the task completion criteria also detailed definition in this script.

ShowPic: In this script, definition of the collision between the currency and the characters, there will be a sound and a picture of currencies after the collision occurred.

SoundSlider: The size of the volume of the game sounds and the control bar is defines in this script.

Code of the Game

GameStart:

```
using UnityEngine;
using System.Collections;
```

```
public class GameStart : MonoBehaviour {
```

```
    public GUISkin mySkin;
```

```
    //save the five background pictures
    public Texture[] mainBack;
```

```
    // Time interval
    float time = 0;
    // Use this for initialization
```

```
    //Choose image
    int tag = 0;
    void Start () {
```

```
    }
```

```
    // Update is called once per frame
    void Update () {
```

```
        //make the picture has the same size with the scene
        guiTexture.pixelInset = new Rect(0, 0, Screen.width, Screen.height);
```

```
        if (tag == 4)
        {
            tag = 0;
        }
```

```

// Press space button to load the game
if (Input.GetKeyDown(KeyCode.Space))
{
    Application.LoadLevel("Game");
}

//Click the picture to see the next picture.
if (Input.GetMouseButtonDown(0))
{
    guiTexture.texture = mainBack[tag];

    tag++;
}
}

void OnGUI ()
{
    GUI.Label(new Rect(Screen.width - 400,30,300,50),"Click to go to the next
picture",mySkin.GetStyle("Label"));

    GUI.Label(new Rect(Screen.width - 400, 80, 300, 50), "Press the spacebar to enter
the game", mySkin.GetStyle("Label"));

}
}

```

Huobi:

```

using UnityEngine;
using System.Collections;

public class Huobi : MonoBehaviour {

    //Particle
    public GameObject pat;

    //if show the UI name on the scene
    bool isShowUI = false;

    //Coins name
    public string coinName = string.Empty;

    //object people

```

```

public GameObject Main = null;

//Main camera
public Camera camera = null;

void Start () {

}

// Update is called once per frame
void Update () {
transform.Rotate(Vector3.up * Time.deltaTime * 100); //Coins self rotation

//if the object getting close to the coins
if(Vector3.Distance(transform.position,Main.transform.position) < 10)
{
isShowUI = true;
}else
{
isShowUI = false;
}
}

void OnGUI ()
{
if(isShowUI)
{
//transform the game world coordinates to the screen coordinate.
Vector3 viewV3 = camera.WorldToScreenPoint(transform.position);

GUI.Button(new Rect(viewV3.x, Screen.height - viewV3.y,400,30),coinName);
}
}

void OnTriggerEnter(Collider other)
{

GameObject tpPat = GameObject.Instantiate(pat) as GameObject; //copy one pat

tpPat.SetActive(true); //Activate the particle

tpPat.transform.position = transform.position; //the pat's position is the position of
the coins

```

```
Destroy(tpPat,1f); //destroy the pat when play it
one second.
```

```
Destroy(transform.gameObject); //destroy the coins
```

```
Man.goodsNum++; //the number of the coins
finding plus one.
```

```
}
}
```

Man:

```
using UnityEngine;
using System.Collections;
```

```
public class Man : MonoBehaviour {
```

```
public int totalNum = 0;
```

```
//fined coins
```

```
public static int goodsNum = 0;
```

```
//set the GUI skin
```

```
public GUISkin mySkin;
```

```
int times = 120; // Sum time
```

```
public float sTime = 0;
```

```
public int currentTime = 0;
```

```
public static bool WLTB = false;
```

```
public static bool GXYB = false;
```

```
public static bool TGTB = false;
```

```
public static bool SYTB = false;
```

```
public static bool YSKXYB = false;
```

```
public static bool XMYB = false;
```

```
//six background picture of the coins
```

```
public Texture2D[] tex = new Texture2D[6];
```

```
//the background picture when the game finish
```

```
public Texture texBG;
```

```

void Start () {
totalNum = GameObject.Find("Goods").transform.childCount;
Time.timeScale = 1;
}

// Update is called once per frame
void Update () {

sTime += Time.deltaTime;

currentTime = times - (int)sTime; //time counter
}

void OnGUI ()
{

GUI.Label(new Rect(20,5,200,50),"You already found : " +
goodsNum.ToString(),mySkin.GetStyle("Label"));

GUI.Label(new Rect(300,5,300,50),"Left : " + (totalNum - goodsNum) + " Need to
find",mySkin.GetStyle("Label"));

GUI.Label(new Rect(Screen.width - 200,5,200,50),"Time:" + currentTime.ToString()
+ " Seconds",mySkin.GetStyle("Label"));

if((totalNum - goodsNum) == 0)
{
GUI.Label(new Rect(Screen.width / 2,Screen.height / 2,250,50),"You
Win",mySkin.GetStyle("Label"));

GUI.DrawTexture(new Rect(0, 0, Screen.width, Screen.height), texBG);

if (GUI.Button(new Rect(Screen.width / 2 - 80, Screen.height / 2, 70, 40), "Exit"))
{
Application.LoadLevel("GameStart");
}

if (GUI.Button(new Rect(Screen.width / 2 , Screen.height / 2, 70, 40), "Retry"))
{
Application.LoadLevel("Game");
}
}
}

```

```

//when time is up
if ((int)sTime >= 120 && (totalNum - goodsNum) > 0)
{
    GUI.Label(new Rect(Screen.width / 2, Screen.height / 2, 250, 50),"You
    Failed",mySkin.GetStyle("Label"));

    GUI.DrawTexture(new Rect(0, 0, Screen.width, Screen.height), texBG);

    if (GUI.Button(new Rect(Screen.width / 2 - 80, Screen.height / 2, 70, 40), "Exit"))
    {
        Application.LoadLevel("GameStart");
    }

    if (GUI.Button(new Rect(Screen.width / 2, Screen.height / 2, 70, 40), "Retry"))
    {
        Application.LoadLevel("Game");
    }

    sTime = 0;
    Time.timeScale = 1;
    currentTime = 0;
    goodsNum = 0;
}

Time.timeScale = 0;
}

if(TGTB)
{
    GUI.DrawTexture(new Rect(50,50,100,100),tex[0]);
}

if(SYTB)
{
    GUI.DrawTexture(new Rect(150,50,100,100),tex[1]);
}

if(WLTB)
{
    GUI.DrawTexture(new Rect(250,50,100,100),tex[2]);
    Debug.Log(WLTB);
}

if(GXYB)

```

```
{
GUI.DrawTexture(new Rect(350,50,100,100),tex[3]);
}
```

```
if(YSKXYB)
{
GUI.DrawTexture(new Rect(450,50,100,100),tex[4]);
}
```

```
if(XMYB)
{
GUI.DrawTexture(new Rect(550,50,100,100),tex[5]);
}
}
}
```

Shoupic:

```
using UnityEngine;
using System.Collections;
```

```
/*
The script for the collision detection script for coins*
*/
public class ShowPic : MonoBehaviour {

public AudioClip clip;

//collision detect
void OnTriggerEnter(Collider other)
{

AudioSource.PlayClipAtPoint(clip,transform.position); //play the collision sounds

//the following code define when the collision happened the litter picture of the coins
will show on the scene

switch (other.collider.name) //the name of the collided coins
{
case "WLTB-M":
{
Man.WLTB = true;
}break;
}
```

```

case "GXYB-Q":
{
Man.GXYB = true;
}break;

case "TGTB-T":
{
Man.TGTB = true;
}break;

case "SYTB-S":
{
Man.SYTB = true;
}break;

case "XMYB-XD":
{
Man.XMYB = true;
}break;

case "YSKXYB-JD":
{
Man.YSKXYB = true;
}break;
}
}
}
SoundSlider:
using UnityEngine;
using System.Collections;

```

```

public class SoundSlider : MonoBehaviour {

```

```

/*
This script use to control the volume of the game.
*/

```

```

//volume value
float value = 1;

```

```

//define UI skin

```



```

public GUISkin mySkin;

void Start () {

}

void Update () {

audio.volume = value;

}

void OnGUI ()
{
mySkin.label.fontSize = 20;

GUI.Label(new Rect(Screen.width - 300, 40, 100, 50), "Volume :",
mySkin.GetStyle("Label"));

value = GUI.HorizontalSlider(new Rect(Screen.width -180 , 60, 150, 50), value, 0, 1,
mySkin.GetStyle("horizontalslider"), mySkin.GetStyle("horizontalsliderthumb"));
}
}

```

Appendix B : Questionnaire

Questionnaire

1. What is your gender?

☐ Male ☐ Female

2. How often do you read books?

☐ Often ☐ Sometimes ☐ Never

3. What is your reading speed?

☐ Slow ☐ Medium ☐ Fast

4. Are you using a Smartphone or tablet?

☐ Yes ☐ No

5. Do you enjoy playing games on smart phones, tablets or computers?

☐ Yes ☐ No

6. Have you ever used games or educational software for learning in your studies?

☐ Yes ☐ No

6.1 If you answered "Yes" to question 6, did you find the game/ educational software based learning method effective?

☐ Yes ☐ No

6.2 If you answered "Yes" to question 6, did you enjoy the experience of using a game/ educational software learning method?

☐ Yes ☐ No

7. Are you interested in learning about the history of money and currency?

☐ Yes ☐ No

Please answer the questions on currency by looking at the pictures



1. Which is the oldest Chinese currency?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

2. Which is the current latest currency?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

3. Which is the Ming dynasty currency?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

4. Which is the Tang dynasty currency?




☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

5. Which is the Song dynasty currency?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

6. Which is the Qing dynasty currency?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

<p>1</p> 	<p>2</p> 	<p>3</p> 
<p>4</p>	<p>5</p>	<p>6</p>



-----7. Which is the correct chronological order of the currency? (Oldest currency first)

- ☐ A. 1, 2, 3, 4, 5, 6
- ☐ B. 5, 3, 1, 4, 2, 6
- ☐ C. 1, 2, 5, 6, 3, 4
- ☐ D. 1, 5, 3, 4, 2, 6

8. I prefer learning about Chinese currency by a game rather than from a book.

- ☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

9. Did you enjoy learning about Chinese currency using the game?

- ☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

10. The game is user friendly?

- ☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

11. The game is easy to understand?

- ☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

12. I have learned something new by using this game?

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

Questions

1. Which parts of the course did you find the most useful in learning about currency?

A.

B.

C. -

Why?

2. Do you prefer learning about currency by reading books or by using an educational game?

- ☐ By reading books ☐ By using a game

Why?

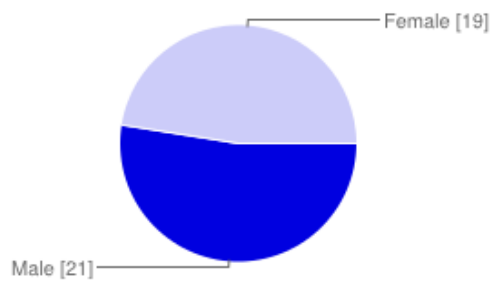
[illegible]

Thank you for participating in this questionnaire.

Appendix C : General result

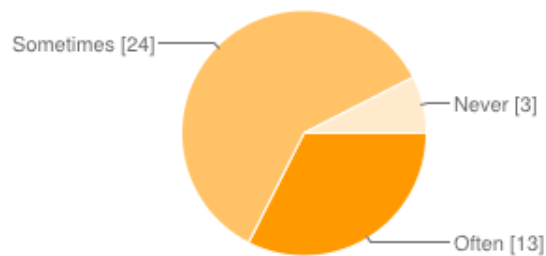
Response summary: 40

1.What is your gender?



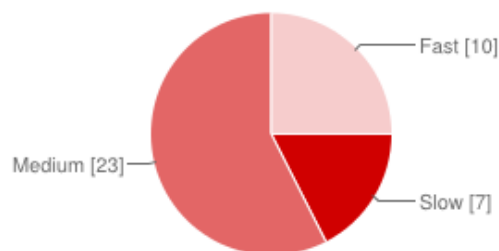
Male	21	53%
Female	19	48%

2.How often do you read books?



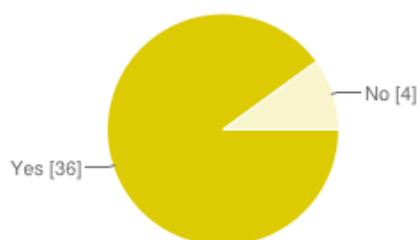
Often	13	33%
Sometimes	24	60%
Never	3	8%

3.What is your reading speed?



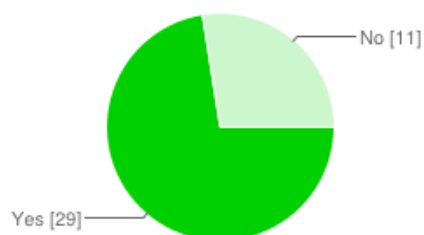
Slow	7	18%
Medium	23	58%
Fast	10	25%

4.Are you using a Smartphone or tablet?



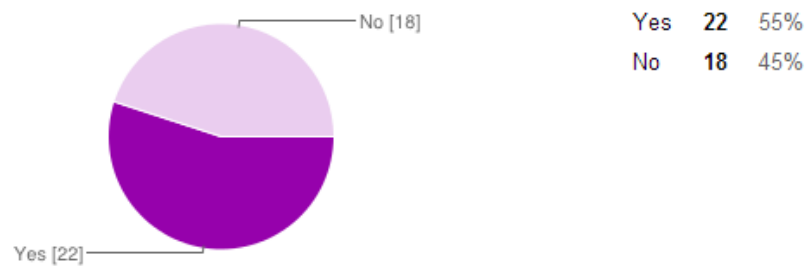
Yes	36	90%
No	4	10%

5.Do you enjoy playing games on smart phones, tablets or computers?

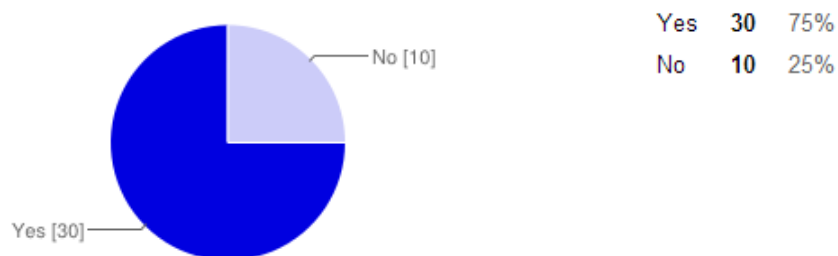


Yes	29	73%
No	11	28%

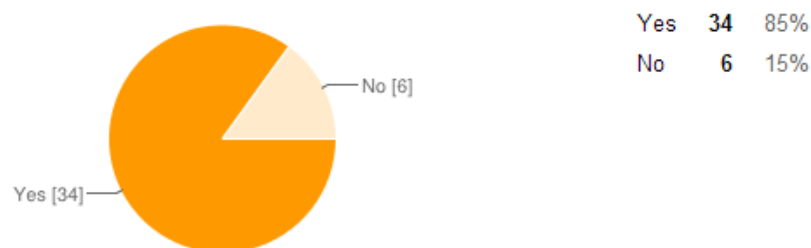
6.Are you interested in learning about the history of money and currency?



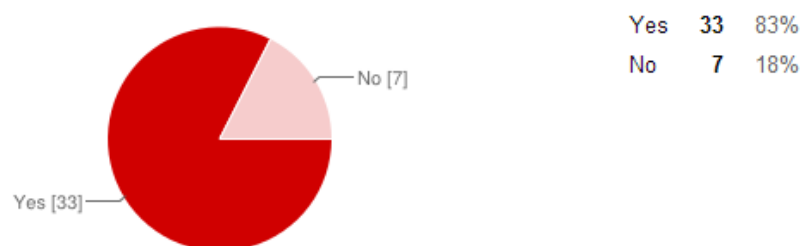
7.Have you ever used games or educational software for learning in your studies?



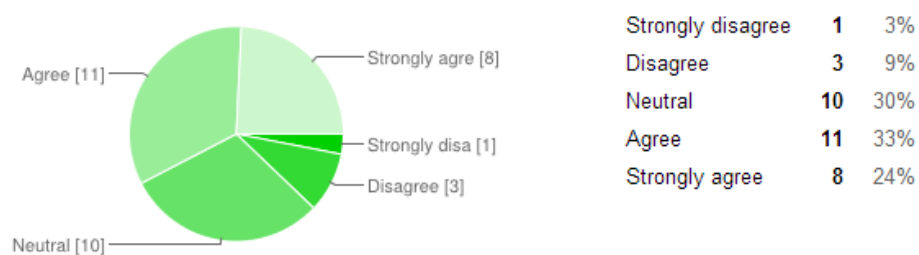
8.Did you find the game/ educational software based learning method effective?



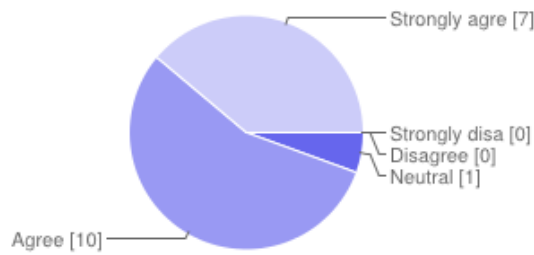
9.Did you enjoy the experience of using a game/ educational software learning method?



17.I prefer learning about Chinese currency by a game rather than from a book.

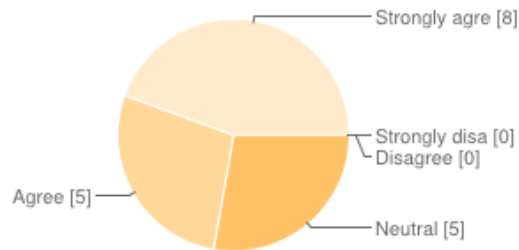


21. Did you enjoy learning about Chinese currency using the game?



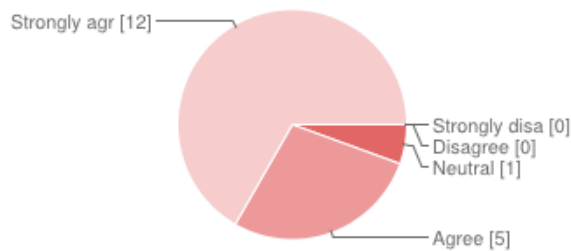
Strongly disagree	0	0%
Disagree	0	0%
Neutral	1	6%
Agree	10	56%
Strongly agree	7	39%

22. The game is user friendly?



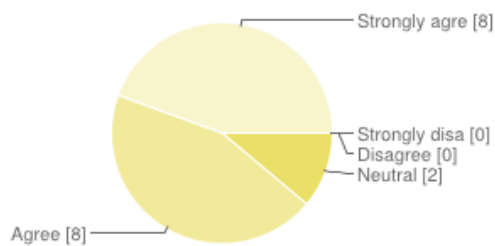
Strongly disagree	0	0%
Disagree	0	0%
Neutral	5	28%
Agree	5	28%
Strongly agree	8	44%

23. The game is easy to understand?



Strongly disagree	0	0%
Disagree	0	0%
Neutral	1	6%
Agree	5	28%
Strongly agree	12	67%

24. I have learned something new by using this game?



Strongly disagree	0	0%
Disagree	0	0%
Neutral	2	11%
Agree	8	44%
Strongly agree	8	44%

Questionnaire (回复) - 第 1 张表 回复

时间戳记	1.What is your gender?	2.How often do you read	3.What is your reading s	4.Are you using a Smart	5.Do you enjoy playing g
2014-7-22 下午01:49:54	Male	Often	Fast	Yes	Yes
2014-7-22 下午04:17:35	Female	Often	Slow	Yes	Yes
2014-7-22 下午04:48:40	Female	Sometimes	Slow	Yes	Yes
2014-7-22 下午05:32:32	Female	Sometimes	Slow	Yes	Yes
2014-7-22 下午10:31:37	Male	Sometimes	Medium	Yes	No
2014-7-22 下午10:55:57	Male	Sometimes	Medium	No	No
2014-7-23 上午10:19:10	Female	Often	Fast	Yes	Yes
2014-7-23 下午02:57:47	Female	Sometimes	Slow	Yes	Yes
2014-7-23 下午03:19:42	Male	Often	Medium	Yes	Yes
2014-7-23 下午07:43:37	Male	Often	Fast	Yes	Yes
2014-7-23 下午08:12:37	Male	Sometimes	Medium	Yes	Yes
2014-7-24 下午04:18:55	Female	Never	Medium	Yes	No
2014-7-25 下午03:01:42	Female	Sometimes	Medium	Yes	Yes
2014-7-25 下午03:25:14	Female	Sometimes	Medium	Yes	Yes
2014-7-25 下午03:25:09	Female	Sometimes	Medium	Yes	Yes
2014-7-25 下午03:29:58	Female	Sometimes	Medium	Yes	No
2014-7-25 下午08:42:35	Male	Sometimes	Medium	Yes	Yes
2014-7-25 下午09:45:42	Male	Often	Medium	Yes	No
2014-7-25 下午09:49:15	Female	Often	Medium	Yes	Yes
2014-7-25 下午09:53:40	Male	Often	Fast	Yes	Yes
2014-7-25 下午10:07:19	Male	Sometimes	Medium	Yes	Yes
2014-7-25 下午10:36:47	Male	Sometimes	Slow	Yes	Yes
2014-7-25 下午10:39:49	Male	Often	Slow	Yes	Yes
2014-7-25 下午10:41:14	Male	Sometimes	Fast	Yes	Yes
2014-7-26 下午02:53:04	Male	Never	Fast	Yes	Yes

时间戳记	1.What is your gender?	2.How often do you read	3.What is your reading s	4.Are you using a Smart	5.Do you enjoy playing g
2014-7-26 下午03:26:31	Female	Sometimes	Fast	No	No
2014-7-26 下午03:45:52	Female	Sometimes	Medium	Yes	Yes
2014-7-26 下午03:57:10	Male	Often	Fast	Yes	Yes
2014-7-26 下午04:04:49	Male	Sometimes	Fast	Yes	Yes
2014-7-26 下午04:22:28	Female	Often	Medium	Yes	No
2014-7-26 下午04:28:36	Female	Often	Medium	Yes	Yes
2014-7-26 下午05:51:48	Male	Sometimes	Slow	No	Yes
2014-7-26 下午08:36:17	Female	Often	Medium	No	No
2014-7-26 下午08:37:10	Male	Sometimes	Medium	Yes	No
2014-7-26 下午08:38:48	Male	Sometimes	Fast	Yes	No
2014-7-26 下午09:04:12	Male	Sometimes	Medium	Yes	Yes
2014-7-27 下午01:02:42	Male	Sometimes	Medium	Yes	Yes
2014-7-27 下午04:05:03	Female	Never	Medium	Yes	Yes
2014-7-27 下午08:36:52	Female	Sometimes	Medium	Yes	Yes
2014-7-28 下午04:27:00	Female	Sometimes	Medium	Yes	No

6.Are you interested in I	7.Have you ever used g	8.Did you find the game/	9.Did you enjoy the expe	10.Which is the oldest C	11.Which is the current I
Yes	Yes	Yes	Yes	1	4
Yes	No	Yes	Yes	1	4
Yes	Yes	Yes	Yes	1	4
Yes	Yes	Yes	Yes	1	4
Yes	No	No	No	1	4
No	Yes	Yes	No	1	4
No	No	Yes	Yes	1	4
Yes	Yes	No	Yes	1	4
Yes	Yes	Yes	Yes	1	4
Yes	Yes	Yes	Yes	1	4
No	Yes	Yes	Yes	1	4
No	Yes	Yes	No	2	4
No	Yes	Yes	Yes	1	4
No	Yes	Yes	Yes	1	4
No	Yes	Yes	Yes	1	4
No	Yes	Yes	Yes	1	4
Yes	Yes	Yes	Yes	1	4
Yes	Yes	No	Yes	1	6
Yes	Yes	Yes	Yes	1	4
No	No	No	No	1	4
Yes	Yes	Yes	Yes	2	4
No	Yes	Yes	Yes	2	4
No	Yes	Yes	Yes	1	4
No	Yes	Yes	Yes	1	4
Yes	Yes	Yes	Yes	5	4

6.Are you interested in I	7.Have you ever used g	8.Did you find the game/	9.Did you enjoy the expe	10.Which is the oldest C	11.Which is the current I
Yes	Yes	Yes	Yes	1	8
Yes	Yes	Yes	Yes	1	4
Yes	No	Yes	Yes	1	4
Yes	Yes	Yes	Yes	1	4
Yes	No	Yes	Yes	1	4
Yes	Yes	Yes	Yes	1	4
No	Yes	Yes	Yes	1	4
No	Yes	Yes	Yes	5	4
No	No	No	No	1	4
No	Yes	Yes	Yes	2	4
Yes	No	Yes	No	1	4
No	No	No	No	1	4
No	No	Yes	Yes	1	4
Yes	Yes	Yes	Yes	1	4
Yes	Yes	Yes	Yes	1	4

12.Which is the Ming dy	13.Which is the Tang dy	14.Which is the Song dy	15.Which is the Qing dy	Which is the correct chro
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	2	1	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
1	5	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	2	1	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
3	1	2	4	1, 2, 5, 6, 3, 4
2	5	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
3	1	6	5	1, 2, 3, 4, 5, 6
6	2	1	4	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
2	1	3	6	1, 2, 5, 6, 3, 4

12.Which is the Ming dy	13.Which is the Tang dy	14.Which is the Song dy	15.Which is the Qing dy	Which is the correct chro
3	1	5	1	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	2	3	6	1, 2, 5, 6, 3, 4
5	2	6	6	1, 2, 5, 6, 3, 4
3	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
3	6	2	1	1, 2, 5, 6, 3, 4
3	1	2	4	1, 2, 5, 6, 3, 4
6	2	3	4	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
2	1	4	5	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
5	1	2	6	1, 2, 5, 6, 3, 4
3	1	2	6	1, 2, 5, 6, 3, 4

17.I prefer learning about Chinese currency by a game rather than from a book.
Neutral
Strongly agree
Strongly agree
Neutral
Agree
Agree
Neutral
Disagree
Strongly agree
Strongly agree
Strongly agree
Strongly agree
Neutral
Agree
Agree
Agree
Disagree
Agree
Agree
Strongly disagree
Agree
Agree
Disagree

4

17.I prefer learning about Chinese currency by a game rather than from a book.
Neutral
Neutral
Neutral
Neutral
Agree
Strongly agree
Neutral
Neutral
Neutral
Disagree
Neutral
Strongly agree
Agree
Neutral

19.Do you prefer learning about currency by reading books or by using an educational game?Why?	21.Did you enjoy learning	22.The game is user frie
Playing game	Strongly agree	Strongly agree
education game , because it's more funny to learn new and boring knowledge.	Strongly agree	Strongly agree
education game , because it's more funny to learn new and boring knowledge.	Strongly agree	Strongly agree
i haven't seen the game, so I do not know		
Game. It's easier to learn when it's fun.	Agree	Agree
To know the value of the coin and the histori of the coin	Agree	Agree
Don't actually know about any games that would present reliable knowledge about historically accurate facts about currency. For that reason, the books/various int		
not really interested in history of currency, but googling something about is good enough		
it is much more fun and you don't have to be able to know the languages , to well at least.	Strongly agree	Strongly agree
i prefer the game because when you play you have to focus but when you read your mind is often in another pl	Agree	Neutral
i prefer the game because when you play you have to focus but when you read your mind is often in another pl	Agree	Neutral
i prefer the game because when you play you have to focus but when you read your mind is often in another pl	Agree	Neutral
games. because its both fun and learning.		
Game is more fun and probably more efficient for learning facts. Book is maybe better if I don't need to learn it in detail, but only need to know where to find the inf		
By using games		
By reading books, it's better to memory because i can back as i want.		
By reading books, More detailed information		
By game, because it's more interesting		
reading paper		
By using games		
by reading books		
education game is more fun then read a book	Agree	Strongly agree
game, its more interesting.	Agree	Agree

19.Do you prefer learning about currency by reading books or by using an educational game?Why?	21.Did you enjoy learning	22.The game is user frie
both , games stimulate memory, so you remember styles and chronology better, books for more detail studies	Strongly agree	Strongly agree
Combin	Neutral	Agree
both, they compliment each other	Agree	Neutral
reading paper	Agree	Agree
A combination. It is good with a part where you yourself get to do something	Agree	Strongly agree
U can update the game, not the book.	Agree	Agree
playing games		
playing games		
reading paper		
Using a game , More fun more easy to learn		
Not much interested in learning	Neutral	Neutral
yes, the game would be easy to get interesting to learn history knowledge like this game.	Strongly agree	Strongly agree
Yes. It is more interesting and takes shorter time to learn through games	Strongly agree	Agree
play games, more focuse		

23.The game is easy to	24.I have learned somet	23.Which parts of the co	24.Do you prefer learnin	18.Which parts of the course did you find the most useful in lear
Strongly agree	Strongly agree	game base study	yes its easy for me then	read books
Strongly agree	Strongly agree			the order of the currency
Strongly agree	Strongly agree			the order of the currency
				(which course?) the reading material was the most useful
Agree	Agree			to learn from a good friend, because she is like a good teacher
Agree	Agree			The Histori
Strongly agree	Strongly agree			the game and that it was easy to play the game. that you learn a
Strongly agree	Agree			i think that when collecting the coins in the game you saw the co
Strongly agree	Agree			i think that when collecting the coins in the game you saw the co
Strongly agree	Agree			i think that when collecting the coins in the game you saw the co
				when yuan learned me about it.
				? I didn't attend any course.
Strongly agree	Agree			
Agree	Agree			

23.The game is easy to	24.I have learned somet	23.Which parts of the co	24.Do you prefer learnin	18.Which parts of the course did you find the most useful in lear
Strongly agree	Strongly agree			memory test
Agree	Agree			Final picture
Agree	Agree			the years of different dynastic monetary systems
Agree	Agree			Pictures
Strongly agree	Strongly agree			the pictures
Agree	Neutral			Material
Neutral	Neutral			
Strongly agree	Strongly agree			
Strongly agree	Strongly agree			Learn about the difference of different coin
				The picture of coins

20.How did you learn Chinese currency ?	
Playing games	
Reading paper	
Playing games	
Playing games	
Reading papers	
Reading paper	
Reading paper	
Playing games	
Playing games	
Reading paper	
Reading paper	
Playing games	
Playing games	
Playing games	
Playing games	
Reading paper	
Reading paper	
Reading paper	
Reading paper	
Reading paper	
Reading paper	
Reading paper	
Reading paper	
Playing games	

20.How did you learn Chinese currency ?	
Playing games	
Playing games	
Playing games	
Playing games	
Playing games	
Playing games	
Reading paper	
Reading paper	
Reading paper	
Reading paper	
playing games	
Playing games	
Playing games	
Reading paper	

Appendix D : Figures:

Figure3:



Figure 4:



Figure5:



Figure6:

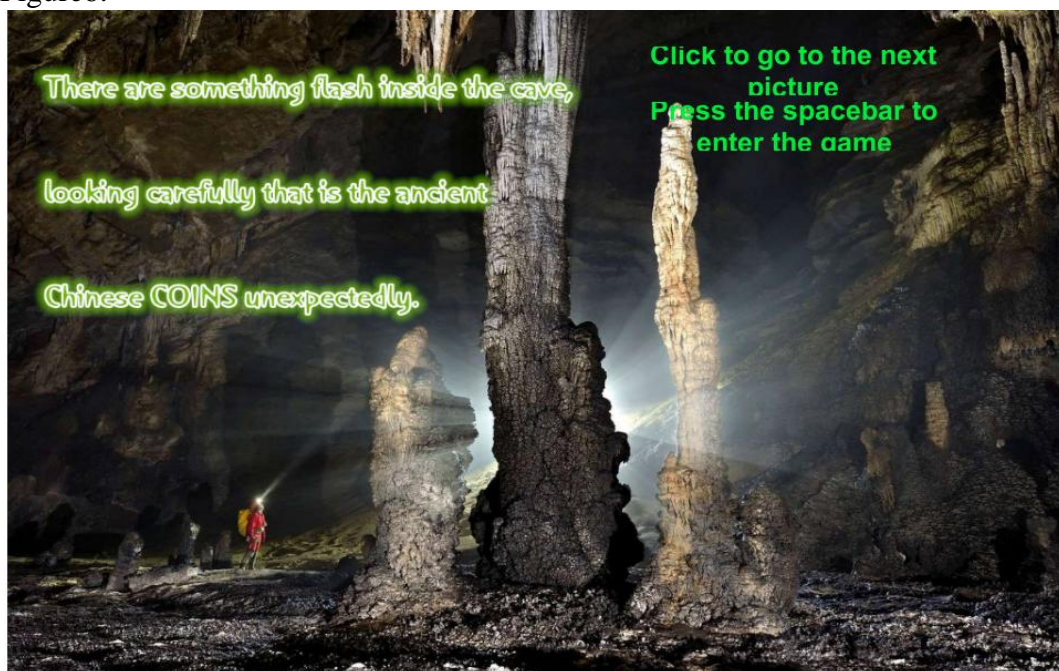


Figure7:

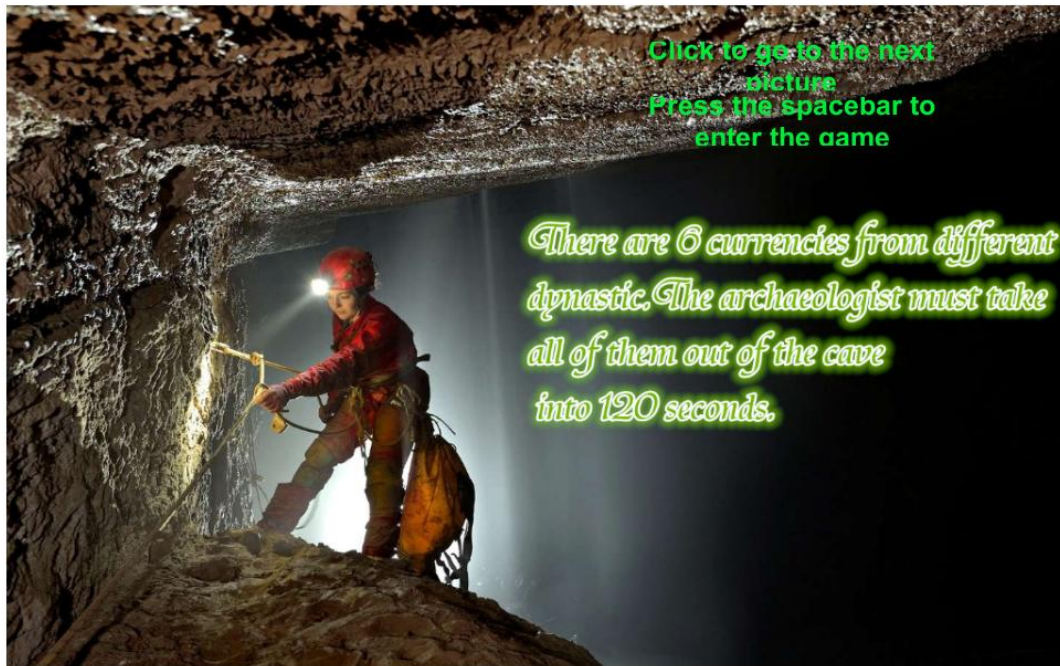


Figure8:



Figure9:



Figure10:



Figure11:

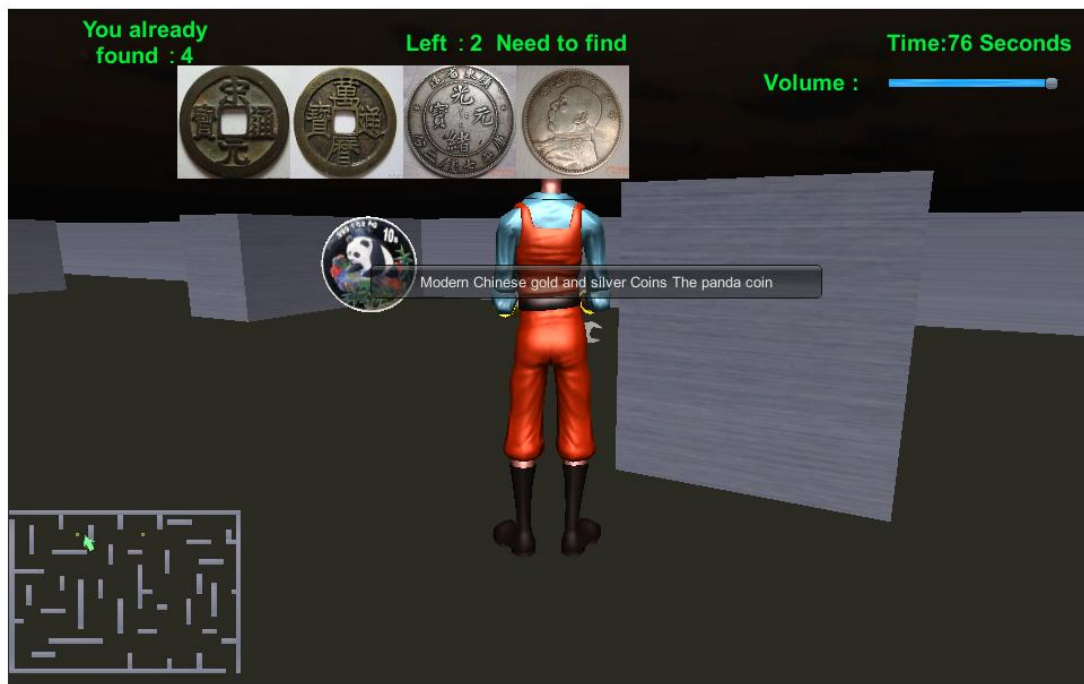


Figure12:



Figure13:

The right order from ancient to modern times



Tang Dynasty
Tang Guo TongBao



Song Dynasty
Song and yuan TongBao

Exit Retry



Ming Dynasty
Wanli TongBao



Qing dynasty
Guangxu wu



Republic of China
Yuan shikai silver



Modern Chinese gold
and silver COINS
The panda coin