Degree project

The study of digital game-based learning on motivating Chinese primary students to study mathematics

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Abstract
The research focus of this paper discusses digital game-based learning as a novel learning approach and further emphasises on the empirical study of technologies motivating Chinese primary students to study and learn mathematics at home. Considering that digital game-based learning is still under development, the effects of it is still controversial. The aim of this research is to examine family users of digital game-based learning systems through online research methods. It is interesting to study this area from the family users’ perspective because of the online context. In China, the concept of education in the family environment is one full of challenges. The design of a digital game-based learning (DGBL) system needs to consider and balance both parents and young learners’ needs. In order to have a comprehensive understanding of the benefits and issues of a DGBL system in China, a qualitative study was employed with an interpretive research approach using online data collection methods. After analysing the empirical findings, the results of the study will be produced. They will help to examine whether DGBL is a favourable approach to aiding Chinese primary students to study mathematics and improve their academic performances at school. The outcomes of this study are expected to contribute to informatic research and design of future DGBL systems.

Keywords
Digital game-based learning, DGBL, Qualitative research, Qualitative data and Online research
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List of abbreviations
AI    Artificial intelligence
AR    Artificial reality
ICT   Information communication technology
IF    Interactive fiction
IMR   Internet-mediated research
IS    Information science
DGBL  Digital game-based learning
NPC   Non-Player Character
1. Introduction
1.1. Background
In the modern world information and communications technology (ICT) is defined as “a convergence of computer technology, telecommunication technology and media technology” and is progressively used more and more; it has now become embedded in almost every part of our lives (Bradley, 2010). However, there is a central concern in building a responsible ICT society that uses an ICT education to lessen poverty in developing countries.

According to the convergence model proposed by Bradley (2010, p. 186), it is understood that “the professional role, private role, citizen’s role and learning role are converging” on a home and the home environment. A home is embedded with many different technologies, developing into a multifunctional space described by Bradley (2010, p. 186) as “a care centre; a multimedia centre; a centre for democratic dialogue; a market place; a learning centre; an entertainment centre”.

With the prevailing use of computers, technology has become a medium of communication, not only for work and in the office, but also for entertainment and education at home (Dahlbom, 1996). During the past decade, Digital game-based learning (hereinafter referred to as DGBL) system is gradually being accepted as a pedagogical tool for schools and parents in Western countries. This trend of a DGBL system was firstly defined by Prensky (2003) as a merger between the most fascinating and interactive innovations of the best computer and video games with detailed academic content.

Gee (2003) highlights that motivation is essential to drive learning. Previous researchers have clarified that DGBL can improve people’s motivation to learn. For example, Prensky (2003) argues that digital games have the magic to keep people interested in learning, giving them an initiative instead of forcing them to learn. Based on Flow Theory, Para and Bizzocchi (2005) indicate that games cultivate play, this creates a state of flow, which boosts motivation, and then reinforces learning. Salavati (2016, p.36) states that “students who enjoy that teaching approach will most likely succeed within their studies”.

Many parents still tend to think of digital “games as frivolous at best and harmful at worst” (Prensky, 2003), despite many previous studies showing that digital games can be regarded as a useful learning tool (Gee, 2003; Kiili, 2005; Neville, et al., 2009).

Prensky (2003) stresses that digital games are not the enemy of parents, but are the best opportunity to engage children in real learning. During the past few years, the attitude of parents to digital games has started to change. More and more parents are realising that digital games are beneficial rather than harmful. In the summer of 2016, Pokémon Go, a mobile app game, was released and immediately became one of the most popular apps around the world. It was easy to notice that both parents and their children were playing in outside so that they could catch Pokémon. This game worked as a bridge to improve family communication.

1.2. Purpose Statement
Inheriting the Confucian legacy, China has a superior high stakes exam-oriented culture and a long custom of prizing academic success. Especially before a university education, Chinese students have to work incredibly hard; they study immensely for various tests and to enter a good university. Also, Tan (2012, p.161) declares that:
“In China, academic achievement is the perceived passport to social and economic mobility and success in life, hence the popular sayings in China that ‘No poverty is worse than a poor education’ and ‘One exam will determine your entire life’. Moreover, a highly competitive society with limited university places and the one child policy in China invariably place a huge burden on the students themselves who feel obligated to obtain good grades for the sake of their parents.”

Computers are only used in a computer course, and many schools even forbid students bringing smartphones to school because they are considered as a huge distraction from learning.

Many Chinese parents still think that computers and video games are frivolous at best and toxic at worst. What is more, several months ago in China, a sensational news story shocked the country. It concerned parents who sent their children to therapy to quit online games however the main treatment in use by the centre was electroshock therapy (Sixthtone, 2016).

To help students from a traditional Chinese test-oriented education, the start-up company DianMao designed a DGBL system, Codemao, in 2015. It aimed to provide interesting courses for coding and following the main national curriculum of China. The aim was for these students to feel motivated to learn rather than pushed to learn. This novelty DGBL system has been chosen as the empirical example for this research.

The Codemao system is a novel DGBL system and is still under development. Codemao has had two different versions, and a new update was released this January. To study whether the DGBL system could actually motivate children to study mathematics and improve their academic performance, qualitative research needs to be carried out. This will also aid the question of what is needed to design a well-balanced DGBL system. A work placement of three months at the company DianMao was also completed, so research was undertaken inside the company.

The inspiration for this topic came from personal friends becoming parents themselves in the past year. This pushed the topic of children’s education to the forefront and was the reason for including parent’s opinions when assessing the effectiveness of DGBL.

1.3. Research Questions
The aim of this research is to examine family users of the DGBL system Codemao through an online research approach. It is particularly interesting to study it from the perspectives of Chinese families due to the pressure to perform well in education. Hence, a fair study of a DGBL system for children requires both the perspective of parents and children.

In order to carry out the purpose of this research it is necessary to understand:
1) What benefits and problems do students and parents experience when using a DGBL system?
2) How do the benefits motivate students to use a DGBL system and gain parents’ support?

This research targets Codemao’s online family users and both parents’ and children’s decisions will influence the continual use of Codemao in the family environment. Considering the system design and business need, a commercial DGBL system, such as Codemao, should ensure family users that it is worth paying for a long period of use. On the one hand, for children, the DGBL system must show that they are enjoying the approaches used. On the other hand, for parents,
the DGBL system should guarantee that their children can be motivated to learn and improve their academic performance.

1.4. Scope and Limitations
The main users of Codemao are online users despite the company offering collaborations with several primary schools and organisations around China. The teachers from these schools and organisations can teach their students basic coding courses with Codemao offline. However, the mathematics course used in this research is only available for online users to study at home. This means that if the students want to learn mathematics on Codemao, they must log on to the Codemao website and sign up to the mathematics course via the WeChat app. This is the most popular instant messaging app in China.

The test-oriented educational background of Chinese parents makes the majority feel that academic performance is the most important aspect for their children’s upbringing. So, parents usually prefer sending their children to traditional educational organisations during their spare time. In a traditional educational organisation, the children’s academic performances could be improved more effectively by completing a great deal of extra reading and writing. These tasks are specially designed to deal with difficult tests at school. Therefore, some parents are always keen on signing up and paying for these extra mathematics courses for their children to improve their mathematics academic performance during their spare time.

Hence, this research only targets the Codemao online family users, which includes the stakeholders, parents and their children. After parents sign up and pay for the Codemao special winter mathematics course, their children can continue learning mathematics during the winter holiday. The DianMao company designed this to follow the Chinese school curriculum.

1.5. Thesis Organization
The following parts of this thesis are organised as follows:

Section two focuses on the literature review. This includes a review of previous research, theories on DGBL, risks of implementing DGBL, a conceptual framework for assessing the effectiveness of DGBL and strategies for designing a well-balanced DGBL system. Section three describes the research methodologies used in this study. The reason for using qualitative research paradigms and methods, the procedure of the data analysis, the research limitations, the reliability and validity of the data are clarified in this chapter. The empirical setting of how this research was conducted in the company Dianmao is also introduced. Section four firstly presents the research data analysis results, which are translated from Chinese to English, sorted and presented in different tables and appendices. Then, the main research outcomes are presented. The empirical findings are depicted to show the feedback of participants using a DGBL system in China, and that facilitates the precise answers to the research questions. In the end, section five and section six are the final discussion and conclusion to this research project.

Further, the organization of this thesis is explained in the following figure 1.1.
Figure 1.1 Thesis Organization
2. Review of the Literature

It is noticeable that ICT is pervasive all around the world. But the concept of using ICT is not popular in the schools of China. As mentioned before, this thesis follows the traditional test-oriented education of China. Students are pushed to learn from their parents and teachers and there is limited usage of technologies in schools.

So when thinking of how to use ICT to make a better world, Walsham (2012) encourages information science (IS) researchers to work on diverse areas and topics, such as education, e-business and marketing. Hence, it is urgent to help students from traditional Chinese test-oriented education and design an effective DGBL system to motivate Chinese students to learn ICT. Furthermore, Walsham (2012, p.89) points out that “the IS field should embrace the old and the new in terms of both technologies and settings”. IS has changed the traditional school setting, for example, the DGBL system like Codemao can work as a novel online school.

The trending phenomenon of DGBL is firstly defined by Prensky (2003, p.4) as “a combination of the most compelling and interactive design elements of the best video and computer games with specific curricular content”.

2.1. The theories behind DGBL

Many previous studies have justified that DGBL can contribute to effective and successful learning. Prensk (2003) argues that digital games can highly motivate learners when studying ‘boring’ and ‘dry’ content and facilitate learner engagement, because digital games possess a more interesting method of learning than traditional means. In addition, when merging digital games with learning contents, Prensk (2003) believes that in these DGBL environments, learners can acquire a very positive learning attitude, such as ‘results-oriented’, ‘cooperative’ and ‘actively seeking information and solutions’.

Following Flow Theory, Para and Bizzocchi (2005) argue that digital game-based learning can act as an effective learning tool because games can bring up play, which creates a state of flow, which boosts motivation, which upholds the learning process. More explicitly, Van Eck (2006) explains the reason why DGBL is effective for learning. It applies several different principles and models of learning. For example, it embodies the principle of situated cognition as the learning is cropping up within a relevant game context. Further, Van Eck (2006, p.4) also states that:

“*What people must learn is directly related to the environment in which people learn and demonstrate it; thus, the learning is not only relevant but applied and practice practiced within on text. Learning that occurs in meaningful and relevant contexts, then, is more effective than learning that occurs outside of those contexts, as is the case with most formal instruction.*”

A similar explanation begins with all learning is like playing a character, and explains that learning is most effective only when the learner can think, act and value like this character. Gee (2003) defines motivation as the willingness of a learner to make an extensive undertaking to participate a new file of learning. He also highlights that motivation is the most essential element that inspires learning. If motivation died, playing would stop and learning would die as well.

In addition, the DGBL system also embodies the process of cognitive disequilibrium and resolution. Based on Jean Piaget’s theories, cognitive disequilibrium means that the learning
processing involves the concepts of assimilation and accommodation. Assimilation represents fitting new knowledge into existing categories and accommodation is the process whereby people must modify their understanding of the world to accommodate for new knowledge that does not fit into any existing category. In the DGBL environment, a continuous cycle of cognitive disequilibrium and accommodation has been created. The extent to which the game creates cognitive disequilibrium does not exceed the capacity of the learner which makes one feel highly engaged with a sense of success (Van Eck, 2006). Kiili (2005) also argues that one can regard online games as a learning environment, which provides learners with engaging learning experiences.

2.2. Review of empirical studies in DGBL
There are many prior empirical studies that have investigated and examined the effects of DGBL on learning and motivation in the campus environment. Through using ‘an interactive fiction (IF) game to teach German vocabulary, reading, and culture to university students’, Neville, Shelton and McInnis (2009) indicate that a contextualised, immersive roleplay game can help students to learn by measuring knowledge retention and transfer, and evaluate the attitudes of students towards the game. Woo (2014) suggests that increasing motivation and relevant cognitive loads can enhance learning efficiency.

By investigating sixty-three university students using an online game entitled ‘Operating a Small Factory in Computer-Aided Manufacturing’, Erhel and Jamet (2013) pointed out that giving learners regular feedback about their performance can also bring about deeper learning in students. The entertainment factor of DGBL becomes the learning factor unbeknownst by the user.

Through examining an educational online game for eight sixth-grade students, Tsai, et al. (2012) indicated that a student’s motivation, ability, and playing skill are all essential factors that collectively and interactively influence the effectiveness of knowledge acquisition in DGBL. These factors are affected by their motivation to play, prior knowledge, as well as online game experience respectively.

Papastergiou (2009) has also shown that regardless of a learners’ gender, DGBL is more effective at teaching high school computer science in Greece following their national curriculum and it is more motivational than non-gaming teaching methods. This was achieved by using a computer game to teach computer memory concepts in the classroom.

Through implementing a DGBL system to teach a Chinese poetry course among junior high school students in Taiwan, Chen and Lin (2014) found that students who received a game-based education had significantly better learning achievements than students who received traditional education. This perceived usefulness can positively influence students’ attitudes towards such a DGBL system.

2.3. Risks of using technologies to achieve educational goals
The terms, ‘techno-tainment’ and ‘edutainment’ were first introduced by Okan (2003). ‘Techno-tainment’ is defined as technology that is heavily intertwined with entertainment but having no value. ‘Techno-tainment’ usually emphasizes technology for technology’s sake without strengthening student writing skills, reading skills and reasoning skills. Correspondingly, ‘edutainment’ implies evidently fascinating learning materials, which include messages sent to both parents and children.
Okan (2003) argues that some learners have an inflated expectation of learning. They wish the process of learning could always be vivid and entertaining, so that they could acquire knowledge without genuine study and hard work, thus they would follow educational technologies blindly.

Undoubtedly, computer technologies have great potential for enriching the approach to which people learn. However, one unexpected danger of implementing computer technologies into education so quickly is that people tend to consider learning as a fun and enjoyable experience. Okan (2003) states that learners who are getting used to the Internet, digital games, and ready-made pictures performed by multimedia generate a different attitude towards learning. Paralleling learning to fun implies that if learners are not having fun, they are not willing to learn. Instead, learning turns into a barrier that needs to be conquered. In other words, computer technologies trivialise the process of learning, instead promoting learning only if it is fun.

Furthermore, Okan (2003) reviews the other risks of using educational technologies, such as students would have short attention spans and lack critical thinking skills. Because children could not refuse to click the flashy special buttons or images impetuously. Selective attention is the ability to command one’s attention and concentrate clearly on what is to be learned without surrendering to distraction. It is one of the meaningful learning skills and now menaced by digital stimulation.

2.4. A conceptual framework of assessing DGBL effectiveness

All, et al. (2015) propose a conceptual framework (see Table 2.1 below) which consists of learning outcomes, motivational outcomes and efficiency outcomes; three main perspectives for assessing the effectiveness of DGBL.

Table 2.1 Table of the Operationalization of DGBL effectiveness (All, et al., 2015, p.36)

<table>
<thead>
<tr>
<th>Learning outcomes</th>
<th>Motivational outcomes</th>
<th>Efficiency outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Situational interest</strong></td>
<td><strong>Enjoyment</strong></td>
<td><strong>Times management</strong></td>
</tr>
<tr>
<td>DGBL stimulates interest in the content matter discussed in the game.</td>
<td>DGBL succeeds in creating an enjoyable game experience.</td>
<td>DGBL succeeds in reducing the time frame required to teach a certain content matter. This is a judgement of relative worth compared to other instructional methods.</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td><strong>Motivation towards DGBL</strong></td>
<td><strong>Cost-effectiveness</strong></td>
</tr>
<tr>
<td>DGBL succeeds achieving learning goals as defined by the game developer/the</td>
<td>Learning with the game-based method is motivating. This is a judgement of</td>
<td>DGBL succeeds in reducing the cost of the intervention with regard to:</td>
</tr>
</tbody>
</table>
client who ordered the development of the game.

**Transfer**

DGBL stimulates application of learned content matter in the game to real world situations.

| relative worth, compared to other instructional methods. | a) The number of learners that can be reached and  
b) The time required to teach the target group worth, compared to other instructional methods. |

Here it can be seen what is relevant to the effectiveness of DGBL: the learning outcomes perspective, increase in interest of the subject, improvement in object performance such as a test and how transferrable the learned knowledge and skills are to real world applications. As for the motivational outcomes perspective, “enjoyment, the extent to which playing the game evoked an enjoyable experience, and increased motivation to learn using DGBL” are identified as relevant (All, et al., 2015, p.29). Finally, regarding the efficiency outcomes perspective there are two factors, time management and cost-effectiveness, which are considered relevant to DGBL effectiveness. They also point out that if a DGBL intervention achieves similar or higher scores compared to other instructional tools, with regard to any of the above-mentioned outcomes, without notably weakening any of the others, then it can be said that this DGBL intervention is effective.

2.5. Strategies for designing a well-balanced DGBL

Through examining a variety of popular computer and video games, Gee (2003) came up with several suggestions for designing an agreeable DGBL. For example, a good DGBL should allow learners to customise the game to their own ability level and learning styles. Thus, students can face challenges that they are capable of achieving and enjoying the pleasant frustration of learning. Furthermore, it is highly valued if students can have some creative input to the game with designers. In this way students are not only consumers but also producers.

Kiili (2005) proposes an experimental gaming model (see Figure 2.1 below) that stresses the design strategies for an effective DGBL system. This includes providing immediate feedback to the player and setting clear goals and challenges that are coordinated with the player’s skill level. The main principle of this model is to connect gameplay with experiential learning, so that it could help flow experience. The model depicts learning as a cyclic system through the clear game process in the game world.
Figure 2.1 Picture of Kiili’s experiential gaming model (Kiili, 2005, p.18)

The experiential gaming model is made of three parts, an ideation loop, an experience loop and a challenge core. The challenges/problems based on educational objectives create the core of the model. The duty of the core is to facilitate the motivation and engagement of the player by supplying pertinent challenges to her or him.

In the game world, Kiili (2005) describes that if players want to overcome the challenges, they will develop solutions in the ideation loop, which includes a preinventive idea generation and idea generation. Preinventive idea generation indicates the fundamental creativity and illustrates a disorganized phase of dropping out solutions. After the preinventive stage, players will take the game constraints and available resources into consideration, then further improves solutions.

After the ideation stage, players will test solutions in the experience loop and examine the effects of actions. The experience loop contains three stages, Active experimentation, Reflective observation, and Schemata construction. In this circulation, Kiili (2005) argues that the reflective observation of the feedback might generate the development of schemata and facilitate the exploration of fresh and exceptional solutions to the challenges. Hence, he suggests that games designers should set clear goals and provide useful feedback to the players in order to expedite flow experience.

Speaking of the motivation and learning point, Kiili (2005) highlights that the force of the core is crucial. The core should bring players with challenges that are balanced with their skill levels in order to boost the tendency of experience flow.
Van Eck (2006) also implies that the most enjoyable games constantly interact with the player and provide feedback, if the game is too easy, the player does not feel engaged.

Based on the theory of motivation, volition, and performance (MVP), Huang, et al. (2010) suggests that the design of DGBL should not only focus on the motivational processing and cognitive impact, but should also consider the extrinsic interest. This can optimise the results of outcome processing along with increasing the relevance of the game content.

Okan (2003, p.259) suggests that “motivating learners is more than adding entertainment value to lessons or tests. Otherwise, as Healey puts it, learners will not be motivated to learn but just to play with the computer”. Furthermore, Okan indicates that the creation of technology-based materials will demand more than simple colour and animation. The DGBL tasks designed to raise the student’s interest must be balanced with those to evolve the intellectual capacity. Thus, it is of great importance for DGBL designers to follow the guidance of educational psychology. What is more, the didactic design of visual displays requires plentiful knowledge of the human cognitive system and how it collaborates with those displays. In addition, Okan demonstrates that if learners have low verbal skills and prior knowledge of the subject, the visuospatial adjuncts can be very supportive. The simple text “can be easily envisioned by the learner does not need additional pictures” (Okan, 2003, p.261). Even if the subject content is complex, visual displays can help enhance understanding in favour of the DGBL system. This serves as a cognitive tool to involve students in learning, rather than just playing a digital game. Last but not least, Okan calls on the necessity of educational and parental critical awareness. Such awareness requires that before intentionally accepting the DGBL system as a symbol of innovation, educators, designers, and parents need to question the didactic and pedagogical philosophy that the DGBL system design can embody.

2.6. Summary

Initial research and theories related to DGBL have been reviewed above. As stated the aim of this research is to examine family users of the DGBL system Codemao and explore which factors influence the continuous use of it. The former theories behind DGBL such as the risks of adapting education technologies and strategies for designing an effective DGBL will be used to interpret and answer the research questions here.


In addition, the conceptual framework proposed by All, et al. (2015) will be used to support the examination of the DGBL in the discussion section. Based on the framework set out, the research section will include the effectiveness of the DGBL system which is assessed in three different criteria: learning, motivational and efficiency outcomes.
3. Methodology

3.1. Methodological Tradition

In this chapter, I will mainly describe the research paradigm, data collection methods and data analysis methods used in this study. After that, the ethical consideration, research limitation, data reliability, and validity will also be presented.

The paradigm of this study is interpretive research. Klein and Myers (1999) state that the reason why the interpretive research could benefit IS researchers to figure out the human action and thought in organizational and social contexts, is that it has the capability to create a profound understanding into information systems area, which includes the management of ISs and ISs development. Further, doing interpretive research means that it is more thoroughly to collect research knowledge by means of social construction, for example, shared meanings, consciousness, languages, documents, tools, etc.

Doing the interpretive research, researchers usually follow the assumption that social reality is subjective or plural, and shaped by social contexts and human experiences. Therefore, it is best studied within its socio-historic context by mediating the subjective interpretations of its distinct participants. Hence, it is essential to interpret students and parents’ opinions and feelings within the social context in order to explore the benefits and problems after using the DGBL system.

3.2. Methodological Approach

The qualitative study research is used as the methodology in this study. Since the qualitative research is designed to help researchers understand “a phenomenon from the point of view of the participants and its particular social and institutional context” (Myers, 1997, p.3). In the meanwhile, those textual data drawing from such phenomenon could not be fully quantified, thus the quantitative research is not suitable for this research. So it is more applicable to do a qualitative research on studying the digital game-based learning phenomenon. What is more, qualitative research methods can help researchers to have a better understanding of people and the cultural and social circumstances within which they live. Therefore, the qualitative study is conducted in the company DianMao, where data collection is mainly through the online observation, online interview, and open online questionnaire.

3.3. Methods for Data Collection

3.3.1 Data collection methods

The main data collecting methods used in this study are online observation, online interview, and open online questionnaire. The purpose of using those methods are presented in table 3.1.

Table 3.1 Data Collection methods

<table>
<thead>
<tr>
<th>Methods</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online observation</td>
<td>Collect direct feedbacks from family users during daily work</td>
</tr>
<tr>
<td>Online interview</td>
<td>In-depth understanding of family users’ opinions to DGBL</td>
</tr>
<tr>
<td>Online questionnaire</td>
<td>Collect the predefined information</td>
</tr>
</tbody>
</table>
Hewson and Stewart (2016) indicate that supported by the coordinated development of the internet user population and the internet technology, the current use, scope and potential of internet-mediated research (IMR) methods is unlimited. IMR methods have now bolstered to break the boundary of qualitative and quantitative research traditions, and create a cross-disciplinary, various, expanded cluster of techniques and procedures, covering a diversity of research domains.

3.3.2 Participant

The research was conducted in the company DianMao, where I had an easy access to the online Codemao family users and colleagues of Codemao. My intern position in this company was working as a course coordinator to communicate with Codemao online users and help them through the Chinese online instant messaging application, Wechat, it supports both the personal computer and mobile device. Every day I logged in the official account of Codemao course coordinator to chat with different online users, observe and summarize the problems they faced when using Codemao.

The target participants in this study were Codemao family users who had signed up the seven-day winter special mathematics course or the free trial course. The invitation of seeking participants was sent to all the targets in the Codemao course coordinator’ friend list via Wechat. Only the users who agreed to join this study are chosen as the main participants of this study.

The seven-day winter special mathematics course was available from January 16 to February 20 and designed as eight grades. But in this research, I only focused on primary students, Grade 1 to Grade 6. The whole course contained seven lessons, each of them last about one or two hours per day. While the free trial course contained one lesson. The course content only included half of the formal first day lesson. Taking this winter special mathematics course by using Codemao, students would be semi self-directed learning mathematics in a novel and game-playing approach.

In the Codemao system, learners were playing as the Coding trainers. They did not need to use web-cam to communicate with distance teachers. Because there was only a Coding Master character in the system, not a mathematics teacher. And all the characters had different cute cartoon figures and portraits. So, when learners used this system to learn mathematics, they would not think that there were some teachers teaching them distantly. They would think that they learn mathematics to complete different tasks assigned by the Coding Master in the game. And when they completed all the tasks, they would feel a kind of achievement and be rewarded some nice gifts. In addition, when the learners could not complete one task, they would repeatedly check the instruction and videos until they finally completed the task.

The empirical research lasted two months and divided into three parts. In the first part, I focused on analysing the components of Codemao, and trying to figure out how it was designed to motivate students to learn. Currently, through browsing the website of Codemao (see Figure 3.1), we could see that it contained an online learning platform (see Figure 3.2) and the additional game called Codemao AR (see Figure 3.3) for both mobile and computer systems. The online learning platform had three updates, and the educational game app was released in the April of 2016.
Figure 3.1 The website of Codemao (Codemao, 2017)

Figure 3.2 The interface of Codemao online learning platform (Codemao, 2016)
Next, in the second part, the fundamental work of this research would be done, which was to collect qualitative data to examine the family users of the DGBL system, Codemao. In this part, I would interview some online family users who signed up the winter special course or the free trial course. After the interview, I would like to provide an open online questionnaire to some family users who signed up the formal winter course, but did not finish the whole course before February 14. The questionnaire (see Appendix 10.2) was designed to collect some general feedback about how they felt about the Codemao winter course and what stopped their continuous usage and learning.

Finally, in the third part, the major work of this research would be done, which was to assess the effectiveness of Codemao based on the conceptual framework for assessing DGBL effectiveness. The extent to which the Codemao system could improve users’ academic performance and produce an enjoyable learning experience would be assessed. Through analysing the collected data, the result of the Codemao effectiveness assessment would be proposed. Then, I could find out if the digital game-based learning system could actually improve users’ academic performance and produce an enjoyable learning experience. The research outcomes could help to propose strategies for improving the future digital game-based learning design.

3.3.3 Online observation
On the grounds of the development of web 2.0 and the enrichment of accessible data of person activity online, the online observation approaches have freshly been of exceptional interest. Furthermore, Hewson and Stewart (2016, p.17) explain that the online observation facilitated the opportunity of collecting research data unobtrusively, and it could help to reduce “data contamination from demand characteristics presenting disclosed observational approaches”. Doing online observation, researchers are able to obtain handy access to an enormous, various accumulation of document archives online, and readily inquiry these for distinct topics and content, is a special trait of IMR approaches which researcher could hardly find a similar supplement in offline observation research.

The online observation is the main method for me to collect qualitative data in the DianMao company environment. As introduced above, my daily job was working as a course coordinator to communicate with online users via Wechat. Using this application, people could not only send instant text messages and voice messages to the other signal user, but also create the chatting group to invite different users to communicate together.

As the course coordinator, I was invited to join in some Wechat user chatting groups. Those chatting groups were created by the course manager. Usually, I would not take part in the user group chatting, unless some users asked for the course help, then I would answer their questions.
and help them solve problems. The Wechat provides an unobtrusive approach for me to observe the Codemao users in the chatting group, without informing the research purpose of this study.

In addition, working documents and tables were shared among staff online in the company DianMao. So, the access to check certain related documents could be assured. Further, the colleagues’ impressions and reactions to the Codemao winter special courses could also contribute to generating some qualitative data. (Myers, 1997)

### 3.3.4 Online interview

Further, the online interview is another favourable method for collecting qualitative data. Hewson and Stewart (2016) argue that interviews in IMR approaches have been used by researcher since the last decades, and there is an obvious difference between asynchronous and synchronous methods for carrying out online interview research. Asynchronous methods, such as email, generally involve a long-term conversation, interviewers and interviewees are sending messages backwards and forwards when they are available. By contrast, synchronous approaches demand to use more progressive, instant chatting technologies. Comparing with asynchronous methods, synchronous methods could make it easy for interviewer and interviewee to preserve coherence and continuity in the topics of the interview, so that researchers are better able to control ‘conversational flow’ with participants.

In the company DianMao, the online interview was conducted as the form of informal interview. Wechat was used to have free chatting with the chosen participants. This application could send instant text messages and voice messages, which provides a convenient tool to do the online interview.

There was no opportunity to interview the parents and children learners separately, I only interviewed them together via Wechat. Children provided some simple answers to the interview questions, and parents answered most of the questions thoroughly.

### 3.3.5 Online questionnaire

Nowadays, the most of online questionnaires and surveys are web-based, supported by many user-friendly and cost-effective websites which researcher could easily access. Hewson and Stewart (2016) highlight that, compared with the email survey, IMR methods can help maintain the consistency of basic survey factors such as page layout, font size, the procedure of presentation of questions, and so on. It is easier to carry out using web-based survey methods.

In addition, the majority questionnaire websites are mindful to realize standards, which expand the flexibility of performing survey across different devices, operating systems and browsers. Some web-based survey methods even include the skip logic, for example, according to participants’ response to former questions, it is available to jump to specific subsequent questions; the question piping, which means using the response of former questions to customise later questions; checking for proper format and response completeness. Those supportive functions give web-based survey methods a big asset when it draws in concerns of consistency, flexibility, validity and reliability. (Hewson and Stewart, 2016)

After the interview, an open online questionnaire was created on wjx.com (a free Chinese online survey website) and provided for the participants, who signed up the formal winter course, but did not finish the whole course before February 14. Because the deadline for the winter course was February 20, they had to start the course at latest before February 14. The link to the online
The questionnaire was sent to 30 participants one by one through Webchat, and 14 of them answered the questionnaire.

The open online questionnaire (see Appendix 10.2) was designed to collect the following general information:
➢ Learners’ grades
➢ How many times did the learners take the course?
➢ Will the learners continue the course?
➢ How did the learners feel about the Codemao winter course?
➢ What stopped the learners using Codemao and taking the course?

3.4. Data analysis method
Myers (1997) states that semiotics, more specifically, the content analysis is a form of semiotics, means seeking for categories and regular patterns in the text and makes conclusions on the basis of these patterns. Following semiotics, the chosen methods for analysing qualitative data in this study are Lichtman’s six steps (2010) to analyse qualitative data.

Lichtman (2010) demonstrated that the analysis is a continuing proceeding during the research. Although the researchers could start the basic analysis when all fundamental data are collected, once they begin to take notes, they have started the process of deliberate analysis. Doing qualitative research would generate plentiful consciousness and shared meanings, it is essential for researchers to be extremely careful and not miss any important information. Hence researchers should follow the six steps procedures raised by Lichtman (2010) to avoid losing meaningful messages in the quality data analysis.

Lichtman (2010) claimed that during the process of preparation and organize data, a plenty of important themes will be made, so it is very imperative for researchers to take notes to avoid losing any precious point during the interview. Further, she suggests that researchers should transcribe the interview materials trough Microsoft word file on a personal computer, where researchers can efficiently read and have a better understanding of those materials. Additionally, in case of data loss, she also suggests that researcher must back up their research data and results on a separate device or drive.

In order to gain the vital concepts from the research data, researchers should give a meaning to them. Once all the data have been stored in the word file, researchers should rearrange them by manually counting the frequency or rates of the similar meaning. This process is done to identify certain regularities and important themes. Researchers should follow this procedure to archive the vital concepts from the research data. (Lichtman, 2010)

Coding analysis as a research approach that helps researchers to transfer all the data collected from the participants into text forms. Then, researchers are able to specify the differences and similarities that contribute a better understanding of the research question or provide a helpful answer to it. What is more, the coding could help researchers to examine the accuracy of the collected data, because researchers could go back to the research context to check if certain regularities and themes are in accordance with participants’ statements (Lichtman, 2010).

According to Lichtman’s six steps (2010) to code the qualitative data, the data analysis of this study is conducted as follows:

✧ Step 1: Initial coding.
Once all the data have been collected, the qualitative data (e.g., the feedback of participants) will be stored in the word file on my personal computer, where I can efficiently read and mark or comment the key points on those materials.

✧ **Step 2: Revisiting initial coding.**
In this step, I draw back to the initial coding procedure again. I will go through the word file again to diminish redundant by renaming all the similar meanings to the matching words, which enhances the initial coding results.

✧ **Step 3: Develop an initial list of categories.**
Following the previous step of revisiting initial coding, I will start rearranging the data by manually counting the frequency or rates of the similar meaning, and putting them into an excel file, which will under a well-organized category.

✧ **Step 4: Modify initial list based on the additional reading.**
After categorizing the initial coded data into the spreadsheet (Microsoft Excel file), I will find out some of them barely important or in the similar expression, which can be revised to the other one or removed as they will irrelevant to the research.

✧ **Step 5: Revisiting your categories and sub-categories.**
Subsequently, I will merge all the similar phrases and classified them into the more formal categories and sub-categories. After that, I will examine the spreadsheet again to check the insignificant ones and remove them. It will be ensured that all unnecessary regularities are deleted, and only relevant patterns are conserved.

✧ **Step 6: Moving from categories to concepts (Reflecting the meaning you ascribe to your data).**
Finally, I will define the concepts from the convinced patterned regularities which will be found through the spreadsheet, and they can give me a good clue to answer the research questions. Lichtman (2010) underlines that the concepts must be defined, because they are the authentic findings from the data analysis and the groundwork for the research discussion. In this research, in order to provide more purposeful concepts and enrich the research discussion, I will define some concepts, following a conceptual framework mentioned in the previous literature reviews.

3.5. Reliability and Validity
Golafshani (2003, p.604) defines that “reliability and validity are conceptualized as trustworthiness, rigor and quality” in the qualitative research. Further, Hewson and Stewart (2016) state that with the developments in the growth and variety of the population of Internet users over the past decades, it is more common to consider Internet as a scene to carry out social and behavioural research. Sample bias is used to a main apprehension in IMR, but many recent studies have demonstrated that data collected from samples selected online can generate reliable, high quality data comparable to or even better than that collected offline. Statistics on the growth and variety of the population of Internet users defend the opinion that Internet is able to provide a convenient access to a diverse, enormous pool of potential research participants.

This research was conducted in China, and all the participants of this research were native Chinese speaking enrolled online. In order to prevent the language issue, the questioners were at first created in Chinese and then translated into English (see Appendix 10.1 & 10.2).
In the DianMao company environment, I combined this research with my daily job. As mentioned above, my job was working as a course coordinator at DianMao. My daily routine was to communicate with different online users via Wechat (an instant messaging application), introduce the system function and nature to them, answer their questions, understand their needs and report bugs to the developer team. Such working routine is exactly like what Walsham (2012, p.3) said, “falls squarely in the interpretive tradition”.

Working as a course coordinator provides a perfect approach to do the interpretive research in the company. And in order to examine the family users of the DGBL system and explore which factors influence the continuous use of it, I need to interpret users’ thoughts and feelings. Thus, collecting a lot of qualitative data is essential for this research.

With the help of another colleague, working as an interpreter to decrease the effect of local dialect, in case the respondent could not speak Mandarin properly. Parents’ voice messages sending via Wechat had been recorded on the smartphone, then summarized in Chinese by certain pattern and posed in Appendix 10.4.

The online observation and interview were carried out by myself. The useful text messages that learners sending during the course, and parents sending via Wechat had been directly saved as screenshots and posed in the Appendix 10.5.

Although the length of participants’ messages could be limited by their own knowledge, all of them expressed their opinions. Therefore, the collected messages could provide sufficient knowledge for answering the main research questions. By those means, the researcher perceived bias of data analysis was able to be minimized. Hence, the reliability and validity of the collected data could be increased.

3.6. Ethical Considerations
After joining the DianMao Company, I had signed the employee confidentiality agreement, anything related to Codemao confidential data would not be disclosed and discussed in this thesis. In addition, the permission to use Figure 3.1, 3.2 and 3.3 was granted by the company CEO and manager via Wechat (Appendix 8.5). So there is no copyright issue to use those pictures in this thesis.

Further, in order to obtain the full consent of the participants prior to the study, all the participants would be informed the research purpose, the research plan and the consent in Chinese. What is more, any offensive or another unacceptable language could be avoided in the preparation of the online questionnaire and interview questions.

Then, I could notify participants to sign the consent which concerns that:
● Their participation is voluntary.
● Their privacy and anonymity will be ensured.
● They have the rights to stop participation at any time.
● The aims and objectives of the research are credible; they are neither deception nor exaggeration.
● The online survey will be abolished immediately after collecting enough data.
● The collected personal data will be documented and encrypted in my private computer to prevent unauthorized persons having access to them.
● The misleading of collected data will be avoided.
● The possible conflicts and affiliations will be declared.
(Bryman and Bell, 2007; CODEX - rules and guidelines for research, 2016)

The Chinese and English consent forms are separately saved in Appendix 8.6 and 8.7. The link of the Chinese consent form was sent to all the participants via Wechat. And the reminder messages were also delivered in order to make them read the consent form and sign it.
4. Empirical Findings

In this chapter, the empirical findings of this research are presented, standing on the empirical data collected from the online observation, online interview, and open online questionnaire. Many valuable data were collected by those methods. According to Lichtman (2010) six steps, the collected data were well organized and analysed. After the analysis of research data, they were succeeding coded into convincing concepts that facilitated the answer to research questions.

10 online family users who signed up the free trial course had been randomly chosen to join this research, but only 6 of them agreed to receive the interview. Before conducting the online interview, I intended to interview the parents and learners separately. But in fact, I only interviewed them together, and it seemed that parents were very keen on standing for their children. The interview data were collected in Chinese, translated in English and saved in Appendix 8.4.

The open online questionnaire has been randomly sent to 30 family users, who signed up the formal winter course. However, only 14 family users have participated in this open online questionnaire. Their answers have been collected and sorted out in Table 4.1. The reasons for them to stop taking the course have been classified by similar patterns and sorted out in Table

Table 4.1 Overview of respondents’ answers in the questionnaire

<table>
<thead>
<tr>
<th>Participant No.</th>
<th>Grade</th>
<th>Times</th>
<th>Will continue the course?</th>
<th>Yes or No, why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>1</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>1&amp;2</td>
<td>1</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>1</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>1&amp;2</td>
<td>1</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>1&amp;2</td>
<td>1</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>4</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>6</td>
<td>4</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>4</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>5</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>5</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>13</td>
<td>6</td>
<td>6</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>6</td>
<td>6</td>
<td>Yes</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 4.2 Reasons for family users not continuing the course

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Type of reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Could not accept to the online education</td>
</tr>
<tr>
<td>3</td>
<td>PC/ Internet issue</td>
</tr>
<tr>
<td>2</td>
<td>Children do not like it.</td>
</tr>
<tr>
<td>2</td>
<td>Bug</td>
</tr>
<tr>
<td>1</td>
<td>Busy, no time to continue</td>
</tr>
<tr>
<td>1</td>
<td>No prior experience, too difficult to use the system (Children)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Little children could not read the text content</td>
</tr>
<tr>
<td>1</td>
<td>No prior experience, too difficult to guide their children (Parents)</td>
</tr>
</tbody>
</table>

From the two tables above, we could see that 10 of 14 participants were no willing to continue the rest course before the deadline. And seven of fourteen participants decided to cancel the course after the first lesson.

Although only 14 participants filled the questionnaire in this research, from their limited answers, we could find out the family users’ feedbacks to digital game-based learning was still far from optimistic.

4.1. Initial coding
Once all the data had been collected, the online observation notes and the feedback from online interviews and online questionnaire were transcribed in the word file. Then, I drew back to the initial coding procedure again and went through the word file again to diminish redundant content. After that, I started rearranging the data by manually counting the frequency of the similar meaning, and putting them into an excel file. As a result, there are seventeen categories generated from the coding process, they are as follow:

1) For some learners with relative high mathematics knowledge and high computer knowledge, the content of Codemao system was too simple and not vivid.
2) Some parents thought that the focal point of course content was not prominent, and the preview part was not prominent as well.
3) The operational and creational content was not enough.
4) Some tasks were not clearly described, and learners did not know how to complete the task.
5) System issue, some family users did not want to or have no time to upgrade Windows XP to Windows 7 or above.
6) Browser issue, some family users did not want to download and install Google Chrome.
7) There were some bugs when using Codemao system.
8) Sometimes parents were not at home, learners with low computer knowledge and low Chinese knowledge could not use Codemao system by themselves.
9) Both parents and learners had low computer knowledge, and they feel that it was very difficult to use Codemao system.
10) Some family users preferred the other offline winter mathematics course.
11) Some family users had a vacation, so they wanted to use Codemao system on the mobile device.
12) Codemao system was a good substitute for real computer games.
13) Using Codemao system could help them save traffic time.
14) It was fun to use Codemao system to study mathematics.
15) It was necessary to study coding and other computer skills.
16) Some family users doubted the identity of Coding Master.
17) It was interesting to collect AR cards.

4.2. Categorizing and Concepts
Based on the conceptual framework and previous literature reviews, there are seven concepts that were coded through the systemic analysis of the collected data:

✧ Situational interest
✧ Immediate feedback
✧ Prior knowledge
✧ Clear goals and challenges
✧ Relevant content
✧ Efficiency
✧ The extrinsic interest

Table 4.3 Categorize the results of initial coding into seven concepts

<table>
<thead>
<tr>
<th>Concept</th>
<th>Results of initial coding</th>
</tr>
</thead>
</table>
| **Situational interest** | ✓ It was fun to use Codemao system to study mathematics.  
|                          | ✓ Codemao system was a good substitute for real computer games. | 
| **Immediate feedback**   | ✓ Some family users doubted the identity of Coding Master. | 
| **Prior knowledge**      | ✓ For some learners with relative high mathematics knowledge and high computer knowledge, the content of Codemao system was too simple and not vivid.  
|                          | ✓ Sometimes parents were not at home, learners with low computer knowledge and low Chinese knowledge could not use Codemao system by themselves.  
|                          | ✓ Both parents and learners had low computer knowledge, and they feel that it was very difficult to use Codemao system. | 
| **Clear goals and challenges** | ✓ Some tasks were not clearly described, and learners did not know how to complete the task.  
|                          | ✓ Some parents thought that the focal point of course content was not prominent, and the preview part was not prominent as well. | 
| **Relevant content**     | ✓ The operational and creational content was not enough.  
|                          | ✓ There were some bugs when using Codemao system.  
|                          | ✓ Some family users preferred the other offline winter mathematics course.  
|                          | ✓ It was necessary to study coding and other computer skills. | 
| **Efficiency**           | ✓ Using Codemao system could help them save traffic time. | 
| **The extrinsic interest** | ✓ It was interesting to collect AR cards. | 

4.3. The Concepts for RQ1

*RQ1: What benefits and problems do students and parents experience when using a DGBL system?*
The main concepts of the Research Question 1 are shown as below:

- Relevant content
- Efficiency
- Prior knowledge
- Clear goals and challenges
- The extrinsic interest

**Relevant content**
With the development of technology, more and more parents realise that learning some technology-related skills could benefit their children's future career. Hence, the most of participants (Codemao family users) were very supportive of the DGBL system as a novelty way for their children to learn coding, and willing to try the free trial course to see how it works to study mathematics.

And, a majority of the Chinese parents were not willing to see their children play video games at home. So they believed that the Codemao system was a good alternative for their children to play during spare time. Comparing to common video games (which patents generally thought that it was a waste of time to play them), their children could at least learn coding or mathematics by playing the Codemao game.

While, due to the immature of Codemao system, the learner might occasionally face several bugs when using it to study mathematics. Moreover, parents complained that the operational and creational content in the Codemao system was not enough, their children just imitated coding operations from the videos to complete the tasks.

**Efficiency**
The results of data analysis revealed that besides thinking about learning some technologies related skills may benefit their children's future career. Some parents were supportive of the system because it could help prevent the traffic jam. In the major big cities of China, the traffic jam was severe; parents usually spent much time on picking up children from schools or other educational organizations. Using this system, children could learn mathematics and coding at home, which helped parents to save much time.

As parents paying real money for their children to use this system, they expected to spend the right money, and this digital game-based learning system could make a big difference for their children.

**Prior knowledge**
According to the analysis results, learners in Grade 1&2 found that it was no easy to use this DGBL system. Because this DGBL system involved many text contents in the gameplay, and only provided some videos and audio images to show learners how to code, use this system and play the game.

Learners in Grade 1&2 only understood a few of the Chinese characters, so it was very difficult for them to read the text content and use this system by themselves. Parents’ guides were heavily needed for them to use this system. However, their patents were not always by their sides. So, when those kinds of learners used this system, they would think that this system was not pleasant to use and bring lots of troubles.
Moreover, for the learners, who had never taken the basic coding course before, or had not used computers very often, thought that it was a disaster to use this system. Because they did not know how to code or play the game with the keyboard, and easily felt panic when the game lost control and then started crying.

Also, some family users preferred the offline winter mathematics course and doubted the effect of Codemao system. For users from certain provinces (for example, Jiangsu and Zhejiang), the course contents were too simple than some parents’ expectations. What is more, during the observation, one mother who was the mathematics teacher indicated that the Codemao special winter course was fun, but it did not provide enough relevant and abstruse mathematics knowledge for her child to take tests at school. Moreover, the Coding Master even provided the wrong answer to one mathematics question when giving feedback to her child.

Clear goals and challenges
Some tasks assigned in the Codemao system were not clearly described, inexperienced learners, did not know how to complete the task by themselves. Moreover, a few parents thought that the focal point of each lesson was not prominent, and the preview part was not clear either. They did not know how to examine their children after finishing one lesson.

While, after the learners getting used to this system, some of them started thinking that the gameplay was too easy, and the mathematics knowledge was too simple. Some of them had already learned at schools. And the mathematics knowledge was not deep enough to deal with the mathematics test at schools. Besides that, this system was assured that each lesson should last at least one hour, but in fact, some learners could complete one lesson in thirty minutes.

The extrinsic interest
When learner completed the entire 7-day course, they would be rewarded some Codemao AR cards, using the Codemao AR app to scan those cards, they could see some lovely characters from the game. It is popular among those learners to collect the AR cards.

The Codemao was an online digital game-based learning system. So a good Internet connection was the key to run this system smoothly. Further, this system was only supported by at least Windows 7 and Chrome browser, but most of the participants were not aware of them.

However, in China, there were many family users still using Windows XP at home. And only a few of them had installed Chrome browser. Hence, due to those two factors, the most of participants could not open the Codemao website successfully at the first time. Although Chrome browser could be easily downloaded from the system website, the operating system issue could not be fixed easily. And only a small part of the parents would consider upgrading their computers’ operation system or change to new computers after facing such issue, while most of them would demand the refund immediately.

Also, some family users had a little bit trouble to log in the right fee-paying accounts. When the family users signed up the special winter course on Wechat (the only way to sign up the course), the system would generate their fee-paying accounts based on their phone numbers.

However, on the system website, four ways (Wechat, QQ, E-mail and phone numbers) were provided for users to register and log in, which confused the new family users. Since the course had been signed up on Wechat, the new family users thought they should log in the website via
Wechat. However, when they did that, they could only find empty accounts and had to ask the course coordinator for help, then felt annoying.

4.4. The Concepts for RQ2

RQ2: How do the benefits motivate students to use a DGBL system and gain parents’ support?

The main concepts of the Research Question 2 are shown as below:

➢ Situational interest
➢ Immediate feedback

Situational interest
According to the data analysis results, the Codemao facilitated the situational interest of learners to use it study mathematics. In this system, learners were playing as the Coding trainers. They did not need to use webcam to communicate with distance teachers. Because there was only a Coding Master character in the system, not a mathematics teacher. And all the characters had different cute cartoon figures and portraits. So, when learners used this system to study mathematics, they would not think that there were some teachers teaching them distantly. They would think that they learn mathematics to complete different tasks assigned by the Coding Master in the game.

Furthermore, this system created an interactive game scenario, which involved an interesting storyline, and some funny NPCs (Non-Player Characters) as companions to talk with the learner. So, the learners would not feel that they were alone when they used this system to study at home.

Immediate feedback
When the learners could not complete one task, they would repeatedly check the instruction and videos until they finally completed the task. And when they faced some mathematics problems, they could receive the immediate feedback from Coding Master. Children were more willing to ask Coding Master for help. On the contrary, when they faced some mathematics problems at school, they usually felt nervous to ask their teachers.

Additionally, some learners could not tell that NPCs were AI (Artificial Intelligence), and believed that NPCs were the real human. In fact, only the character Coding Master was semi AI, some colleagues were playing this character to guide and answer learners’ questions behind the screen.

During the online observation, we noticed that some learners would text the NPCs (except Coding Master) back, and ask them some questions. Although the other NPCs only texted them back under the system setting, and could not seriously answer their questions. Learners would still feel the gameplay was attractive. Because everything in the system was brand-new and full of challenges, they had never met and used it before.

And some of them even wanted to make friends with the NPCs. For example, an NPC called Lulu, she was a lovely girl in the system and very popular among the learners. When one lesson was completed, some learners would say goodbye to Lulu and look forward to meeting her in the next lesson.
4.5. Summary
As a new DGBL system, Codemao aimed at changing the test-oriented education has faced many queries. A lot of family users held some complicated feelings about it. Curious, ignorance, support and doubt are four of the most common feelings. Based on the results of data analysis, the answers to research questions have been revealed.

According to the empirical findings, a part of the participants felt very disappointed with the DGBL system. Because the system set up and the operation was beyond their prior knowledge, system designers failed to set clear goals and challenges that were coordinated to the player’s skill level. In addition, the system content could not cover the various editions of textbooks around China. Therefore, participants from the provinces with advanced textbooks would think the course contents (mathematics) were too simple, and some parents doubted that their children’ mathematics academic performances could actually be improved by playing some simple games, and thought those games had nothing related to mathematics. Also, during the winter holiday, some of the family users were going out for vacation and asking to use mobile devices to take the special winter course. But the Codemao did not support the mobile devices yet.

Compared with the traditional education approaches, the online DGBL system could provide immediate feedback to users under the good internet connection, and help them to save a lot of traffic time. More importantly, Codemao facilitated the situational interest of children to use it learning. When they used this system to study and learn mathematics, they would not think that there were some teachers teaching them distantly. They would think that mathematics knowledge can help them to complete different tasks assigned by the Coding Master in the game. Moreover, when they completed all the tasks, they would feel much achievement and be rewarded some nice gifts (Codemao AR cards), and that could motivate them to keep using Codemao to study and learn mathematics.
5. Discussion
This section contains a discussion of the empirical findings and reflection of research results. The discussion of the empirical findings is divided into three parts. The first and second parts discuss RQ1 and RQ2 separately. The discussion will be presented through the analysis and understanding of the empirical findings, what the results imply for this research and with reference to the literature review and the defined concepts presented in the previous section. The third part deals with the general reflections based on the findings and outcomes of the RQ1 and RQ2 discussion.

The aim of this qualitative study is to examine DGBL systems from users’ perceptions and experiences through online research methods, further emphasizing more on using DGBL system as a study tool in the family context. These topics are covered by RQ1 and RQ2 with defined concepts.

5.1. Discussion of RQ1
Q1: What benefits and problems do students and parents experience when using a DGBL system?

The findings of the research question 1 were explained by the five different concepts, Relevant content, Efficiency, Prior knowledge, Clear goals and challenges, The extrinsic interest.

Relevant content
Many previous studies have justified that DGBL can contribute to effective and successful learning. Prensk (2003) argues that digital games can highly motivate learners from the “boring” and “dry” learning content and facilitate the learner engagement.

With the development of technology, more and more parents realise that learning some technology-related skills could benefit their children's future career. Hence, the most of participants were willing to use the Codemao system as a novelty way for their children to study coding and mathematics.

On the other hand, a majority of the Chinese parents were not willing to see their children play video games at home. So they believed that the Codemao system was a good alternative for their children to play during spare time. Comparing to common digital games (which patents generally thought that it was a waste of time to play them), their children could at least learn coding and mathematics by playing the Codemao game.

Efficiency
In the efficiency perspective, two factors (time management and cost-effectiveness) are considered relevant to DGBL effectiveness. Comparing with the traditional education organizations, Codemao system could help participants to save a lot of traffic time. In the major big cities of China, the traffic jam was severe, and parents usually spent much time on picking up children from schools or other educational organizations. Using Codemao system, children could learn mathematics and coding at home, which helped parents to save much time. As parents paying real money for their children to use this system, they expected to spend the right money.

However, it was not easy to compare which one provided the much cheaper course. The 7-day Codemao course charged 199 RMB, while the traditional education organizations would charge at least 100 RMB to thousands RMB based on different course content.

Prior knowledge
Okan (2003) demonstrates that if learners have low verbal skills and prior knowledge of the subject, the visuospatial adjuncts can be very supportive. Even if the subject content is complex, visual displays can help enhance understanding in favour of the DGBL system. This serves as a cognitive tool to involve students in learning, rather than just playing a digital game. Last but not least, Okan calls on the necessity of educational and parental critical awareness. Such awareness requires that before intentionally accepting the DGBL system as a symbol of innovation, educators, designers, and parents need to question the didactic and pedagogical philosophy that the DGBL system design can embody.

According to the analysis results, learners in Grade 1&2 found that it was no easy to use this DGBL system. Because Codemao system involved a lot of text contents in the gameplay, and only provided some videos and audio images to show learners how to code, use this system and play the game. So it was very difficult for them to read the text content and use this system by themselves. Parents’ guides were heavily needed for them to use this system. However, their patents were not always by their sides. So, when those kinds of learners used this system, they would think that this system was not pleasant to use and bring lots of troubles.

In addition, there were some participants, who preferred the traditional education approach. For example, one mother, who was the mathematics teacher, indicated that the Codemao winter special course was fun, but it did not provide enough relevant and abstruse mathematics knowledge for her child to take tests at school, and the Coding Master even provided the wrong answer to one mathematics question when giving feedback to her child. Further, some parents also complained that the operational and creational content in the Codemao system was not enough, their children were simply imitating coding operations from the videos to complete the tasks.

Clear goals and challenges
Creating an effective DGBL system, Kiili (2005) suggest that, designers should set clear goals and challenges that are coordinated with the learner’s skill level. However, some tasks assigned in the Codemao system were not clearly described, inexperienced learners, did not know how to complete the task by themselves.

While, after the learners getting used to this system, some of them started thinking that the gameplay was too easy, and the mathematics knowledge was too simple. Some of them had already learned at schools. And the mathematics knowledge was not deep enough to deal with the mathematics test at schools. Besides that, this system was assured that each lesson should last at least one hour, but in fact, some learners could complete one lesson in thirty minutes.

In this case, the system designers were not setting clear goals and challenges that were coordinated to the learners’ skill level.

The extrinsic interest
Based on the theory of motivation, volition, and performance (MVP), Huang, et al. (2010) suggests that the design of DGBL should not only focus on the motivational processing and cognitive impact, but should also consider the extrinsic interest. This can optimise the results of outcome processing along with increasing the relevance of the game content. When learner completed all the 7-day course, they would be rewarded some Codemao AR cards. Using the Codemao AR app to scan those cards, they could see some lovely characters from the game. It is popular among those learners to collect the AR cards and made them feel the Codemao course was quite enjoyable and full of surprise.
5.2. Discussion of RQ2

Q2: How do the benefits motivate students to use a DGBL system and gain parents’ support?

The findings of the research question 2 were explained by the two distinctive concepts, Situational interest, and Immediate feedback.

Situational interest

Prensk (2003) argues that digital games can highly motivate learners and facilitate the learner engagement because digital games have the magic to keep people actively learning instead of forcing people to learn. Further, Van Eck (2006) explains that DGBL implies the principle of Situated cognition, which means that the learning process is taking place within a purposeful the game context. And Gee also indicates that “all learning involves playing a character”, learning reaches the best effectiveness only if the learner can think, act and value like this character (2003, p.3). Neville, et al. (2009) indicate that the contextualized, immersive roleplay game can help students to learn by measuring knowledge retention and transfer and evaluate the attitudes of students toward the game.

Using Codemao to learn mathematics, the learner was playing as a Code Trainer. To be a good Code Trainer, the learner needed to complete a variety of tasks assigned by the Coding Master. From the empirical findings, we can find out that students have developed a lot of situational interests when using Codemao system to study mathematics. And this enjoyment fosters their motivation towards both mathematics and DGBL.

Immediate feedback

Erhel and Jamet (2013) point out that if giving learners regular feedback about their performance, entertainment instruction of digital game-based learning can also bring deeper learning to learners just like learning instruction of DGBL by experimenting on a bunch of students from several universities.

When learners faced some mathematics problems, they could receive the immediate feedback from Coding Master. It seemed that learners were more willing to ask Coding Master for help. On the contrary, when they faced some mathematics problems at school, they usually felt nervous to ask their teachers. In this circumstance, learners would feel that mathematics learning was interesting and could be semi self-directed to study mathematics, instead of being fed mathematics by their teachers.

Also, the DGBL embodies the process of cognitive disequilibrium and resolution. Based on Jean Piaget’s theories, cognitive disequilibrium means that the learning processing involves the concepts of assimilation which represent fitting new knowledge into existing categories, and accommodation which implies the process whereby people must modify their understanding of the world to accommodate new knowledge that does not fit into an existing category (Van Eck, 2006).

At the beginning of using Codemao to study mathematics, many learners would feel that it is too difficult to play, because they had never used it before. If the learners could not complete one task, they would repeatedly check the instruction and videos until they finally completed the task. And when they got used to it, they became enjoying the gameplay and felt a sense of achievement when completed a task assigned by Coding Master.
However, sometimes the quality of feedback could not be ensured, it was pointed out by the learner’s mother, who was a primary school mathematics teacher, that Coding Master provided the wrong instruction to the learner, then she started complaining about Codemao system and asked for the refund. Although it only happened once, users still left a negative comment on Codemao system, and it made the parent and learner doubt the use of digital game-based learning.

5.3. Additional outcomes
Tsai, Yu and Hsiao (2012) indicate that learners’ learning motivation, learning ability, and playing skill are the essential factors that collectively and interactively influence the effectiveness of knowledge acquisition in DGBL. While the main problems that participants suffered during the Codemao special winter course, were lack of computer knowledge and playing skill. Further, the unbalanced game challenges and course content also had a negative impact on attracting students to continue using the DGBL system to study mathematics.

All, et al. (2015) propose a conceptual framework that defines the effectiveness of digital game-based learning from three factors, learning outcomes, motivational outcomes and efficiency outcomes. And, in this research the effectiveness of a digital game-based learning system could be examined from four aspects:

1) The extent to which using the system increased the learner’s interest in the subject;
2) The extent to which using the system improvement in objective performance;
3) The extent to which using the system motivation to learn by using DGBL;
4) The extent to which using the system produced a pleasurable learning experience

From the learning outcomes perspective, the factors (increased the interest of the subject, improvement in objective performance (e.g., in a test) and the extent to which the learner's ability to apply acquired knowledge or skills to real-world situations) are regarded as relevant to judge the effectiveness of DGBL.

According to the research data, we could consider that children learners had increased the interest of mathematics to some extent. However, no data had been collected to prove that the learners’ academic performances had been improved in the test or not. Moreover, no data had been collected so far, could measure the extent to which the learner's ability to apply acquired mathematics knowledge and coding skills in the real-world situation either.

From the motivational outcomes perspective, “enjoyment, the extent to which playing the game evoked an enjoyable experience, and increased motivation to learn using DGBL” are identified as relevant (All, et al., 2015, p.29). When finishing all the 7-day special mathematics course, Coding Master would ask the learners how they felt about the whole course one by one. Moreover, we were glad to notice that the most of learners liked this course and enjoyed using this system to learn mathematics knowledge in the end.

In the beginning, many new family users thought the system was too difficult to use. Once they got used to this system, learners started enjoying using the system to learn mathematics, and parents felt delighted about their children’ behaviours as well. This transformation of participants had shown that the DGBL system had produced a positive effect on improving learners’ motivation to learn mathematics.
5.4. Reflection

Based on the collected data, we could see that the learners’ feedbacks play a significant role in influencing their parents’ attitudes and opinions to the digital game-based learning system they used. "My child likes your system” or “my child does not like your system,” which is essential for the parents to decide if they would be willing to pay for using the system or make the refund after the first lesson.

In the family environment, the stakeholders (learners and parents) have been seen as a whole by system designers. Because their attitudes and opinions would be influenced by each other, and both of them would decide whether they want to use the digital game-based learning system or not. Therefore, the design of DGBL needs to find a balance point to gain the whole family users. Moreover, the DGBL designers should insist on the improvement of motivating learners to learn both effectively and joyfully. Hence, four suggestions for design a well-balanced DGBL system have been proposed as follows:

✓ Allow learners to customize the game. In this case, learners can face the do-able challenge and enjoy the pleasant frustration. Further, it is highly valued if the learners can co-create the game world with designers, so that learners could be not only consumers but also producers.

✓ Setting clear goals and challenges that are coordinated to the player’s skill level and intellectual capacity. If the game content is highly beyond learners’ play skills, they could not experience any entertainment from DGBL. Thus, it is of great importance for DGBL designers to follow the guidance of educational psychology.

✓ DGBL designers should realize that motivating learners is more than combining entertainment elements to lessons. Otherwise, learners would just to play the game instead of being motivated to learn.

✓ DGBL designers should keep the educational and parental critical awareness, which means questioning the didactic and pedagogical philosophy that embodied in DGBL.
6. Conclusion

In this section, overall conclusions are made about the research study. Then, the researcher’s contribution is explained, following some suggestions for future research.

6.1. Conclusions

This research discussed DGBL as a novel learning approach and further emphasised on the empirical study of technologies motivating Chinese primary students to study and learn mathematics at home. The followed methodology was qualitative research with the interpretive paradigm. IMR methods, such as online observation, online interview, and online questionnaire, were used to collect research data in the DianMao company. Family users of Codemao system were recruited to join this study. Once all the data had been collected, the researcher transcribed the interview with the help of Lichtman’s six steps, analytical strategies as presented in the methodology section. The outcomes were further discussed by analysing data, concerning previous literature reviews.

There are five different concepts formulated for the research question 1: *What benefits and problems do students and parents experience when using a DGBL system?*

The concepts are Relevant content, Efficiency, Prior knowledge, Clear goals and challenges, The extrinsic interest. With those five concepts, the study has found responses to the first research question:

On the one hand, the DGBL system provided a novel learning approach, facilitating learners to enjoy the learning. Moreover, parents found it was a nice substitute to the real digital game. Besides that, compared to traditional education, the DGBL system could help participants to save a lot of traffic time and it was much cheaper. On the other hand, for the participants with low prior knowledge, they would not feel easy to use the DGBL system. Because it involved many text contents in the gameplay, and only provided some videos and audio images to show learners how to code, use this system and play the game. For the participants with high prior knowledge, some of them thought that DGBL system did not provide enough relevant and abstruse mathematics knowledge. The clear goals and challenges of the DGBL system were coordinated to the learners’ skill level.

There are two distinctive concepts formulated for the research question 2: *How do the benefits motivate students to use a DGBL system and gain parents’ support?*

They are Situational interest and Immediate feedback. With the two concepts, the study has found responses to the second research question:

Using DGBL system to study and learn mathematics, learners had developed the enjoyment and the situational interest to some extents. Moreover, this enjoyment fostered their motivation towards both mathematics and DGBL. Receiving the immediate feedback from Coding Master, learners would not feel that they were fed mathematics by teachers, and they just completed some tasks assigned by Coding Master. Also, the DGBL also embodies the process of cognitive disequilibrium and resolution. If the learners could not complete one task, they would repeatedly check the instruction and videos until they finally completed the task. Moreover, when they got used to it, they became enjoying the gameplay and felt a sense of achievement when completed the task.
6.2. Research contribution
There is only one author in this thesis work. It discussed digital game-based learning as a novel learning approach and emphasised on the empirical study of technologies motivating Chinese primary students to study and learn mathematics at home. The inspiration for this topic came from personal friends becoming parents themselves in the past year. And it pushed the topic of children’s education to the forefront and was the reason for including parent’s opinions when assessing the effectiveness of DGBL. The data collection was collected by the researcher, and all the data results were discussed in connection with the previous literature reviews.

6.3. Future Research
The methodologies and empirical findings described in this research can be further extended to study other DGBL systems in different countries, contexts, and subjects. In general, DGBL should be considered as a useful learning approach (Gee, 2003; Kiili, 2005; Neville, et al., 2009; Para and Bizzocchi, 2005; Prensky, 2003; Tsai, et al., 2012; Van Eck, 2006; Woo, 2014). Also, speaking of the education situation in China, it was interesting to jump out of the school environment and entered the family environment to consider how to design the DGBL that could improve the education environment and facilitate building a good ICT society.

The implication of this study could contribute to the technological education researchers, designers and companies, such as DianMao, inspire them to design more balanced educational games and DGBL systems, which could not only create the pleasurable user experience but also motivate students to be self-directed learning. There is an excellent potential for the organizations to invest in such advanced educational technologies. It might be practically possible to imagine and appreciate the future benefits of DGBL system, and soon it is expected that all schools and families will use this kind of system very soon.
7. References


8. Appendix

8.1. Questionnaire in Chinese

1. 你给孩子报名的是几年级的课程？
   a) 一二年级
   b) 三年级
   c) 四年级
   d) 五年级
   e) 六年级
   f) 七年级
   g) 八年级

2. 到今天为止，你的孩子一共上了几节课？
   a) 1
   b) 2
   c) 3
   d) 4
   e) 5
   f) 6

3. 你的孩子会继续来上课么？如果不，继续下一个问题。
   a) 会，原因是_________

4. 你的孩子为什么不继续来上课呢？
   a) 不会，原因是_________

8.2. Questionnaire in English

1. Which grade of the course do you sign up for your child?
   a) Grade 1-2
   b) Grade 3
   c) Grade
   d) Grade 5
   e) Grade 6
   f) Grade 7
   g) Grade 8

2. How many times courses your child has finished so far?
   a) 1
   b) 2
   c) 3
   d) 4
   e) 5
   f) 6

3. Does your child want to continue the course? If not, next question.
   a) Yes, the reason is __________

4. Why your child doesn’t want to continue the course?
   a) No, the reason is __________
## Questionnaire feedback in Chinese

### 8.3.1. Chinese version

<table>
<thead>
<tr>
<th>参与者编号</th>
<th>年级</th>
<th>上课次数</th>
<th>想要继续上课</th>
<th>不想继续上课</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>一二年级</td>
<td>1</td>
<td>短信后家长主动致电表示最近小区没网，笔记本配置太低，无法顺畅上课。家长想要先通过短期的上课来发现孩子对这个课程的喜爱程度，来提高孩子的兴趣点。如果孩子喜欢，后续希望编程猫有更好的形式来培养孩子在这方面的才能。希望编程猫有更好的形式来上课。已与家长沟通，我们将来的教育形式会不断进步，但暂时只有在线教育。可以关注我们的编程猫公众号。另外跟家长说有更深入的教学上的问题可以与班主任沟通。</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>四年级</td>
<td>1</td>
<td>家长表示孩子不喜欢这个课，不打算上了</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>八年级</td>
<td>1</td>
<td>已拨通，电脑被家长工作着，小孩子无法上课</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>一二年级</td>
<td>1</td>
<td>家长回复短信表示在外休假，可能最多再上一节课。</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>六年级</td>
<td>1</td>
<td>家长表示孩子无法接受这种形式上课，不打算上了</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>一二年级</td>
<td>1</td>
<td>家长抱怨课程不适合一年级的孩子。首先孩子看不懂字，不会打字，然后孩子不会电脑，没有电脑基础，上第一节课时任务的模块也有点问题，家长自己也操作不了。问猫老祖，猫老祖也是反复电脑式的回复。家长希望退款</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>一二年级</td>
<td>1</td>
<td>短信后家长主动致电表示最近小区没网，笔记本配置太低，无法顺畅上课。家长想要先通过短期的上课来发现孩子对这个课程的喜爱程度，来提高孩子的兴趣点。如果孩子喜欢，后续希望编程猫有更好地形式来培养孩子在这方面才能，希望编程猫有更好的形式来上课</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>五年级</td>
<td>4</td>
<td>2.15 家长希望课程可以延时上，认为这样更能帮助学生预习</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>六年级</td>
<td>4</td>
<td>孩子不想上课了，建议转赠给亲戚孩子</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>三年级</td>
<td>4</td>
<td>2.16 家长已知，家长喜欢这个课</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>四年级</td>
<td>5</td>
<td>上课遇到过比较多问题</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>六年级</td>
<td>5</td>
<td>家长已知，反馈上课时课程系统卡住不动了</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>六年级</td>
<td>6</td>
<td>家长表示没办法了解到孩子到底学到了什么</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>六年级</td>
<td>6</td>
<td>家长反馈我们的老师有很多数学题都答不上来，很多答案都是错的错误。这样会误导孩子。</td>
<td></td>
</tr>
<tr>
<td>Participant No.</td>
<td>Grade</td>
<td>Times</td>
<td>Will continue the course?</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>-------</td>
<td>-------</td>
<td>---------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Yes or No, why?</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>After the SMS, parents called the community to indicate that there is no network recently, the laptop configuration is too low to smooth the class. Parents want to discover their children's interest in the course through short-term classes, and to raise their children's interest. If they like it, they want to have a better form of programming cats to cultivate their children's ability in this respect. They want to have a better form of programming cats to teach (there is a whole continuity of education for children in this area). Studying here is not just online education. We have communicated with parents that our future education will continue to evolve, but for the time being, only online education (which is convenient for everyone in time) will be able to focus on our programming cat public address. In addition, parents have more in-depth teaching problems and can communicate with their class teachers.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
<td>Parents say that children do not like this class and do not plan to go there.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>1</td>
<td>Computers are occupied by parents, and children are unable to attend classes.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1 &amp; 2</td>
<td>1</td>
<td>The parent's reply to the text message indicates that the child is on vacation, and the child may take up to one more class.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>1</td>
<td>Parents said that the child can not accept this form of class, not intending to continue.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1 &amp; 2</td>
<td>1</td>
<td>Parents complain that the course is not suitable for first-year children. First of all, the child can't read the words, can't type, and then the child won't have a computer, no computer foundation. The module for the first class task is also a bit problematic, and the parents can't operate it themselves. Ask the cat ancestors some questions, the cat ancestors are also repeated computer-style responses. Parents hope to refund.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1 &amp; 2</td>
<td>1</td>
<td>After the SMS, the parents actively called to indicate that the community had no network recently, and the notebook configuration was too low to be able to go to class smoothly. Parents want to find out how much their children like this course through short-term classes to improve their interest. If the child likes it, follow-up hopes that the programming cat has a better form to cultivate the child's talents in this aspect. Have a better form to attend classes.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>5</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>6</td>
<td>4</td>
<td>The child does not want to continue the class, it is recommended to give it to relatives and children.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>4</td>
<td>Parents like this course</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>5</td>
<td>Encountered many problems in class.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>5</td>
<td>The course system is shut during class.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>6</td>
<td>6</td>
<td>Parents said that they have no way of knowing what the child has learned.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>6</td>
<td>6</td>
<td>Teachers have many math problems that can't be answered. Many of the answers are wrong mistakes. This will mislead the children.</td>
<td></td>
</tr>
</tbody>
</table>
8.4. Interview feedback

8.4.1 Chinese version

A. 关于寒假数学课内容
1. 课程内容简单，量少，讲解不生动，教材版本可能不同，内容要更细致一些
2. 学习重点不突出，预习的知识不突出
3. 创新思维少
4. 可以增加评估环节，检测学生掌握程度
5. 操作环节，不知道操作的原因及目的，操作简单，以听为主。
6. 课程给的任务不明确，同时也不知道怎么完成任务

B. 关于系统问题
1. XP 系统，不会升级/没时间升级/不想升级
2. 不想下载谷歌浏览器，觉得要求太多
3. 猫老祖回复慢，后台效率低，家长产生猫老祖后台是真人还是机器的问题
4. 使用过程出现课程卡机现象，操作断断续续，技术问题需改善
5. 保存和发布作品速度慢

C. 家长和孩子本身
1. 家长工作忙，学生不会单独操作
2. 家长和学生都不懂操作编程猫，觉得操作难，不会操作三维空间
3. 孩子上其他兴趣班，没时间学习课程
4. 家长不感兴趣
5. 买完课后可以保留，开学之后可以再次使用
6. 登录账号和报名上课的账号不对应
7. 希望手机号可以绑定多个账号
8. 如果没有顺利上课（系统或浏览器问题或中途卡机）本课时不会算成一节课
9. 一节 1-2 个小时，有家长认为时间很长，希望可以再划分成小课时
10. 家长询问能不能用手机操作编程猫，手机操作更能随时随地使用课程
11. 试听课的时间只有下午 3 点和晚上 7 点，两个时间点都比较特殊（如学生 3 点有兴趣班，晚上 7 点晚餐时间），应多增加试听课的时间点
12. 正式课排课后忘记了去上课，建议编程猫后台系统有短信通知
13. 孩子感觉 MC 的版本有点低，不过瘾，建议最好是 1.5 以上的版本
14. 程序和试听课预约在同一个时间，猫老祖处挑出来的信息是错误的
15. 上课时间到了却没能和猫老祖联系（后台未备注原因，但防止是编程猫后台的问题）
16. 不知道/忘记了登陆的密码
17. 对于低年级学生，课程操作存在着难度问题，家长建议内容再细致，难度再降低
18. 相应地区可以开展线下课程
19. 关于结课后的礼品使用可以发送短信告知

8.4.2 English version

A. About the winter vacation mathematics class content
1. The course content is simple, the amount is small, the explanation is not vivid, the textbook version may be different, and the content should be more detailed.
2. The learning focus is not prominent, and the knowledge of the preview is not prominent.
3. Less innovative thinking
4. Can add evaluation links to detect students' knowledge level
5. Operation is rigid, I don't know the reason and purpose of the operation.
6. There are few customer operations and creative links, mainly listening.
7. The task given by the course is not clear, and I don't know how to complete the task.

B. About system problems
1. XP system, will not upgrade / no time to upgrade / do not want to upgrade
2. I don't want to download Google Chrome, I feel that I have asked too much.
3. The cat ancestors responded slowly, the background efficiency was low, and the parents produced the cat ancestors backstage is the real person or the machine problem.
4. The phenomenon of course card machine appears in the process of use, the operation is intermittent, and the technical problems need to be improved.
5. Save and publish works slowly

C. Parents and children themselves
1. Parents are busy with work, students will not operate alone
2. Parents and students do not understand the operation of programming cats, feel that the operation is difficult, will not operate three-dimensional space
3. The child has other interest classes and has no time to study the course.
4. Holidays need to travel, visits during the Spring Festival, return home without a computer, or the computer needs to be worked by parents.
5. Students are not interested
6. Can be retained after the course is purchased, can be used again after school
7. The account that is logged in and registered for class does not correspond to the account.
8. If there is no smooth class (system or browser problem or mid-way card machine), this class will not be counted as a class.
9. A class of 1 to 2 hours, some parents think that the time is very long, I hope that can be subdivided into small class hours.
10. Parents ask if they can use the mobile phone to operate the programming cat, and the mobile phone operation can use the course anywhere.
11. The time for the audition is only 3 pm and 7 pm. Both time points are special (such as students are interested in classes at 3 o'clock and dinner at 7 o'clock in the evening). You should increase the time of the lectures.
12. After class, I forgot to go to class after class scheduling. It is recommended to have a SMS notification in the programming cat background system.
13. The child feels that the version of MC is a bit low, but not addictive. It is recommended that the version is preferably above 1.5.
14. Programming Lessons and Audition Lessons At the same time, the information picked up by the cat's ancestors was in turmoil.
15. The class time has arrived but I have not been able to contact the cat ancestors (the reason is not noted in the background, but the prevention is the problem of programming the cat background)
16. Do not know / forgot the password for login
17. For the lower grade students, there are difficulties in the operation of the course. Parents suggest that the content is more detailed and the difficulty is reduced.
18. The corresponding area can carry out offline courses
19. You can send a text message about how to use the gift after the class.
8.5. The permission to use Codemao data in this thesis
Comments:
#1: Please add a summary of the interview and questionnaire feedback in English; otherwise it is very difficult to follow the coding and categorizing process. This summary can be in the appendix.
8.6. Informed Consent Form in Chinese

知情同意书

请在阅读资料后和/或听取有关研究的解释后填写此表格。

论文题目：基于数字游戏的学习对促进小学生学习数学的影响研究

研究员：彭晓明

感谢您对参与这项研究的兴趣，在您同意参加之前，组织研究的人必须向您解释这个项目。

如果你有任何问题，请询问研究人员，然后再决定是否加入。你会得到这份同意书的复印件，随时保存和参考。

参与者陈述

我同意：

- 我明白，如果我在任何时候决定不再参加这个项目，我可以通知研究人员并立即撤退。
- 我同意为了研究研究而处理我的个人信息。
- 我知道这些信息将被严格保密。
- 我知道我的参与将被录音/录像，我同意使用这个材料作为项目的一部分。
- 我知道我提交的信息将作为报告发表。保密性和匿名性将保持不变，不可能从任何出版物中识别我。
- 我同意上述研究项目对我的解释是满意的，我同意参加这项研究。

签名：日期：
8.7. Informed Consent Form in English

<table>
<thead>
<tr>
<th>Informed Consent Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.</td>
</tr>
</tbody>
</table>

**Project Title:** The study of digital game-based learning on motivating Chinese primary students to study mathematics

**Researcher:** Xiaoyue Peng

Thank you for your interest in taking part in this research. Before you agree to take part, the person organising the research must explain the project to you.

If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you to decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

**Participant's Statement**

I agree that:

- I understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately.
- I consent to the processing of my personal information for the purposes of this research study.
- I understand that such information will be treated as strictly confidential.
- I understand that my participation will be taped/video recorded and I consent to use of this material as part of the project.
- I understand that the information I have submitted will be published as a report. Confidentiality and anonymity will be maintained and it will not be possible to identify me from any publications.
- I agree that the research project named above has been explained to me to my satisfaction and I agree to take part in this study.

**Signature:**

**Date:**
8.8. Original observation data in Chinese

很好，很有兴趣，而且很有收获，所以积极性很强！就是建议孩子多读作品，如果能多在微信或其它平台上展示会更好！咱们班级也是一个推广，而且有好多孩子也在咨询，估计也有几个报名的。

嗯嗯，其他的课程都可以扫码到手机的，现在代码是作品分享不多，我们的技术部已经在开发这个功能了。
下课啦，今天上课感觉怎么样？

2017-01-20 20:27:30

你好，就是我的网速通讯不行

2017-01-20 20:28:27

老是和组织失联

2017-01-20 20:28:31

但是结果还是坚持完成上课，值得鼓励

2017-01-20 20:29:06

恩，因为这里是每天我最期待的地方

2017-01-20 20:29:18

真的吗

2017-01-20 20:29:36
2017-01-20 20:30:30
猫老板好开心

2017-01-20 20:30:41
可以告诉我原因吗

2017-01-20 20:31:37
我很喜欢跟着老板一起工作的时间，这里很好玩，总是有新奇有趣的东西，看也看不够

2017-01-20 20:33:03
谢谢老板，猫老板每天都期待你的到来

2017-01-20 20:33:35
有无所不的猫老板，有强大的队友，还有很多很好的同志

2017-01-20 20:35:42
希望有更多的探险可以和你一起进行^_^
太难了

孩子接受不了

是操作不会还是知识点不理解呢？
这套课程的内容是预习下学期知识点，您报名的是六年级课程，这节课主要涉及的知识点是负数哦

昨天 19:31

孩子不喜欢，内容太复杂，太多，一次接受不了

又不能复看

您可以保存每节课任务的，孩子课后仍然可以复习😊

－－－

好吧

有没有直接的链接呢

那个东西好烦人 他才5岁也不认识字
您好！因为我是学校的老派，如果课程变化或者我想推荐给学生的，在我尝试之前，已经推荐给了一些学生。

不过，上了几节课之后，高年级的学生普遍反应太简单，低年级的孩子反应，不知道该做什么，看不懂。

我今天试听完了之后，有这样一些体会：1.交代背景的对话，占的时间太多了，我听得有些不耐烦。2.对六年级的孩子，负责的概念太笼统了，但不是说我不选择六年级的课程就成为问题了，我选择买这个课程是想强化学校里所学不够的地方，或者老师解释得比较匆忙的地方。

是的，知识点太简单，操作不够一目了然。

他是否能玩出名牌我也认可，平板上玩的cf，水平跟那样子，就是听了张晨光的介绍，才让他接触这个的。

只为减轻游戏瘾

所以才要引导的，引向编程方面。我儿子是先编程后玩cf的，但自己玩没氛围，所以这个挺好的，cf可以编程模块，不是单纯游戏这么简单

男孩子都喜欢玩游戏，要跟不跟得上

也不难，板结网了，也不教他，才帮助他去学编程。
不客气

20:31

孩子现在上完课了，

笔记，有格式参考吗？

什么笔记呢？

不到两个小时，是否完成这堂课的内容？家长如何知道反馈？

上课之后猫老祖提示看自己的笔记！所以，想参考一下
刘老师，上了六次课了，来反馈一下孩子的收获。我发现面对网络上的老师，孩子确实更愿意告诉对方哪里不理解，比如她会问为什么圆锥的体积是同底等高的圆柱的1/3，会告诉老师她觉得圆柱体的体积公式不好记，对比例尺的问题有疑问也会老实提问...可能是因为猫老祖不会骂她吧😊另外提个小建议，请刘老师反馈一下。 searchData 就是希望猫老祖在最后一次课上能提醒她养成一些好的数学学习习惯，比如画图可以帮助理解，计算要打草稿，她很喜欢凭空想，想了半天，最后还是错，毕竟能力还没到那个程度。我说的她听不进去，看看猫老祖说的是不是比较有效。因为明天有事，最后一次课我已经调到了正月初七才上。最后提前祝您新春快乐🎉🎉🎉