RITVET

Digital Game and Mathematical Learning: Mathematic Quiz Shooting Game (MQSG)

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Abstract: Mathematics is one of the most important subjects for primary school as it requires students to do good drills and mastery so that students can achieve better results. However, the pervasive advancement of technology today demands a more effective and up-to-date approach to learning and training. Therefore, this study and development for this game application is conducted to help students in Year 6 in primary school to provide drills and vary the form of training in other platforms that use technology that is in the computer game application platform. In addition, this also gives students more effective time management while playing this game application. The development of this game application was developed by Unity software as used as the main platform, Adobe Illustrator to design icons and buttons appropriate to the game application and subsequent use of C Sharp programming using Microsoft Visual software for product functionality. Therefore, the developers use the Game Development Life Cycle (GDLC) model as a methodology and also as a guide and objective for the development of this game application. The application of this game also goes through several tests that will be evaluated by experts in related fields. According to experts, this application is very good to help students in learning mathematics subjects and can even attract the attention of the target users involved. It is hoped that this game application can give a positive impact to the students to provide appropriate preparation in facing Mathematics subject during secondary school.

Keywords: Game Apps, Mathematic, Game Development Life Cycle

1. Introduction

Game-based learning (GBL) has its own uniqueness in attracting the attention and interest of the individual in learning the subject. Digital games used in GBL are able to enhance understanding and reinforce student's memory on a subject being taught (Rabu & Talib, 2017). In fact, well-designed educational games show great potential for students to understand more deeply and improve through the learning process (Wang & Zheng, 2021). The use of interactive learning using technology is motivated by a variety of parties proposing that learning should be centered on cognitive processes in the production and design of GBL. Moreover, digital GBL approach can be utilized as an educational tool which can boost students' wellbeing and self-esteem, help them improve their soft skills, develop their critical thinking, decision-making and problem-solving skills, as well as maintain a healthy mental and psychological balance (Anastasiadis et al., 2018). Furthermore, Qian & Clark (2016) claimed that digital GBL and 21st century skills have been gaining an enormous amount of attention from researchers and practitioners because of the positive effects of games on learning. Their findings suggest that a GBL approach might be effective in facilitating students' 21st century skill development.

Using technology to use digital-based learning is motivated by a range of parties who suggest that learning should be centered on cognitive processes in any game-based learning creation and design. This is because many forms of video games are nowadays well known for their First-Person Shooter (FPS) genres including Player Unknown's Battlegrounds (PUBG), Fortnite, Call of Duty and others from various platforms such as computers, consoles and devices telecommunications that make such games extremely lacking in the application of educational-based gaming experiences. In learning Mathematics, the fact shows that students' interest toward mathematics is still low because most students think that mathematics only contains numbers, formulas, and the abstract theorem that were very hard to understand (Azmidar et al., 2017). Therefore, GBL and training will motivate and inspire students to learn more easily and faster, and also to teach students when answering questions in good time management. Based on the background of the presented problem, the game application needs to be developed to provide students with application and alternative learning in a video game of the same genre as the first-person view for the Year 6 Mathematics subject. Furthermore, game development can focus more on training so that students can complete their time and become familiar with it. Therefore, the objectives of this project are:

- Design game apps based on Year 6 Mathematics Subject.
- Develop a game called Mathematic Quiz Shooting Game (MQSG) in the first-person view genre using 3-Dimensional Animation on the computer platform.
- Perform functionality test of MQSG.

1.1 Literature Review

Mathematics has been regarded as a fundamental subject because arithmetic and logical reasoning are the basis of science and technology (Yeh et al., 2019). Their research claimed that the existence of a significant percentage of low-achieving students is probably due to teacher-led instruction, which still dominates mathematics classrooms in most Asian countries. Mathematics is one of the most important subjects for primary school students to learn, particularly for elementary school students. This is because mathematics is important to the everyday life of a person. In addition, Hodanoca & Nodar (2016) stated that Mathematics significantly influences pupils' and students' education both in a special branch (mathematical knowledge) and in terms of moral education. Mathematics has its own uniqueness because it requires strong proof with the mastery of specific symbols and numbers as well as the interrelationship of related mathematical structures.

According to Hanus & Fox (2015), traditional and conventional school teaching can have a positive and positive effect in combination with the use of technology, particularly in modern times, as it is an

effective strategy to support student-centered learning. Furthermore, learning becomes more immersive as students communicate with their peers using technology (Hsiao et al., 2014). Moving on from Tasir et. But with the introduction of technology today , various forms of teaching and learning can be combined using technologies such as computers.

Furthermore, GBL can have a positive impact, particularly in mathematics learning, as students, especially children, experience the joy of playing early in their education as they encounter their own learning experiences (Alsawaeir, 2017). Therefore, developers want to implement the practice of playing in the game so that students do not feel they are learning but can experience the fun of playing. In addition, According to Gozcu & Caganaga (2016), GBL creates a successful and positive classroom environment where students and their learning are central.

In this study, the developer implements the development in the game application using behaviorism theory. The behavioral theory is one of the most widely used theories as a tool in the process of teaching and learning. According to Muflihin (2009), this behavioral theory is a learning theory that needs to change human behaviour, using the interaction of stimuli and responses as Ivan Pavlov experimentally put it in. In addition, humans can be controlled by manipulating the communicating stimuli through their actions (Mukminan, 1997). In general, before starting a study an individual should be prepared to be cognitive, psychomotor, and effective. There will be a training session during the learning that takes place, where more experience is acquired, so that more information and skills are learned. Similarly, the development of game applications requires students to be cognitive, psychomotor, and effective before starting the game. Likewise, the creation of game apps involves students to be cognitive, psychomotor, and efficient before beginning a game. The game involves repeated activities for paper 1 subject, so that a student can respond and obtain positive stimuli.

Moreover, this cognitive theory also takes the view that all students are consciously utilizing their learning to interpret current knowledge. Typically speaking, this philosophy stresses the method of absorbing the latest facts and creating new ideas as collected (Shokhibul Arifin, 2016). Therefore, with this philosophy in the creators of game apps, students are more able to grasp and learn about addressing any query that is being posed appropriately and efficiently.

2. Methodology

The Doppler Interactive Game Development Life Cycle (McGrath, 2011) has been selected by developers as the methodology for the creation of this Mathematic Quiz software shooting program, since it includes development phases appropriate for the game application. The phases contained in this methodology are the beginning phase, the production phase, the testing phase, the beta testing phase and finally the production phase. Therefore, The Game Development Life Cycle (GDLC) approach is one of the easiest to use to ensure this game development project is reliable, effective and productive. This is because GDLC has five usability criteria according to Ramadan and Widyani (2013), which are fun, balanced, complete and accessible.

The First phase is the initial phase, game developers need to review the literature on the game applications and identify the game genre to be developed. This step often needs thoughtful and engaging ideas which allow developers to build quality and best ideas. Therefore, the Interview was conducted with the subject matter expert (SME), a mathematics teacher from the SK Pintas Raya, Pn. In addition, in this phase also the game design, software selection and hardware requirements for the construction of the game should be determined. Furthermore, the most important aspect of this stage is the identification of genres. In the development of this development project, developers chose the appropriate genre of game, whether casual or casual.

The Second phase is pre-production, the pre-production development phase shall be the planning phase prior to actual production. This phase aims to get an early overview of the implementation and development of the game development process. Hence, developers use brainstorming methods to

identify game characters and game storylines prior to the next activity. Therefore, the activities and processes performed during this phase include game storyboarding, game design, prop design, game background and appropriate audio use as planned under the project development schedule for game applications. The factor in the design and design of the game storyboard is to provide an initial overview of the game's design and storyline to develop. Furthermore, this game application should set the appropriate themes for that game according to the user's target. Additionally, developers need to design appropriate metaphors and environments, and even game rules, and how to identify and define play during this phase.

The third phase is the production phase. This phase is a very important and most crucial process in the production phase of the game application development is the production of a prototype that works to provide a clearer and more detailed gameplay and gaming experience. This is to make sure the game works and works as desired. In addition, programming that acts on the backdrop of a game product is important in developing and building physical games, scores and character interactions in the game. As such, script references from various sources became necessary to create this game application using C# as a main source code to discover.

The fourth phase is Alpha Testing, this phase needs to do Internal testing that was conducted by the developer himself and the SME consisting of teachers selected by the developer of this game application, teachers who teach Mathematics subjects in SK Alor Janggus and SK Malawa to test their functionality, usability and output of this game application while playing with quantitative instruments. After that, Test output results are feedback from the developer as well as testers from the SME. As a result of that output the developer will have to decide whether to move the game app to the next phase or to repeat the pre-production phase.

The fifth phase, the Beta Testing is a testing that focuses and performs on target users. Beta testing still uses the same testing method as before in the testing phase because the prototype being tested is a prototype that has gone through the process of refinement and has been improved. Therefore, testers can test this development product in terms of usability, functionality and performance in this game application. In addition, in this improvement test, users are given more freedom to play and gain the best game experience as this test needs to get appropriate feedback related to the criteria of enjoyment and positive input to access.

Therefore, this beta test was conducted and randomly selected from 20 to 30 students from SK Alor Janggus and SK Malawa as the schools had their own computer lab to test for this phase in the game application. But unfortunately, Due to the Covid-19 pandemic and the Malaysia Movement Control Order (MCO), this beta test cannot be done. The last phase is the release phase. This phase allows this game application to be officially released to users. This release includes the launch of this game application as well as documentation regarding user manuals.

3. Results and Discussion

3.1 Result

Developers have conducted a study by the SME on this game analysis application to improve the game application using two mediums, online as well as conventional or face-to-face. The selection of five SMEs was also based on areas developed by developers relating to game development applications. Experts who responded to this expert checklist included primary school's teachers who taught mathematics subjects at the Sekolah Kebangsaan Alor Janggus in Kedah and Sekolah kebangsaan Malawa in Sabah. In addition, related field lecturers from Politeknik METrO Tasek Gelugor also included as a SME.

Table 1 shows the analysis of Interaction Design in the development of this game application. There were 8 question items on this table. 5 question items give 100% full acceptance of student interaction

design items ie Use of buttons / icons in this game app, Button navigation / easy-to-understand icon, Easy-to-use icon / icon Navigation, This game application works well when playing and the application of this game can provide convenience and positive impact to Year 6 students. However, only 2 question items by experts are not sure which game instructions and game information in this game app are easy to understand and this game app can interest students, especially Year 6 students. Only an expert does not accept that the Buttons / icons in this working game app are good because they are in part needed by the developer.

Table 1: Analysis of interaction design

Item	Questions for the experts	Frequency			Percentage of Acceptance (%)
		Yes	Not sure	No	
1	Use appropriate buttons / icons in this game application.	5	0	0	100%
2	The buttons / icons in this functional game app are good.	4	0	1	80%
3	The navigation Button / icon is easy to understand.	5	0	0	100%
4	Navigation Button / icon is easy to use.	5	0	0	100%
5	Game instructions and information games within this game application are easy to understand.	4	1	0	80%
6	This game application works well.	5	0	0	100%
7	This game application can provide Year 6 students with positive and positive impact	5	0	0	100%
8	This game application can be interesting especially for Year 6 students.	4	1	0	80%

Table 2 shows a result of the interface design in the development for this game application. Hence there are 10 questions related to the interface design for this game application. As a result of the interface design analysis in the development of this game application, 8 question items out of 10 question experts have agreed and given 100% acceptance for question items such as text size, font type, interface design, button design used , which is used appropriately, the buttons used are easy to understand, the icons used are easy to understand and lastly the layout is used appropriately and the color choices used in this game app are appropriate and interesting with this game application. However, only two items have an uncertain agreement among panels which is 'Graphic / Image Design used to make this game look interesting' and 'Graphic / Image used in accordance with this game application'. One factor that experts feel is uncertain of the two items is that they feel that the image design used should be more interactive in terms of color choice. In addition, the graphic design also needed to fit the subject.

Table 2: Analysis of interface design

Item	Questions for the experts	Frequency			Percentage of Acceptance (%)
		Yes	Not sure	No	
1	The size of the text used is appropriate with this game app.	5	0	0	100%
2	The font type of the text used is appropriate with this game app.	5	0	0	100%
3	Design the interface used appropriately and suitable.	5	0	0	100%

		Yes	Not sure	No	
4	Graphic / image design used to make this game application look interesting.	5	1	0	80%
5	The graphic / image design used makes this game application look interesting.	5	1	0	80%
6	Button design used fit within this application.	5	0	0	100%
7	The buttons used are easy to understand in this game application.	5	0	0	100%
8	The buttons used are simple understood in this game application	5	0	0	100%
9	The buttons used are simple understood in this game application	5	0	0	100%
10	Color options used in this game app are appropriate and interesting.	5	0	0	100%

Based on Table 3, the results of the content design analysis done in the development of this game application, a total of 4 question items 5 question items 5 questions of experts have been made and give 100% acceptance of question items as the instructions given in this application are simple understood, the timing and also the number of bullets given appropriately, rewards such as extra time and extra bullets appropriate in this application and the last is the form of questions given to the appropriate students. While only one question item is the only panel, there are definitely those who need questions related to students' interests to use this game application. The factor is why he showed that the design of the content contained in this game application such as game instructions and also the atmosphere in the game should be more interactive and diversified by developers.

Table 3: Analysis of Content Design

Item	Questions for the experts	Frequency			Percentage of Acceptance (%)
		Yes	Not sure	No	
1	This game application can interest students in Mathematics	4	1	0	80%
2	Instructions given in this game application easy to understand	5	0	0	100%
3	The timing and also the number of bullets given appropriate	5	0	0	100%
4	rewards such as extra time and extra ammunition (ammo) are appropriateand relevant in this app	5	0	0	100%
5	the form of question given to students appropriate.	5	0	0	100%

4. Conclusion

The process of testing and evaluation plays a very important role in assessing the quality and testing of the functionality of the developed game apps. The process in this phase can serve as a guide to developers and resources for improving the applications developed to be more quality and to help developers achieve their product development objectives. In conclusion, developers have found that this MQSG application has good development features. However, this game application still needs some improvements in the future to be more interactive and better. Therefore, it is hoped that improvement can be performed based on recommendations from experts in order to produce more interesting and effective game apps that can provide clear information to users.

Acknowledgement

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