Roll-A-Die: Probability in Android Platform for Grade Schools

Jenelyn M. Aranas, Alexander A. Hernandez, Ronald Angelo V. Santos, Ronald R. Erosa, and Joedanica Casanova

***Abstract*—Mathematics is one of the most genuine subjects taken up by review schools and also in college. Grade school students might get troublesome in comprehension with the new educational standards that are set by the government. This study aims to create or to create a mobile game application utilizing an Android platform to provide a better understanding on solving and analyzing probability. The mobile game application uses a good and interactive designs to have a better interaction with the student while they are playing the game. A survey of the student's perception of the mobile game application is conducted to know if the game shows an effective way of teaching the students about probability. This application helps in providing acceptable and reasonable practices in solving probability.**

***Index Terms*—Mathematics, mobile application, probability game, Unity 3D.**

I. Introduction

Probability is the core subject of mathematics and being used as a tool for the population modeling. Probability is the study of randomness of an event to occur [1]. Probability is the certainty of what we do not know. And how we can calculate that event that we do not know [2]. Various of teachers look for the issues of probability or in math subject since some assessment from grade school students, some of the students were not interested in the subject, and few students appreciate math subject or probability issue. The main objective of many elementary school courses is to improve and enhance the skills of the students in solving math problems. To improve the standard education through the advance technology. Institute of Technology Bandung (ITB) created Crayonpedia and Education Echo-System, as a place to manufacture learning process [3]. With the implementation of DepEd with K to 12 educations the competitive skills of the students are highly improved [4].

In the recent years, AR applications have gain popularity to children's and educational organizations are increasingly interested in applying education into technology [5]. One of the innovations is the utilization of learning studies guided by game-based learning. With the games it stimulates motivation and competitive skills of students that plays the game. And can be easily adapted to different knowledge levels [6].

Initial findings with the effects of various digital game-based learning environments. Help student gain peer collaboration with the teachers and also it is effectively promoting learning with the use of digital game-play [7]. Popularity of digital game-base games has grown immensely in recent years. Many studies said that with the digital game-base education, students adapt pleasure and fun in the game and also it improves the learner's motivation in the field of learning [8]. The new teaching technique of teachers is through the game-based education. With this, the students enhance their interest in mathematics and also improve the learning in mathematics [9]. With the development of educational video games, the teachers applied the education game-based software to be more attractive to the students.

The general objective of the game, is to enhance the problem solving skills of grade school students. And also to give them knowledge about the probability and how to solve probability.

II. Review of Related Literatures and Studies

Mathematics is an important matter in our daily lives. However, many of us do not want to accept the fact that it is used every day. Also, students that are in grade school, middle school and also in college find mathematics as a hard subject for them. However, with a game application that is applied to mathematics, by doing so, the students that play the game will have a self-learning by playing the game that is implemented with mathematics. With mobile math games, the experiment shows that students enhance their logic, problem-solving skills by playing math games [10]. GeoGabra, a free open source application that is being used for teaching math. The teaching method is to play the game Candy Crush and how to teach basic idea of mathematics.

The rapid growth of technology affects the students focus on playing gadgets, and also affects the learning ability of the students. However, with the idea of this study, the construction of a mobile game application that can help student's math learning skills easier by playing the game. The study stated that with the experiment on an elementary school to know the result of a mobile game learning to the students. The result of the experiment is that the students are not just enhancing the students learning abilities [11]. Many studies say that mobile game application base on mathematics can enhance students learning the process by playing the game, and also it can improve the problem-solving skills of the

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student by playing the game. So with the study, further strengthen the digital game-based learning of math with the use of a mobile game application [12]. Using mobile game applications in teaching gives an active learning with fun in an excellent manner [13].

The study stated that in the 2013 curriculum, it is focused on learning process on student activity. It also finds out that it is hard to teach mathematics without the use of instructional materials and the implementations of assessments. The use of Three Layered Thinking, the layers is used for educational games in learning process to enhance the mathematical skills of a student [14]. This paper stated that because of the digital generation, teachers develop a new guidelines of teaching for the student. The use of technology in teaching is much easier, because the students adopted the technology in a just a matter of time. By this the student enhances problem-solving skills and logic research through video games with mathematics. [15]. There are several of tools that is used as a learning and teaching process today. One of those tools is the multimedia course ware, that is being used in Malaysia educational system [16]. The result of creating a mobile game-based application is, that the students are able to self-study through the game application and greatly increase the interest in learning mathematics. Computer video games are offering important educational benefits to students because of its interaction with the students.

III. Methodology

This mobile game is part of a large game development project involving a non-government educational foundation, professional technological institution, and a network of elementary schools in the Philippines. The project aims to provide a set of mobile games for elementary students to enhance their academic performance on mathematics subject.

We used agile method to develop the game. Requirement and analysis, this process is for the game requirements. Design, we used Unity android platform to develop and design the game with the use of unity it is more easy to create an interactive game design. Development, with the development of the game we asked for assets that will be used for developing the game. Testing, we used different devices to test the compatibility of the interface of the game. Implementation, were the game is being played by students and other user.

There are two modes for the game the practice and the challenge mode. This mode is to make the students to think harder and to understand further the subject mathematics. And also the topic probability. With this game modes, the students can easily adapt and enhance their mathematical thinking and also the student's problem solving skills.

This study will contribute to the future researchers in a way of upgrading, enhancing and thinking of a new methods and game modes to further explain the topic probability and the subject Mathematics. This study will make them think of something on how to improve the teaching skills and the problem solving skills of teachers and also the students.

The parts of the article presents roll a die in the mobile game application. In this Fig. 1, it displays the system architecture of the mobile application. With this layered architecture, it further discusses the development of the game. "Game Application", is where the game assessment and the mathematical skills is tested. "Game Engine Framework", is where the game objects, game and math logic occurs. The component, attributes of the game is discussed. This layer discusses every function of the game and how the game flows. "Graphic Rendering and Physics", the audio, graphics, data and as well as the memory of the game application can be manipulated. "Game States, Data, and Memory Processing", this is the platform where the game application is developed and put on quality testing and enhancing the design of the game.

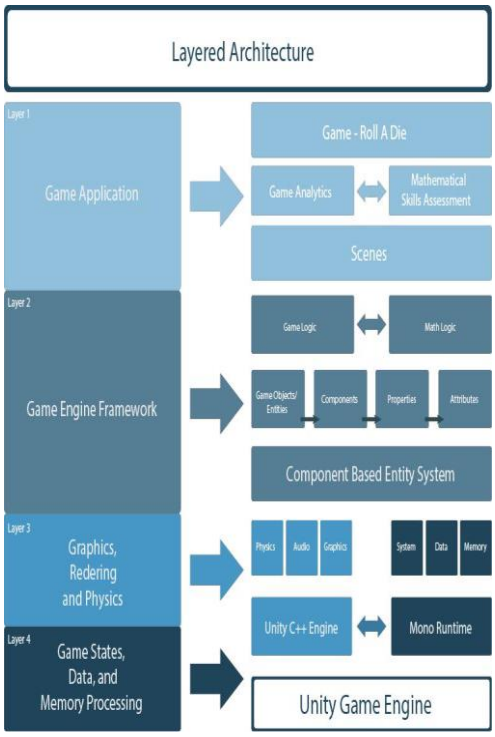

Fig. 1. System architecture.

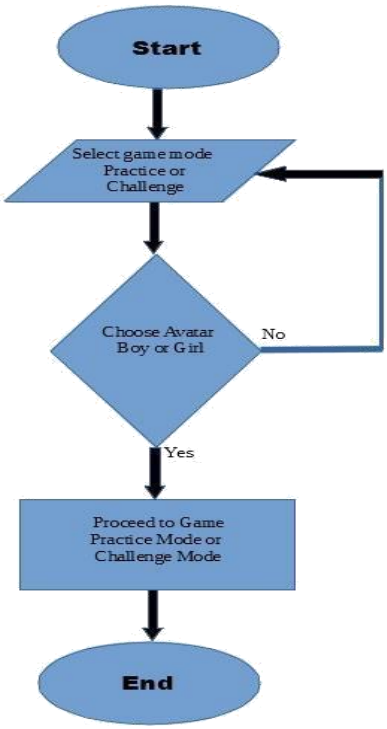

Fig. 2. System flow chart.

In this Fig. 2, the flow of the game is shown. First you need to select the game mode, practice and challenge mode. And after you need to select an avatar to play with. And lastly you can proceed to the game.

The effectiveness of this game is that the student will surely learn and enhance the student's mathematics skills.

Fig. 3. Opening scene.

In this Fig. 3, the game menu is shown to the student. Also, it has two modes the practice and the challenge mode. The practice mode and challenge mode differs only on the timer set on the challenge mode. However, the main goal of the game is to help the student reach the school by answering the questions along the path. In this game, the questions are continuously appearing and right after the questions are all answered. The student will automatically move, depending on the correct answer that the student got.

The effectiveness of this main menu is to introduce the student to the game itself. And also by determining which one will the student chooses, it will be the studies goal to enhance and to make them learn all about probability and solving skills.

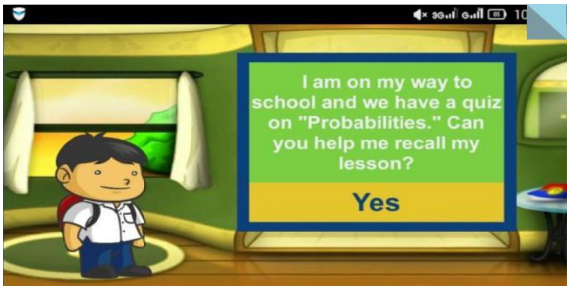

Fig. 4. Game story.

In this Fig. 4 the game explains to the student on, what will he do throughout the game go through in order to reach the school.

With the story of the game, it adds up enjoyment to the student. It is very effective to give them more entertainment for them to seriously play the game and achieve the goal.

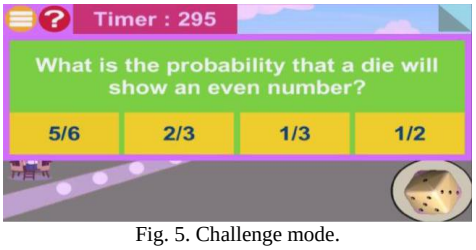

Fig. 5. Challenge mode.

In Fig. 5, it shows the question for each steps. The questions are continuously appearing till it reach the final question.

Challenge mode is where the student can test whether the student learn something from the practice mode. It is very effective for them to play this game mode, because it can test the mathematics skills of student and also to enhance it at the same time.

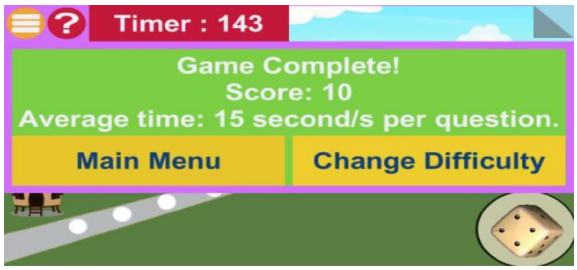

Fig. 6. Challenge mode – result.

In Fig. 6, it shows that the student has successfully answered the entire question along the path to the school. And gain a score.

With this result the student will know if he correctly answered all the questions properly, it is effective that the students know the score they got. So they can practice more and study hard to achieve a high result.

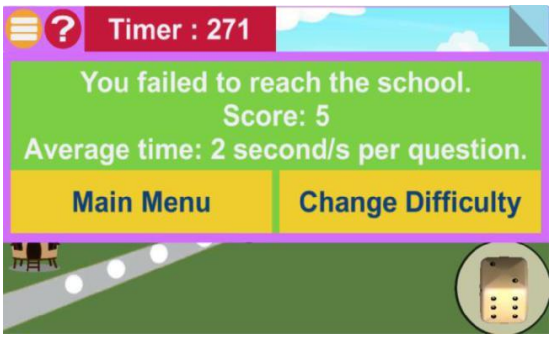

Fig. 7. Challenge mode – result.

In Fig. 7, by the end of the questions. The result will automatically pops and, it will let the student know if he/she successfully answer all the question. And if not this message will be shown, and the student can repeat the game from the beginning.

TABLE I: SUMMARY OF THE SOFTWARE EVALUATION

Criteria	Mean	Interpretation
1.Functionality	4.00	Acceptable
2. Reliability	3.95	Slightly
		Acceptable
3.Usability	4.20	Acceptable
4.Efficiency	4.00	Acceptable
5. Maintainability	4.00	Acceptable
6.Probability	4.00	Acceptable
Over-All Weighted	4.6	Acceptable
Mean		

IV. RESULTS AND DISCUSSION

The software evaluation receives an overall rating of [4.6] having an interpretation of Very Good as a result. The result shows that the mobile game applications performance has achieved the goal of the study which is to develop a mobile game application that can help the students understand problem solving and also enhance students own skill in

mathematics and in probability.

V. Conclusion

This research aims to present a mobile game application for grade school students to learn mathematical problems such as probability in a much easier way of solving a problem. This project was able to attain an excellently organized introduction for grade school and is much more learnable than previous ones that are published. (a) One of a good recommendation is to be able to develop the same game that can be played even in IOS software. (b) Developing and enhancing the graphical interface of the game for a better quality, and also creating new maps for the students to enjoy the game.

Acknowledgment

The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments. Avoid expressions such as "One of us (S.B.A.) would like to thank ... ." Instead, write "F. A. Author thanks ... ." **Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page**.

References

[1] H. R. Chen *et al*., "Design of digital game-based learning system for elementary mathematics problem solving," in *Proc. 2015 8th International Conference on Ubi-Media Computing (UMEDIA)*, pp. 303-307, IEEE, 2015.

[2] Y. H. Lin, "Integrating scenarios of video games into classroom instruction," in *Proc. First IEEE International Symposium on Information Technologies and Applications in Education*, pp. 593-596, 2007.

[3] I. Radu *et al*., "Discovering educational augmented reality math applications by prototyping with elementary-school teachers," in *Proc. 2016 IEEE on Virtual Reality (VR)*, pp. 271-272, 2016.

[4] S. Grau *et al*., "Games4Learning: How to integrate serious games to personalized learning itineraries?" in *Proc. 2015 10th Iberian Conference on Information Systems and Technologies (CISTI)*, pp. 1-6, 2015.

[5] S. Chatterjee *et al*., "Computer game-based learning and pedagogical contexts: Initial findings from a field study," in *Proc. 2011 IEEE International Conference on Technology for Education (T4E)*, pp. 109-115, 2011.

[6] R. Takaoka *et al*., "A framework of educational control in game-based learning environment," in *Proc. 2011 11th IEEE International Conference on Advanced Learning Technologies (ICALT)*, pp. 32-36, 2011.

[7] M. Giannakos *et al*., "Math is not only for science geeks: Design and assessment of a storytelling serious video game," in *Proc. 2012 IEEE 12th International Conference on Advanced Learning Technologies*, pp. 418-419, 2012.

[8] K. Kalemis, "Can games based learning assists teachers in achieving the aims of curriculum to bilingual students of different ethnic minorities?" in *Proc. 2011 Third International Conference on Intelligent Networking and Collaborative Systems (INCoS)*, pp. 76-83, 2011.

[9] U. Cukierman *et al*., "Playing with maths: GeoGebra application for meaningful education," in *Proc. 2014 International Conference on Interactive Collaborative Learning (ICL)*, pp. 243-248, 2014.

[10] R. C. Chang and C. Y. Yang, "Developing a mobile app for game-based learning in middle school mathematics course," in *Proc. 2016 International Conference on Applied System Innovation (ICASI)*, pp. 1-2, 2016.

[11] G. J. Hwang *et al*., "Effects of the mobile competitive game approach on students' learning attitudes and flow experience in field trips," in *Proc. 2014 International Conference of Educational Innovation through Technology (EITT)*, pp. 3-8, 2014.

[12] K. H. Yang *et al*., "Development of a digital game-based learning system with graduated prompting strategy for math course," in *Proc. 2016 5th IIAI International Congress on Advanced Applied Informatics*, 2016, pp. 423-426.

[13] S. Noordin and W. F. W. Ahmad, "Using game as part of the knowledge transfer module in a multimedia courseware: Lines and planes in 3-dimensions," *National Postgraduate Conference (NPC)*, pp. 1-3, 2011.

[14] A. G. Safitri *et al*., "Design and implementation of educational game based on thematic curriculum using three layered thinking model (Case study: Applying number and social arithmetic in the real life)," in *Proc. 2015 4th International Conference on Interactive Digital Media (ICIDM)*, pp. 1-7, 2015.

[15] J. Huizenga *et al*., "Mobile game-based learning in secondary education: engagement, motivation and learning in a mobile city game," *Journal of Computer Assisted Learning*, vol. 25, no. 4, 332-344, 2009.

[16] H. Helge, "Research on interactive interests of pupil-oriented mathematics learning using game-based animation," in *Proc. International Conference on Application of Information and Communication Technologies*, pp. 1-5, 2009.

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