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Fostering Computational Thinking Skill through Math Legends Application: Framework Design

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Abstract

Mobile games have become popular for children and play a vital role in the culture of young people. Games can now be played anytime and anywhere using smartphones, tablets, iPad, and laptops. With the rapid development of electronic devices that provide a foundation to deliver learning through mobile games. The researcher proposed a mobile game-based learning framework to improve the computational thinking skills of students with motivation and cognitive learning outcomes. The framework focuses on the application framework of Unity 3D for designing a game application. Unity3D used to develop video games for web plugins, desktop platforms, consoles, and mobile devices, The main purpose of this study is to design the framework for the proposed math legends mobile game-based learning to foster computational thinking..

Keywords – *computational thinking skills, mobile games, mobile game-based learning*

I. INTRODUCTION

With the increasing number of mobile games, students are more engaged as one way of getting fun thus, others result in dropouts or addiction. Using games with computer-generated agents is one of the alternative ways to help the perception of individuals because games also design to create challenges in every level, Gamers will face a lot of problems but solutions are formulated with strategies and algorithmic [9]. In the light of this opinion, it can be stated that computational thinking is related to various factors. One of these factors is the mobile games that is another approach in developing the problem-solving skills of students and discover some techniques or strategies in creating certain solution [10].

Computational thinking is used in our everyday lives to solve a certain problem and runs through every function of a modern business. One solution in solving a problem from difficult into a simple form is to utilize computational thinking [1]. The outcome of computational thinking is a combination of humans and machines and it is not mastery but it is more on the calculation techniques to solve difficult problems [2]. Mobile game-based learning with socio-affective and cognitive have a potential way for the improvement of learning for young adults [3].

Moreover, With the rapid development of information technologies, the needs of the community have changed [4]. According to The International Society for Technology in Education (ISTE) to improve the problem-solving skills of the students the use of new technology will be a big help in developing computational thinking skills and creativity [5]. They also said that digital games are effective in developing the problem solving, creativity and reflective thinking skills of individuals because of their active participation in providing solutions and immediate results [6]. With this, students would live and work with a big influence by computing values [7]. Furthermore, due

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to increasingly information-based society, computational thinking are necessary skills for the students that can help them solve problems and create effective solutions to lessen the skills gap between education and the workplace [8]. Teens who play online games are just having enjoyment because they want to feel relief during school hours and students also tend to feel stress due to loads of school work like quizzes, reviewing for examination and doing case studies and through playing it will relieve their stress [11]. It is undeniable that playing online games provide them something that no one can provide and according to some researchers, it enables the mind of players to be more active and also help them improve their decision making especially those adventure games that keep the players to be alert, active and strategic.

Computational thinking is a fundamental skill that opens student's minds in using data, technology, resources, and people in a manner that shifts us from technology consumers to creators.

Mobile gaming is one of the widely used leisure activities by many people. With this fast development, online gaming was also created to give entertainment to people regardless of age, gender and status of life.

According to the study "Regardless of the format of the game, students can simultaneously build their problem-solving skills while having fun throughout the process if an instructional game is well-designed"[12].

It has been observed by some researchers that games bring about positive learning to students if it is always being utilized inside the classroom [13]. In recent studies, educational games are essential to be discovered to analyze the outcomes and to create a "state of the art"[14]. Moreover, there are also studies that with proper implementation of game structures in creating games are qualified to motivate the learners.

Challenges are also felt by other parents, friends or students. As of now people are more engaged with the use of new technology like a smartphone for gaming, communicate with their loved ones and for educational purposes but lack of monitoring or improper use of technology will distract the learning activities of students. [15]. Moreover, studies found out that the increased time spent on the internet can lead to negative impacts and also studies revealed the human brain is easy to destruct and one reason is using technology when it is not properly monitored[16].

However, in line with this opinion, the result of the study of Castillo revealed that even if the respondents play online games still the personal interaction with others is not affected and the academic performance is still good enough even if they spent time playing[17]. Games have an important role in the development of the cognitive, physical, social, and emotional well-being of children and youth[18].

Moreover, game players can make decisions easily especially in the middle of a field and also the brains of action video game players can collect information more efficiently compared to non-gamers [19].

With the use of mobile devices, it supports students to process and locate information and also one of the practices of teachers[20] and students nowadays utilize mobile devices as part of the resources for learning[21]. Computational thinking is part of analytical thinking together with mathematical thinking that is a necessary skill to solve a problem [22].

Computational thinking is the entire knowledge which an individual must possess to handle problems and make possible solutions[23]. Computational thinking is incorporated into the development of an educational environment [24]. Also, applications like social networks and cooperative technologies and the digital world play a

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vital role in the development of computational thinking skills[25].

Critical thinking is one of the most important characteristics in education to reduce the skills gap in the workplace today. Critical thinking is acknowledged in every 21st-century learning framework, assessed as one of the most important super skills to have[26].

In the recent study investigating the results of game-design, learners were able to engage in [27]and computational thinking concepts[28]. Moreover, other researchers showed that game-design students improved in their learning and problem-solving perceptions[29].

Nowadays, digital technologies have played a vital role inside the classroom and as years pass by it will become useful or is embedded in the instructional materials as another digital method of teaching [30]. Computational thinking is becoming a fundamental skill for the 21st century, to be able to compete globally. It is important to introduce these concepts in content areas. Specifically, computational thinking must be introduced as early as the primary grades and then continue through secondary grades and beyond [31]. Computational thinking is an ability to process solution to solve a certain problem[34].

The research study focuses on the design framework for the proposed mobile game-based learning to improve one's computational thinking skills in terms of problem-solving, critical thinking and logical thinking.

This study looks into the conceptual framework that helps to design mobile learning games for improving the computational thinking of students.

II. METHODOLOGY

a. Research Design

The researcher employed quantitative data analysis in determining the experiences in playing mobile games. Observation and documentary analysis was used to measure the effect of mobile games utilization to one's computational thinking ,Scholastic Abilities Test for Adults (SATA) is a tool used to examines competence in abilities related to academic success was utilized to determine the effect of mobile games utilization, the result of the test was the basis in designing the conceptual framework in the development of the proposed math legend games to foster computational thinking.

The researcher used systematic reviews to find out the relevant framework to come up with the proposed application.

The distribution of the respondents is illustrated in table 1.

Table 1. Distribution of Respondents

Respondent	Number
Senior High School	66
College	30
Total	96

The respondents are all from the Panpacific University, Urdaneta City Pangasinan. The respondents were composed of students of college and senior high school.

III. RESULTS AND DISCUSSION

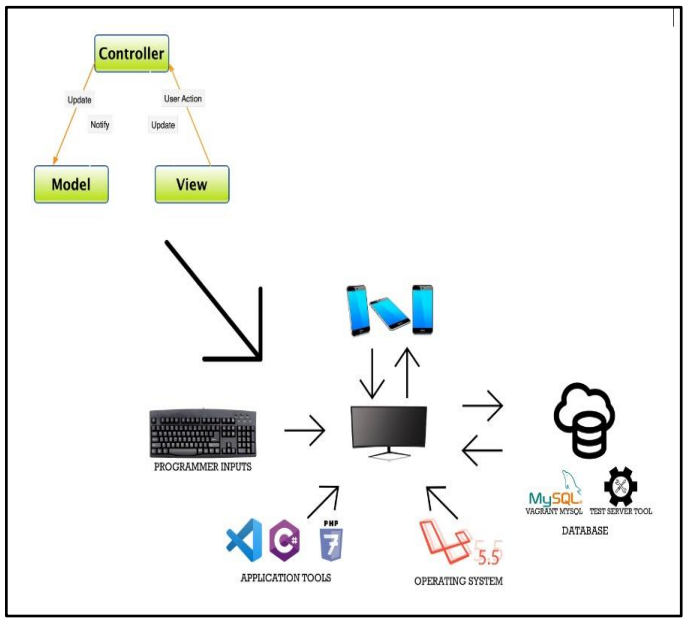

Figure 1: Application Framework programming for mobile games

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Figure 1 described the application framework for math legend mobile games. Unity 3D is used to create 3D game applications for mobile, desktop, web and consoles. Mysql-vagrant also used to run Mysql locally for development. Laravel was also utilized as one of the open-source PHP web framework intended for the development of web applications following the model view controller (MVC) architectural pattern and C# programming language used with XML-based Web services on the .NET platform and designed for improving productivity in the development of Web applications.

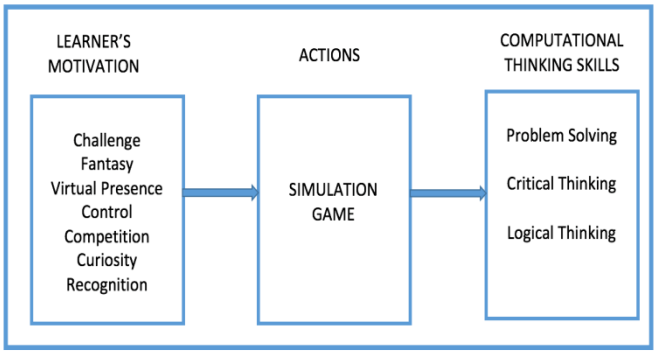

Figure 2: Conceptual Framework for using Simulation Game to Enhance Learner's Motivation and Computational Thinking Skills

Figure 2 shows the proposed conceptual framework for using simulation games to enhance the learner's motivation and computational thinking skills. Moreover, simulation game affect the learners' motivation since the proposed mobile game contains the following attributes like challenge that will create competition of the mobile gamers, Fantasy that produced imagination related with responsibilities, control that build power affecting people's behavior ,curiosity that creates a strong desire to learn ,competition that generates the activity of competing and lastly, recognition that makes the action of recognizing[32]. With these attributes, playing the proposed math legend games shall improve the learner's motivation and computational thinking.

In the recent study, Computational thinking (CT) is a concern with summarizing, designing and developing abstractions in which they are related to logical thinking and requires fundamental ideas to conceptualization.

The foundation of computational thinking is problem-solving which enhances logical thinking. The algorithm contains the construction of the step by step process to solve a problem, simulation demonstrates the algorithm and implementing models on the design and socializing that contains cooperation during the competition and simulation of the games that focus on the brainstorming to improve the critical thinking[33].

IV. CONCLUSION

In this research study which present a proposed conceptual framework for mobile game-based learning to improve computational thinking skills, using simulation game to be the tool in developing a mobile game for math subjects should concern about the study and design of the game. Through the support of the seven characteristics like competition, challenge, virtual presence, fantasy, control, curiosity, and recognition the learners will have more motivation to learn about the math subjects to foster computational thinking skills.

For further work from what was mentioned above that there is a need for the researcher to develop a mobile game application for math subjects with cognitive learning outcomes and motivation as part of their instructional materials to improve the computational thinking skills of the students.

REFERENCES:

[1] J. M. Wing, "Computational thinking," Commun. ACM, vol.49, no. 3, pp.33–35, 2006.

[2] J. M. Garrido,Introduction to Computational Modeling Using C and Open-Source Tools. CRC Press, 2014.

[3] Mitchell, A. (2007) '"Get real!" – reviewing the design of a mobile learning game', in Pachler, N. (Ed.): Mobile Learning – Towards a Research Agenda, The WLE Centre, London, pp.75–104.

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ISSN: 0193-4120 Page No. 38 - 43

[4] Sadi, S., Şekerci, A. R., Kurban, B., Topu, F. B., Demirel, T., Tosun, C., Demirci, T., &Göktaş, Y. (2008). Effective technology use in teacher education: the views of faculty members and preserviceteachers.International Journal of Informatics Technologies, 1(3), 4349.

[5] ISTE (2015). CT Leadership toolkit. Retrieved on 19 January 2017

[6] Boyle, E., Connolly, T. M., &Hainey, T. (2011). The Role of Psychology in Understanding the Impact of Computer games Entertainment Computing, 2(2), 69-74.

[7] Valerie Barr and Chris Stephenson. 2011. Bringing computational thinking to K-12: What is involved and what is the role of the Computer science education community? ACM Inroads 2, 1, 48-5

[8] Yadar, A., Mayfield, C., Zhou, N., Hambrusch, S.,andKorb, J. T. 2014. Computational thinking in elementary and secondary teacher education. ACM Trans.Comput. Educ. 14, 1, Article 5 (March 2014)

[9] Wing, J. M. (2008).Computational thinking. Communications of the ACM, 49(3), 33-35

[10] HaticeDurakYildiz, FatmaGizemKaraoglanYilmaz, RamazanYilmazBartin University, Turkey, Examining the Relationship between Digital Game Preferences a Computational Thinking S, Contemporary educational technology, 2017, 8(3), 359 369killsHarris, C. (2009).

[11] Kuss, Daria J. and Mar D.Griffiths.(2012).Adolescent Online

[12] MacKenty, B. (2006). All Play and Retrieved from https://owl.english.purdue.edu/pwl/resource/560/07

[13] Kuss, Daria J. and Mar D.Griffiths.(2012).Adolescent Online

[14] Malone, T. &Lepper, M. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In R.E.Snow & M.J. Farr (Eds.), Aptitude, Learning and Instruction III: Conative and Affective Process Analyses. Ê Hillsdale, N.J.: Erlbaum.

[15] Castillo J. &Dumrique D. (2018).Online Gaming: Impact on the Academic Performance

[16] Anderson, Janna, and Lee Rainie. (2012, February 29).Main findings: Teens, technology, and human potential in 202 and Social Behavior of the Students in Polytechnic University of the Philippines Laboratory High School

[17] Castillo J. &Dumrique D. (2018).Online Gaming: Impact on the Academic Performance

[18] Goldstein, Jeffrey, (2012) "Play in Children's Development, Health, and Well-Being", Toy Industries of Europe.

[19] Green CS, Li R, Bavelier D. Perceptual learning during action video game playing. Topics in Cognitive Science. 2010;2:202–216

[20] Syvanen, A., Beale, R., Sharples, M., Ahonen, M., & Lonsdale, P. (2005).Supporting pervasive learning environments: adaptability and context awareness in mobile learning. In Proceedings of the IEEE International workshop on wireless and mobile technologies in education (WMTE'05) (pp. 251–253).

[21] Roschelle, J. (2003). Unlocking the learning value of wireless mobile devices. Journal of Computer Assisted Learning, 19(3), 260–27

[22] Wing, J. M. (2008).Computational thinking.Communications of the ACM, 49(3), 33-35

[23] Korkmaz, Ö.,Çakır, R., Özden, M. Y., Oluk, A., &Sarıoğlu, S. (2015). Investigation of individuals'computational thinking skills in terms of different variables. OndokuzMayis University Journal of Faculty of Education, 34(2), 68-87.

[24] Morelli, R., De Lanerolle, T., Lake, P., Limardo, N., Tamotsu, E.,&Uche, C. (2011).Can an android-app inventor bring computational thinking to k-12. In Proc. 42nd ACM Technical Symposium On Computer Science Education (SIGCSE'11)

[25]Güney, C., &Çelik, R. N. (2009). Spatial informatics and spatial governance. 12. Turkey Scientific and Technical Mapping Conference, 11-15 May 2009, Ankara.

[26] Huitt, W. (1998). Critical thinking: An overview. Educational Psychology Interactive. Valdosta, GA: Valdosta State University. Retrieved from http://www.edpsycinteractive.org/topics/cogsys/critthnk.html [Revision of paper presented at the Critical Thinking Conference sponsored by

Gordon College, Barnesville, GA, March 1993. Journal,52,46 48.

[27] Baytak, A., & Land, S. M. (2010). A case study of educational game design by kids and for kids. Procedia - Social and Behavioral Sciences, 2(2), 5242–5246. doi:10.1016/j.sbspro.2010.03.853.

[28] Baytak, A., & Land, S. M. (2011). An investigation of the artifacts and process of constructing computers games about environmental science in a fifth grade classroom. Educational Technology Research and Development, 59(6), 765–782. doi:10.1007/s11423-010-9184-z.

[29] Denner, J., Werner, L., & Ortiz, E. (2012). Computer games created by middle school girls: Can they be used to measure understanding of computer science concepts? Computers & Education, 58(1), 240–249.

[30] Schofield, D. (2014). A virtual education: Guidelines for using game technology. Journal of Information Technology Education: Innovations in Practice, 13, 25-43. Retrieved

[31] Jake A. Qualls and Linda B. Sherrell. 2010. Why computational thinking should be integrated into the curriculum. J. Comput. Sci. Colleges 25, 66–71.

[32] Thomas Hainey, WimWestera, Thomas M. Connolly, Liz Boyle, Gavin Baxter, Richard B. Beeby and Mario Soflano. Students' attitudes toward playing games and using games in education: comparing Scotland and the Netherlands. Computer & Education, Vol.69, pp.474-484, 2013.

[33] CaginKazimoglu, Mary Kiernan, Liz Bacon and Lachlan Mackinnon. A serious game for developing Mackinnon. A serious game for developing computational thinking and learning introductory computer programming. ProcediaSocial and BehavioralSciences, Vol.47, pp.1991-1999, 2012.

[34] Wing JM (2010) Computational thinking: what and why ? https://www.cs.cmu.edu/CompThink/resources/TheLinkWing.pdf