Developing Mathematic Studies-Digital Game to Increase Student’s Self-Regulated Learning Time Management: A Literature Study

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**Abstract.** The media use increasingly dominates teaching-learning activities along with technology development. One of technology uses in education is the use of video game in mathematic learning and time management. Time management is a part of self-regulated learning; thus through easy access to technology and internet, the students can expectedly develop their SLR and time management abilities. Meanwhile, video game has elements that can be found in mathematic learning and thereby videogame can be an alternative learning media. To develop video game for mathematic learning and time management, digital game-based learning method can be used. This study will find out how to use mathematics in video games, the relationship between time management and self-regulated learning, and what a teacher needs in developing digital game for learning purpose. The result of current study shows that video game and mathematics are interrelated, particularly in developing logic-mathematic ability, and time management and self-regulated learning are correlated positively. To develop the two elements for one digital game, teacher should consider the targeted students that will use the media and gameplay, transparency, and additional learning in the digital game to be developed.

# INTRODUCTION

Technology has developed very rapidly in various areas, particularly education. Education is a system aiming to create individual’s smart and quality character. Through education, the students are expected to be better and competent persons in their own field. Education is defined as a conscious planned attempt in the process of realizing a learning process in which the students are required to develop their self potency and skill necessary to themselves, society, nation and state. Learning model using technology as the learning media has begun to be applied in education field. In utilizing technology a learning media with many advantages can be created, among others, through developing a more innovative and interactive learning. The learning process will be held interactively to motivate the students to be more active, to provide joyful circumstance, and to create a space that can develop students’ potential talent, interest, creativity, skill, and psychological development.

Recently, the more advanced technology development encourages the attempt of updating and utilizing technology in the learning process. A teacher is required to be able to use the media provided by the school and the media is possibly consistent with time development and demand. In addition to be being required to use the available learning media, teacher is also required to create skilfully the unique learning media to be used in the learning process if the media has not been available at school. The application of 21st-century technology is also required in an education relating directly to student learning, that is expected to build the students’ joyful interactive interesting learning spirit, in both learning material discussion and competency teaching, question like discussion, debriefing, multiple choice, essay, and so on. In the 21st-century technology era, education world has many subject-related educating games that have been developed as learning media to students aiming to teach primary education such as writing, reading, counting, drawing, etc. Through direct approach to students, games are fairly effective with comfortable, interesting, and understanding learning system.

In addition, despite the importance of academic success, many studies investigating time management have been done regardless comprehensive theoretical model to understand its relation to students’ participation, learning or achievement. In this technology development, students can learn independently and teacher provides a rich conceptual framework desirable to comprehend the (college) students’ time management and to guide the studies examining its relation to their academic success.

Digital Game Based Learning (DGBL) is a method using game technology today and even any digital game can be called learning media or instrument if it contains cognitive element of learning. In the digital game based learning, students are expected to learn and to think directly through the action taken by the students in the game. The learning game in this 21st-century educating game can be made as an alternative means to improve mathematics learning in joyful experience and educating students to think more critically. Thus, it can be said that through implementing Digital Game Based Learning (DGBL), the learning is not only interesting but also motivating because the form of media is game containing mission or problem. Here the author wants to review literatures studying the procedure of developing educating game for mathematic learning since 2016. Then, article is reviewed according to the topic selected. The published articles obtained will be selected based on the criteria of article that can be used as literature review. The next step of research is to describe the result of literature survey and to discuss the finding of literature survey.

# RESEARCH METHOD

This research used literature review research method. Literature review is a systematic, explicit, and reproducible method to identify, to evaluate, and to synthesize research papers and the idea yielded by researchers and practitioners. Literature review aims to analyze and to synthesize the knowledge existing related to the topic studied to find the gaps for the research to be conducted. The more detailed objectives are explained by Okoli & Schabram (2010): to provide background/theoretical base for the research to be done, (2) to study the depth or breadth of previous studies related to the topic to be studied and (3) to answer practical questions with an understanding on what have been yielded by the previous studies.

Writing literature review needs a procedure. Polit & Hungler in Carnwell (2001) divides the procedure into five steps: (1) defining the scope of topic to be reviewed, (2) to identify the relevant sources, (3) to review literature, (4) to write the review, and (5) to apply literature to the study to be conducted. Ramdhani, Amin & Ramdhani (2014) explain four stages in making literature review: (1) selecting topic to be reviewed, (2) tracking and selecting the appropriate/relevant article, (3) analyzing and synthesizing literature and (4) organizing review writing.

# RESULT AND DISCUSSION

From the articles collected for this literature review, it can be seen that the learning by utilizing educational technology shows the effectiveness of technology use with teacher’s support and the structure of individual classification, the improvement of students’ performance and its correlation to the students’ prior knowledge. In mathematics, the mathematic competency modeling can be defined as cognitive, effective, and metacognitive dimensions. However, some researchers state that this definition seems to be ambiguous because it belongs to effective and metacognitive dimension. Most approaches used to assess modeling competency are holistic, because modeling is generally considered as a collaborative process. In practicing arithmetic using practicing video game and education practice, the time to do the task shortens during the activity and academic year; thus, the mathematic subject in the school should have various activities in the class.

This study on digital game based learning experience in the primary school students proves that the use of teacher scaffolding can affect knowledge learning, and arithmetic skill, and the development of students’ interest in mathematics. Particularly, whole-class and one-to-one scaffoldings are useful in the digital game based learning in primary education. Whole-class scaffolding is important for students to start practicing and solving arithmetic problems for the integers in orientation phase and in some first game days, meanwhile one-to-one scaffolding pertains to the performance of individual students during the game. This study on the students’ experience with digital game based learning in the primary school proves that the use of scaffolding by teacher can affect knowledge learning, and arithmetic skill, and the development of students’ interest in mathematics. Particularly, whole-class and one-to-one scaffoldings are useful in the digital game based learning in primary education. The result of research shows that the integration of two scaffolding strategies into some phases of digital game based learning process can improve the students’ learning activity and their perception on mathematic learning in primary education. Therefore, the use of technology in mathematics can be beneficial. For the learning utilizing educational technology, the effectiveness of technology use is found in the teacher’s support to the use and the structure of individual grouping, the improvement of children’s performance, and their correlation to the students’ prior knowledge. Because video game belongs to technology, it can be used in mathematic learning.

The procedure of solving mathematic problem and to pass through the levels of video game is the same. However, unlike mathematic activities – making the students experience negative feeling – video game improve positive emotion. *Video game* is considered as reaction, relaxation, and providing a means of switching from academic aspect as it is not related to mathematic knowledge making the students stressed or afraid. Video game world enables us to use all of their potencies for educational purpose by leading them to work on the knowledge - despite the part of students’ life – making them stressed and resulting in uncertainty in using traditional methodology and instrument. For the future researches, we can apply video game use as a means of facilitating knowledge by creating gamified environment in the class, just like what is demonstrated in such a way that encourages students’ emotion and motivation to mathematic learning. Similarly, by utilizing video game as the instrument of working on logical-mathematical knowledge, we can obtain a more in-depth understanding on the students’ emotion when facing logical-mathematical knowledge and whether or not the use of video game can change the feeling (emotion).

Therefore, mathematic learning with *game-based learning* can be a good method to be developed. It is supported with articles reporting that game-based learning for mathematic learning has positive and mixed effects on students’ motivation participation, attitude, enjoyment, flowing condition, etc. However, it is noteworthy that there is likely other mathematic learning model than game-based learning model, particularly for primary school, because previous shows still small effect value.

Game-based learning model is still used until today, either digitally or non-digitally. It can also be seen that game-based learning can improve various aspects of students, such as motivation, achievement, learning understanding and experience, and even emotion. Just like other teaching method, game-based learning can be optimized by teacher to get the expected student outcome.

It can be seen that to develop a digital game-based learning, some points should be taken into account. The first one is the digital game being the target of students. The articles studied reveal that digital game-based learning is implemented widely in primary schools. It is irrefutable that mathematics is the subject less favouring by the students. To the primary school students, the mathematic abstract concept is still difficult and thereby a learning that can generate students’ activity and creativity is required by emphasizing the active, creative, effective, and joyful learning and the students’ understanding on mathematic concept can be developed better. Thus, a media with game-based learning for mathematics should be able to develop the students’ ability of solving mathematical problem and their adaptive skill.

In addition to age group, the point to be considered is students’ experience with digital technology, students in the class is heterogeneous with various backgrounds, including economic condition. Not all students have laptop or cellular phone; thus, the development of digital game-based learning should be adjusted with the condition of students, rather than be generalized. It will be difficult for independent learning at home due to the limited technology the students have. Thus, majority of articles studied found the implementation of game-based learning at school in which teachers can provide the facilities needed.

Having set up the targeted students for game-based learning, an educator should develop the game to be used in the learning. From articles studied, the points considered are, among others, the abilities of solving problem and of improving the learning outcome, but there is no specification of mathematic material. Nevertheless, this method is still applied to any material with some adjustment. The previous studies found that *gameplay* is the most important part in developing the game for digital game-based learning. Through gameplay, students can solve problem in their own way; moreover various games studied also provide some ways to solve problems. From the gameplay triggering students, they will be involved more in solving problem and generating motivation to complete the game. Thus, the development of digital game should have many alternative ways for the students to interact in order to find their own solution.

In addition *gameplay*, transparency can help students motivated better in *digital game-based learning*. In relation to the problem solving using gameplay, the transparent end goal of game can trigger students to complete the game in the way they considered the best one. Another transparency involves feedback and ranking system that can serve as the guidelines to detect analytical pattern, to show the error for correction, and appreciation in the form of mark or point.

Additionally, teachers can insert other learning than mathematic learning into the game. From the articles reviewed, it can be found that teachers insert teaching related to emotional development, linguistic intelligence, and computational thinking. It proves that digital game-based learning can be used to teach two subjects all at once, ad even the subject not taught compulsorily at school. If teachers want to teach the hazard of drug or the depression awareness in digital game of mathematic subject, they can integrate into it. However, teacher should be able to insert it softly and in line with the mathematical material taught.

The articles also show the relationship between *time management* and *self-regulated learning*. A study conducted on students found that the time management and the successful study performance are correlated strongly, surpassing sex, age, admission qualification, and even number of semester existing in the degree program. Students’ life needs good time management to compensate potential side job and personal life. If students have weekly time allocation system, they can achieve the targeted completion. They also can have counsellor to guide them.

Time management can be treated as the connector of SRL and MSL, because the failed self-regulation of metacognitive strategy is very closely related to students’ abilities of planning, monitoring, and evaluating their academic task. On the contrary, compared with men, women show low predisposition to regulate cognitive and metacognitive process, and thereby decide academic postponement. The construct of time management affects academic task postponement insignificantly. General data confirms an idea that postponement represents the students’ failed self-regulating behaviour. As expected, the dilating behaviour of doing task is very closely related to the students’ poor abilities of planning their study and of regulating their cognitive learning strategy. In addition, a thorough examination reveals that time use and metacognitive process regulation seem to have the same power in negative relation to the predisposition of postponement. It means that knowing how to regulate time collectively with poor metacognitive process regulation or poor collective time management and knowing how to regulate metacognitive process can lead the students to postpone task completion. This explanation confirms our consistency of finding in previous studies, underlining the important role played by temporal and metacognitive component in the students’ academic achievement. Compared with women, men show deficit of time management, operated as self regulation. In addition, the men’s predisposition to show low-level metacognitive learning strategy appears as another key factor in predicting the dilating behaviour in academic learning.

Time management and learning strategy also affect SRL learning and improve academic performance. Students can activate their consciousness and inform the effective learning strategy and motivate them to use it productively; thus they then can decide better how they can improve their learning skill and implement the appropriate learning tactic independently to improve their academic outcome. Briefly, successful online course and blended course not only pertain to how effective the strategy is needed to be practiced by the students, but how the students compensate the effective learning strategy with productive self-regulation (i.e. planning, monitoring, and regulation) equivalently. Considering this, educators encourage the use of effective learning strategy with some modification in their teaching approach and/or through designing feedback intervention that can be followed up.

The relation between SRL strategy and supporting media is difficult to define. Thus, it is difficult to evaluate the effect of the instrument on the SRL strategy in the students. Furthermore, the evaluation on the effect of instrument should be based on self-reported questionnaire and actual pattern of interaction between students’ activities and online environment, specific instrument, and their learning outcome or performance. In the research studying specifically Massive Online Open Course, it can be found that this instrument has not been evaluated largely in the term of its effect on students’ strategy. The future instrument design should be based on the obvious relationship between students’ activity and SRL strategy to facilitate the measurement of its effect on 5-10 week course only. In addition, the use of system allowing for time management facilitates and guides the students to study the course consistently and helps the students practice more. An effective time management will affect the performance. Briefly, the positive change is conducted in the time management behaviour and this will improve their self-regulation later.

# CONCLUSION

Recently, technology develops very rapidly. Because many aspects beginning to utilize technology in daily life, education field also starts to utilize it as well, particularly in class learning and time management, related to the self-regulated learning. In relation to mathematics learning, video game technology can be used to practice logical-mathematical ability and to entertain the students all at once, in order to be an alternative media through digital game-based learning. In developing digital game-based learning for mathematics, some considerations are needed. Firstly, the target of student that will learn and their background should be considered earlier for development purpose. Then, teacher development can focus more on challenging gameplay and transparency that can trigger the students to find their own solution and get satisfaction when they have completed the game. Teacher can insert other learning that is inline with the main mathematic learning, in this case time management.

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