

# Game Based Learning: Design a Multimedia with DDD-E Model for Mathematics Education

<https://doi.org/10.3991/ijet.v15i21.16353>

Nina Ikhwati Wahidah <sup>(✉)</sup>

Universitas Negeri Jakarta, Jakarta, Indonesia  
Universitas Nahdlatul Ulama Lampung, Lampung, Indonesia  
ninaikhwatiwahidah19@gmail.com

Wiwin Rita Sari, Ike Festiana

Universitas Nahdlatul Ulama Lampung, Lampung, Indonesia

Nasir

Universitas Islam Negeri Raden Intan Lampung, Lampung, Indonesia

**Abstract**—The purpose of this article is to provide insight into how to design game-based learning. In the 21st century learning focuses on the process of skills in applying materials using technology, and collaborating. Mathematics learning is learning that requires students to not only memorize and read but also be directly involved in the process of finding concepts. Learning media is an alternative to creating interactive and fun learning. In this study the research design adaptation of the multimedia development research model: Decide, Design, Development and Evaluation (DDD-E). The results of this study are in the form of conceptual and procedural models of steps in developing game-based learning for mathematics subjects using the DDD-E model design.

**Keywords**—Game Based Learning, Design, Multimedia, Mathematics, education

## 1 Introduction

In the twenty-first century, learning should focus on processes that allow students to have the skills to apply the material they have learned, use meaningful technology, and collaborate. The development of communication technology is able to make all the events in the world known quickly through television and the internet. Technological development causes communication not only to be done face-to-face, but can be done remotely through virtually. The world of education also requires new ways of communicating. Learning not only occurs through direct communication (face to face) but also multimedia (indirect) indirect communication. Multimedia is a combination of text, art, sound, animation, and video delivered through computers or electronic and digital equipment [1]. If using these multimedia elements such as im-

ages and animations that are equipped with sound, video clips, and information in the form of text, it will be able to give clear meaning to people who need it. Interactive learning multimedia can be divided into eight types, namely: tutorials, hypermedia, drills, simulations, games, tools and open-ended-learning, environment, test, and web-based-learning [2].

Trends in education research indicate an increased interest in seeing how games can affect learning [3]. Increased use of games in learning due to more evidence of effectiveness [4]. Several studies have been conducted related to the effectiveness of gamification in various domains such as business, mathematics, statistics, computer science, biology, and psychology [5]. But the use of games in learning has not become a habit, due to a lack of insight into the use of games in different contexts [6] and doubts about the integration of games in the curriculum, and their use in different learning contexts [7].

Mathematics is one of the subjects that requires the application of constructivist-based learning. Students not only memorize and read but are involved directly in the process of finding concepts. Especially in Indonesia, mathematics is still a subject that is less desirable. For this reason, innovation is needed in learning.

The application of learning media is an alternative to create interactive and fun learning. One of them is through game-based learning. Technological sophistication can be used as an effort to support learning activities. With the help of games as a medium can increase student motivation [8] and encourage students to explore science concepts explicitly and attentively [9]. There for the authors want to develop game-based multimedia for mathematics subjects

## **2 Literature Review**

### **2.1 Game based learning**

Game-based learning enables simplification of concepts in learning and adapts them to the needs of students. [10] There are many terms found in various literatures related to the use of games in education. Some use the term game base learning, and there is also gamification (gamification) and in this paper the term "game-based learning" is used. Game based learning is a type of game with clear learning outcomes [11]. Game based learning is defined as "Activities that have a game at its core, either as a main activity or as a stimulus for other related activities, and have learning as a desired or incidental outcome" [12] Playing and exploring digital games has a positive influence on attitudes towards game-based learning [13]. Transmitted from the game, learning material must always provide a learning experience (learners), the game must be a model that reflects the practice and culture of related topics, interacts with real-world models in a personal, social way and develops knowledge competencies.[14]

Based on the description above, it can be concluded that game-based learning is applying the game mechanism for non-game activities to change students' behavior. Game based learning works through more interesting technology that encourages users to engage in desired behavior, help solve problems, and take advantage of in-

volvement in a game. This technique can encourage someone to do work that is usually boring to be more fun.

## **2.2 Learning theory that supports the development of game-based learning**

Game based learning is a form of model that is designed to arouse excitement in students so that it can increase the likelihood of longer stored concepts, knowledge or skills that they are expected to get from the game. The form of game (game) presented here still refers to the learning process and with this formatted interactive program is expected to occur learning activities while playing. This the user does not feel that they are actually learning. The game is a well-designed program to motivate students and improve their knowledge and skills.

Research studies must integrate evidence with basic theories. Game based learning model can also refer to behavioristic theory which states that learning is a change in behavior as a result of the interaction between stimulus and response. This theory emphasizes the formation of behaviors that appear to be learning outcomes. In addition to the behavioristic theory that underlies the development of game-based learning there is also a theory of constructivism. This constructivism theory states that students / students must find themselves and transform complex information, check new information with old rules, and revise it if the rules are not appropriate For students to truly understand and be able to apply knowledge, they must work to solve problems, find all their own things, and strive with their own ideas [15]. According to this theory of constructivism, one of the most important principles in educational psychology is that educators are not just giving knowledge to students. Students must build their own knowledge in their minds. Educators can facilitate this process by giving students the opportunity to find or apply their own ideas and teach students to be aware and consciously using their own strategies for learning.

## **2.3 Mathematical learning**

Mathematics, more than any other subject, has the ability to teach logic (developing reasoning skills, the ability to agree logically from what was originally given, and sufficient requirements to determine concepts, make decisions, find ways to solve problems). [16] Learning mathematical is a process of interaction between the teacher and students and between students and students, wherein the process plays an active role in investigating a problem, looking for relationships, calculating, making predictions, and verifying to form mathematical concepts and knowledge in students. Mathematical learning must pay attention to certain principles. This is in line with the principles and standards of school mathematics from the National Council of Teachers of Mathematics which states 6 principles in school mathematics, namely equity, curriculum, teaching, learning, assessment, and technology [17] Furthermore, in the principles and standards of school mathematics from NCTM, it is stated that "effective mathematics teaching requires students to learn and then challenge and support them to learn it well". Therefore, the teacher must have an understanding of the students' knowledge and needs and be able to provide motivation in their learning activities.

Furthermore, Van de Walle, Karp, & Bay-Williams [18] stated that: To provide high-quality mathematics education, teachers must:

1. Understand deeply the mathematics they are teaching
2. Understand how children learn mathematics, including awareness of the individual mathematical development of their own students
3. Select instructional and strategies that will enhance learning.

Based on that opinion, what students learn about mathematics in school is very dependent on the learning process in the classroom. This means that in order for the learning process in the classroom to have high quality the teacher must understand deeply the mathematics material taught, understand the characteristics of students, and choose and use appropriate strategies in the learning process. Selection of learning strategies is one of the keys to successful learning. Integrating technology into learning practices is part of the idea of learning strategies. In mathematics education, infusion of technology substantially changes the way in which mathematics is taught and studied. Technological capabilities enable the addition of resources to mathematical content, so that teaching methods can be practiced in unique ways [19].

### **3 Method**

The approach in this study uses research and development (R&D) design. Research and development (R&D) are process of researching needs and then developing products to meet those needs.[20] Furthermore, the design used in this study is an adaptation of the Ivens Barron DDD-E model.[21] This DDD-E model is a design model for multimedia development. There for the researchers adapted this model.

## **4 Result and Discussion**

### **4.1 Conceptual model**

The conceptual model of this study is an adaptation of the DDD-E model. The step in the development of the DDD-E model is to decide, design, develop and evaluate. The description of the conceptual model for the development of game-based multimedia learning in mathematics subjects is as follows:

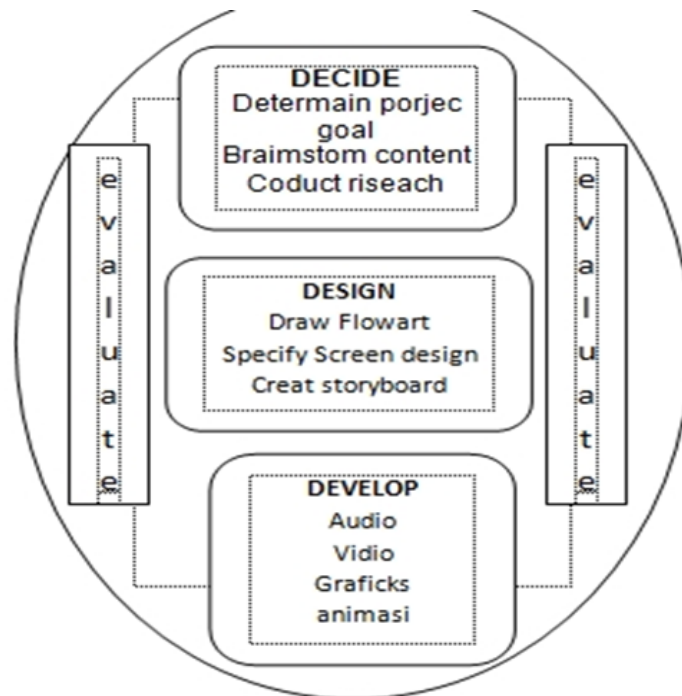


Fig. 1. DDD-E Development Model

**Decide:** At this stage researchers analyze and make decisions to determine which software will be used to develop game-based multimedia and also the type of hardware that will be used to operationalize the learning media by considering several things such as effectiveness, suitability and students' abilities in use hardware.

**Design:** At this stage researchers conduct material analysis to determine the depth and breadth of the material. After conducting material analysis, a flowchart and storyboard are made. Flowcharts are made to provide an overview of the flow or course of interactive learning media from one scene to another. Storyboard or visual script is made to describe each scene which includes visual appearance, audio, duration, and other information needed.

**Develop:** At this stage researchers develop elements of interactive learning media needed, namely text, illustration material, animation, and audio. After that researchers make interactive learning media using software that has been determined at the stage of deciding.

**Evaluate:** This stage the researcher evaluates interactive learning media products. Evaluation in this study uses formative evaluation, namely using the material, media, language and student expertise. evaluation from one to one expert evaluation, and students, then evaluation of small group and trial evaluation.

#### 4.2 Procedural model of game-based learning in mathematics education

Procedural models develop game-based multimedia learning in mathematics subjects. In this study adapted from the DDD-E development model syntax. The syntax is as follows:

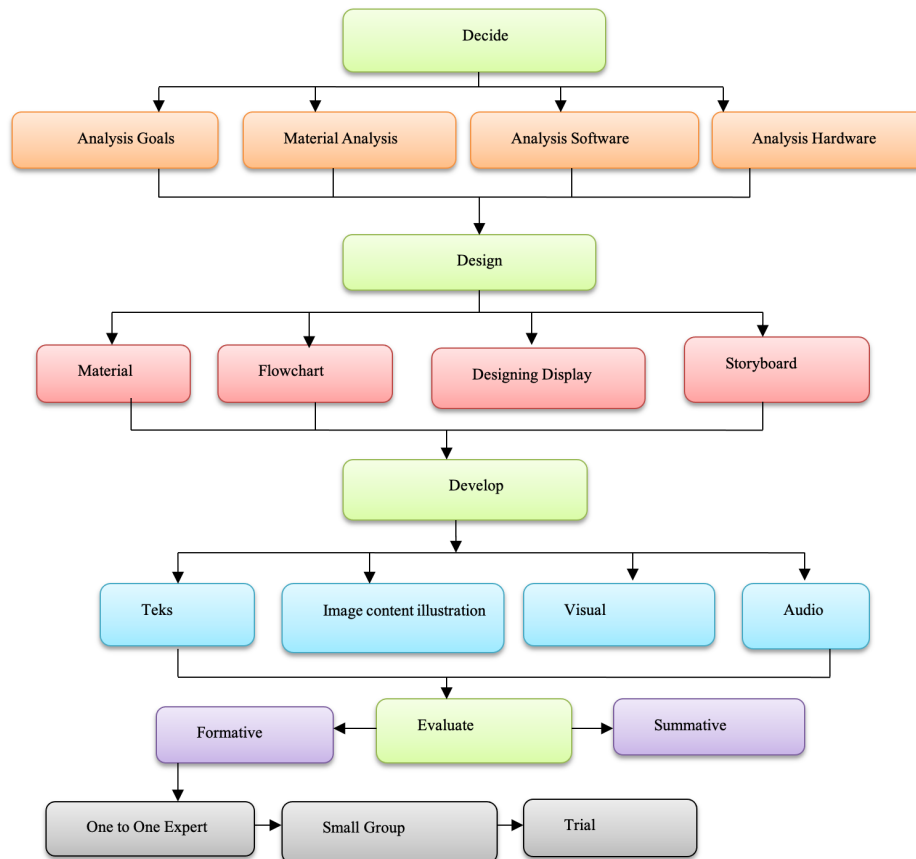


Fig. 2. Procedural Models

## 5 Conclusion

Mathematical is one subject that requires the application of constructivist-based learning. The application of learning media is an alternative to create interactive and fun learning. One of them is by utilizing technological sophistication through game-based learning. The results of this study are conceptual and procedural models in developing game-based learning for mathematics subjects.

## 6 Acknowledgement

The author would like to thank Lembaga Pengelola Dana Pendidikan (LPDP) and Program Beasiswa Unggulan Dosen Indonesia Dalam Negeri (BUDI-DN) for all supported in this study and research.

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## 8 Authors

**Nina Ikhwati Wahidah** is a PhD Candidate of Educational Technology, Universitas Negeri Jakarta, Jakarta, Indonesia, and work in Universitas Nahdlatul Ulama Lampung, Lampung, Indonesia

**Wiwin Rita Sari** works in Universitas Nahdlatul Ulama Lampung, Lampung, Indonesia

**Ike Festiana** works in Universitas Nahdlatul Ulama Lampung, Lampung, Indonesia

**Nasir** works in Universitas Islam Negeri Raden Intan Lampung, Lampung, Indonesia

Article submitted 2020-06-17. Resubmitted 2020-07-14. Final acceptance 2020-07-14. Final version published as submitted by the authors.