

# THE APPLICATION OF GAMIFICATION CONCEPT TO ANDROID-BASED MATHEMATICS LEARNING APPLICATION IN SMP NEGERI 1 CANGKUANG

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## ABSTRACT

SMP Negeri 1 Cangkuang is one of junior high school that located in Kabupaten Bandung precisely located on Tenjolaya Street, Kecamatan Cangkuang, the same with ordinary junior high school, mathematics is one of the subject that be taught in this school. The learning method that used in that school was using conventional method that is lecture method, this causes the learning of mathematics become not interesting. Based on questionnaire of 116 responder, 69% of students having difficulty learning mathematics, 66% of students don't like mathematics and 73% of student think that learning media that available (book) feel not interesting. The absence of alternative media and the limitation of school facilities make student less interested and motivated in learning mathematics. Based on that problem, the solution offered is making of learning media alternative with gamification concept for pushing of student interest and motivation to study mathematics. Gamification is the process of applying game mechanisms to non-game activities to increase interactivity. This application was developed with Octalysis framework gamification method with CAI method and the ARCS learning model as a reference for its development. The results of this study indicate that the application of learning mathematics with the concept of gamification can increase student interest by 35%, the motivation in learning mathematics increases by 33% and the student understanding increases by 43%. In addition, based on interviews and questionnaires, this application can be used as an alternative media for mathematics learning for students.

**Keywords** : Gamification, Android, CAI, ARCS, Mathematics

## 1. INTRODUCTION

Mathematics is one of the disciplines that are awarded to students from the elementary level up to a higher level. It makes mathematics as a subject with an important role both in shaping the mindset of students' mathematical quality and usefulness in everyday life[1].

Junior High School is a formal education after primary school. SMP Negeri 1 Cangkuang a Junior

High School in Bandung regency precisely located on Jalan Tenjolaya, Ciluncat, District Cangkuang. Same with the other junior high schools, in SMP Negeri 1 Cangkuang are Mathematics which is one of the subjects tested.

Based on interviews with one Mathematics teacher in class VIII SMP Negeri 1 Cangkuang, it is known that there is still a learning process using the conventional method of the lecture method, application of this method resulted in students easily bored and do not understand the material. Based on the results of the questionnaire on 116 respondents, 69% of students' difficulties learn mathematics, 66% of students do not like math, 73% of students consider learning media are available now less attractive, 72% of students having trouble finding learning media and 58% of students felt less suited to conventional methods used today. Not suitably applied learning methods, lack of interest of the students will be math, as well as the absence of an existing alternative learning media, impact on the value obtained by the students, based on the data value is there, 67 of 116 students have grades below 71, where the figure is KKM to class VIII. Based on the facts obtained from interviews and questionnaires should be an alternative learning media that can attract students and help students to learn mathematics.

Based on previous research conducted by Muhammad Fate in 2017, the results showed the application of the concept of gamification has increased the students' motivation to Mathematics [2]. In addition, based on research conducted by Puspita Octafiani in 2017, the results showed the application of gamification concepts not only can enhance students' interest and motivation to make it easier to understand the material and problem solving for students[3]. Based on these results the authors decided to use the concept of gamification as an effort to increase the interest and motivation of the students.

Gamification is the process of using mechanisms or rules in the game on a non gaming activity with the aim of increasing user interactivity[4]. There are many methods of gamification, in this study the authors use methods Octalysis framework. Octalysis a gamification method developed by Yu-kai Chou 2015[5], Yu-kai Chou is a gamification expert who

was named the best gamification teachers in 2014, 2015 and 2017 by the World gamification Congress and gamification Europe Conference[6], Octalysis methods designed to optimize human motivation in a system[7], Based on that this method can be a solution to increase the interest and motivation of students to learn mathematics.

Based on the problems already outlined, the authors decided to conduct the study entitled "Application of Concept Gamification On Android-Based Applications of Mathematics Education (Case Study SMP Negeri 1 Cangkuang) ".

### 1.1 Purpose and Objectives

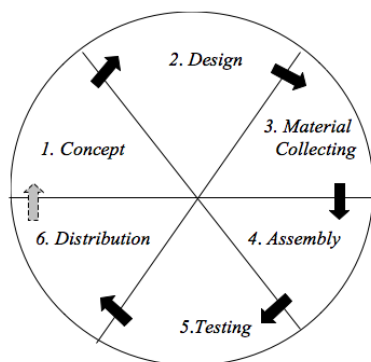
The purpose of this research is to build math learning app with gamification concept.

The purpose of this study are as follows:

1. Increasing interest and motivation of students to learn mathematics.
2. Make it easy for the students to learn math.
3. Enhance students' understanding in mathematics.
4. Make media alternative teaching students to learn mathematics.

### 1.2 Research Methods

Software development method used is the Multimedia Development Life Cycle (MDLC). According to Luther-Sutopo multimedia development is based on six stages, namely the concept, design, collection of materials, manufacture, testing and distribution[8],



**Figure1.** MDLC Methods

Description steps - steps from MDLC models contained in Figure 1 are as follows:

1. **Concept:** Stages of the process to determine who the users are using the application and determine the type of application being made. In this case the user is class VIII SMP Negeri 1 Cangkuang. In addition to this process done some analysis to produce a draft application to be built, the analysis of which the analysis procedures that work, analysis of similar applications, the architecture program, analysis methods gamification octalysis, analysis methods of CAI, the analysis of non-functional

requirements and requirements analysis functional ,

2. **Design:** At the design stage determined the flow and the display will be built based on the concept of the previous stage.
3. **Collecting Material:** In the material collection phase conducted by making assets like images to be used in applications such as image buttons, pop ups, and character. Then collect the sound that will be used in applications that are built.
4. **Manufacture:** Production stage is based on the design stage. Phase preparation is carried out by using Construct 2 R265 and Phonegap to change the application made to the format APK.
5. **testing:** Testing conducted after the completion of the manufacture and all data has been entered. Testing done in three stages, using alpha testing using a black box as testing functional and beta testing using a questionnaire distributed to students in class VIII SMP Negeri 1 Cangkuang as an assessment of the gaming applications that have been built, interviews to the teacher concerned and do testing quasi-experimental method (pre-test post-test) to determine the effect of the use of applications on the motivation and interest of students in mathematics.
6. **Distribution** will be done is by uploading the application of learning Math Magician to a special website that will students can download the application on the website.

## 2. RESEARCH CONTENT

### 2.1 ARCS Model

Attention Relevance Satisfaction Confidence Model or abbreviated ARCS is a learning model developed by Keller in 1987, this model is a form of problem-solving approach to designing aspects of motivation to encourage and motivate students to learn [9], ARCS Model has four components include:

1. *Attention/* Attention (Generating attention of students to learn)
2. *Relevance* (Explaining or associate learning with students' needs)
3. *confidence* (Fostering sure the students)
4. *satisfaction* (Making sense of satisfaction students)

### 2.2 Method of gamification

Gamification is the process of using mechanisms or rules in the game on a non-game activities with the aim of increasing user interactivity[4], Gamification has a design that prioritizes or focus on human motivation in the process not the design focuses on functionality.[5]

### 2.2.1 Octalysis Framework Method

Octalysis Framework is a gamification method developed by Yu-Kai Chou in 2015. The method was developed based approach gamification Blackhat / whitehat and right brain and left brain. This method begins by applying the elements that have been provided (gamification Level I) in 8 core drive that can be seen in Figure 2.

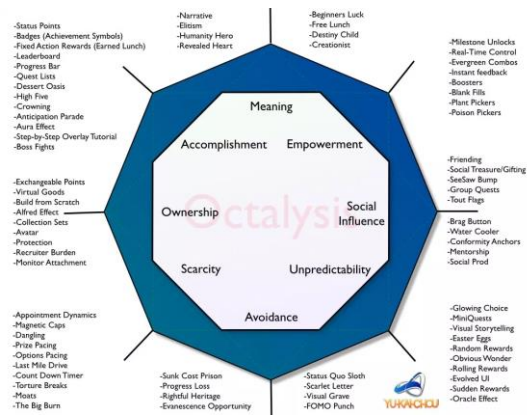


Figure 2. Octalysis Framework

8 cores drive in such a framework octalysis [5]:

1. *Epic Meaning and Calling* On this drive someone to be convinced that they are doing something great or felt he was chosen to do something.
2. *Development and accomplishment* : Internal drive to make progress, develop their skills and overcome challenges.
3. *Empowerment of Creativity and Feedback*: Users involved in the creative process as to try different combinations.
4. *Ownership and Possession*: This drive allows users motivated karenan they feel like having something.
5. *Social Influence and Relatedness*: Encouragement that comes from the environment.
6. *Scarcity and Impatience*: The urge to get something because they do not have it.
7. *Unpredictability and Curiosity*: The urge to find out what will happen next.
8. *Loss and Avoidance*: This drive is based on penghidaran something negative happens.

After applying the elements of the game that will be used, the elements are arranged into four phases that are part of the framework octalysis level II. Here are four phases octalysis level II framework:

1. Discovery phase is an initial stage in which new users enter the application system and the introduction of the application.
2. Onboarding phase is the phase in which the user getting to know the groove and the rules of application.
3. Scaffolding phase is the phase where users start using the application after getting to know the groove and the application's main mission.

4. Endgame phase, this phase aims to keep the player to keep using the application after the goal of the app has been reached.

### 2.3 Media Learning

Here the notion of instructional media, according to experts [10]:

1. Messenger technology that can be used for learning purposes.
2. Physical means to deliver content / learning materials such as books, movies, videos, slides and so on.
3. Means of communication in print or heard of view, including hardware technology.

#### 2.3.1 Method of CAI

Methods of Computer Assisted Instruction (CAI) is one of the media that can attract and were able to increase students' motivation. [11]CAI method presented in the form of interactive learning media which has the goal to present the learning content. CAI method may take the form of tutorials, drill and practice, simulations and games.

#### 2.4 Analysis of the Problem

Analysis of the problem is the first step of the identification and evaluation of the problems that existed before the application of learning is built. Analysis of existing problems are as follows:

1. Learning is still using the conventional method (Method lecture) that resulted in the learning process less attractive and interactive impact on the lack of interest and motivation to learn as well as the students' understanding less.
2. The absence of alternative learning media other than books that support student learning.

#### 2.5 Description of System Built

The system to be built is a math learning application based on Android. This system has two interfaces, namely as a Front-End and Back-End client as a server. Here are grooves contained in the application that will be constructed as follows:

1. Students as a client can access the material, exercises and evaluation through Android smartphone.
2. Teachers can monitor student learning outcomes through the website (Back-End) with computers connected to the Internet.
3. Admin (Master) can add users through the website (Back-End) with computers connected to the Internet.

Here is the architecture of applications to be built can be seen in Figure 3.

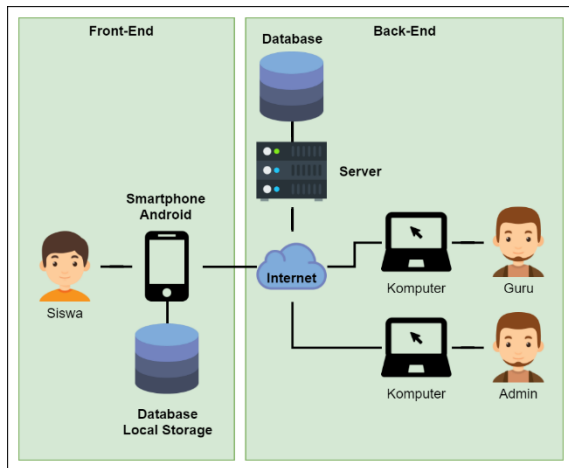


Figure 3. Application Architecture

Applications built using gamification Octalysis CAI Framework and methods adapted to the model of ARCS. Here's mapping application needs based on the model ARCS:

1. *Attention*

The following adjustments built applications based on components of attention:

- a. *Personal arousal* : Gamification Octalysis (Narrative, Visual Storytelling, Avatar, Freelunch, Easter Eggs, Appointment Dynamic, Mystery Boxes)
- b. *variability* Methods CAI tutorial models (use of video media)
- c. *inquiry arousal*: Gamification Octalysis (Narrative and Plantpicker)

2. *Relevance*

Following adjustment application is built on component relevance:

- a. *Goal Orientation* Methods CAI tutorial models (Presentation syllabus)
- b.  *motive Matching*: Method CAI tutorial models (Presentation syllabus)
- c. *familiarity* Methods CAI tutorial models (Examples of cases about tailored to students' lives today)

3. *confidence*

Following adjustment application is built on confidence component:

- a.  *Learning Requirements* : Gamification Octalysis (Milestone Unlock and Quest List)
- b.  *Success Opportunities* : Gamification Octalysis (Group Quest)
- c.  *Personal Control* : Gamification Octalysis (Status, Progress Bar, Rewards, Dangling and Anchored Juxtaposition, The Sunk Cost Prison and Countdown Timers)

4. *satisfaction*

The following adjustment based application built satisfaction components:

- a. *Intrinsic reinforcement* : Gamification Octalysis (Badges, Trophy Shelves, Virtual Goods, Build From Scratch, envolved UI)

- b. *extrinsic rewards* : Gamification Octalysis (Status and Leaderboard)
- c. *equity* : Gamification Octalysis (Prod Social and Collection Sets)

2.5.1 Analysis of gamification

Analysis gamification 2 is divided into gamification analysis of level 1 and level 2.

2.5.1.1 Analysis of gamification Level I

Gamification analysis tailored to the ARCS model of the previous point which can be seen in Figure 4.

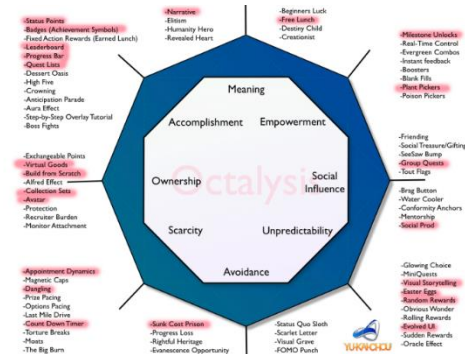


Figure 4. Gamification Level I

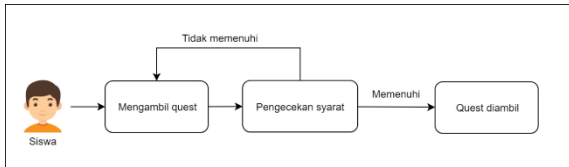
2.5.1.2 Analysis of gamification Level II

Elements that have been defined at the level of 1 is based on the following four phases:

1. *Discovery phase*: in this phase the application uses several techniques that game Narrative, Visual Storytelling, Free Lunch and Avatar. Users were first presented with a story that illustrates why they should use this application and complete the mission in accordance with the game and Visual Narrative techniques Storytelling. After that the user create his avatar as a character who will be running the existing mission. The introduction ends with the awarding of points and gold as a form of Free Lunch.
2. *Phase Onboarding*: students entering the main page of the form UI that displays the characters that have been selected. Then, students can see beruapa Points Status Points and Energy have been a guideline value for using the application. Students are also able to see a variety of tasks along its reward on the page Quest List.
3. *Phase Scaffolding*: users perform activities in accordance with the Quest List to achieve the goals of the application. Users can see the level of achievement in learning through accumulated points leaderboard results of tasks that have been completed, the user can see the jam that earned badge on the profile page (Trophy Shelves). At this stage the user is presented a challenge that is where users perform such evaluation exercises and exam using Fisher Yastes Shuffle algorithm to reduce the level of fraud. There is a joint exercise with the



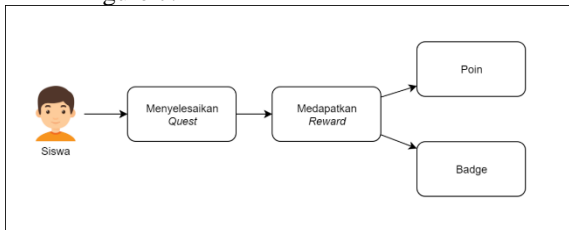




**Figure6.** Quest Flow

#### 4. Rewards analysis

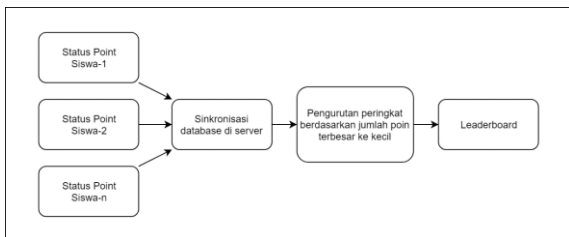
Reward shape adapted to the status that is used on existing applications, the following reward groove on the application to be built can be seen in Figure 7.



**Figure7.** Reward Flow

#### 5. analysis Leaderboard

*leaderboard* obtained from the accumulation of student learning outcomes, the following Flow Leaderboard on the application to be built can be seen in Figure 8.



**Figure8.** Flow Leaderboard

### 2.6.1 Learning Media Analyst

Analysis of learning medium 2 is divided into material analysis, model analysis tutorial and drill and practice models.

#### 2.6.1.1 Analysis of Material

Materials used in the application of mathematics learning curriculum eighth grade in 2013 were taken from the book of Mathematics issued by Kemendikbud in 2018 semesters 1 and 2.

#### 2.6.1.2 Model Analysis Tutorial

Tutorial method used in applications that will be built is a model of linear and branched tutorial. Both models are used by adjustments to unlock game milestones and plant elements picker, where users can define their own plot and follow the path that has been determined.

Instructional media content customized by model ARCS where before it goes into the explanation of matter, there is an explanation of syllabus material.

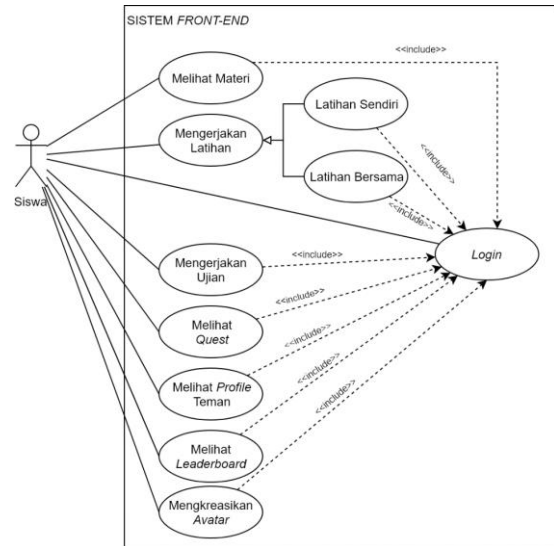
### 2.6.1.3 Analysis of Drill and Practice Model

*Drill and Practice Model* These applications are divided into 2 exercises and evaluation. Users can perform two modes of exercise is exercise alone and exercise together.

### 2.7 Front-End Functional Requirements

#### 2.7.1 Use Case Front-End

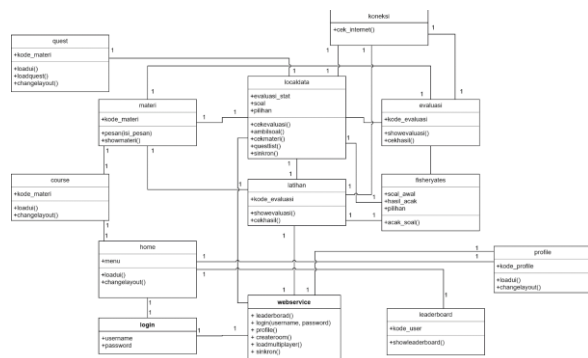
The following use case front-end of the application of mathematics learning with gamification concept can be seen in Figure 9.



**Figure9.** Use Case Front-End

#### 2.7.2 Class Diagram Front-End

Here is the class diagram of the front-end of the application of mathematics to the concept of gamification can be seen in Figure 10.



**Figure10.** Class Diagram Front-End

### 2.7 Back-End Functional Requirements

#### 2.7.1 Use Case Back-End

The following use case the back-end of the application of mathematics to the concept of gamification can be seen in Figure 11.



**Table 2.** Assessment criteria

No.	value Percentage	Criteria
1	0% - 19%	Very bad
2	20% - 39%	Bad
3	40% - 59%	Neutral
4	60% - 79%	Well
5	80% - 100%	Very good

Based on the processing of data obtained from 81 respondents calculations with the results of 83% in the area very well.

### 2.9.2.2 Pre-test and post-test

Here are the results of pre-test and post-test:

1. Workmanship question: is performed to determine student understanding changes after using applications built.

**Table 3.** Results Working Problem

	<i>Pre-Test</i>	<i>Post-Test</i>	<i>gain</i>
<b>Total</b>	4750	5870	34.15
<b>Average</b>	58.64	72.47	0.42

2. Questionnaires interests: conducted to determine the student's interests change after using an application that was built.

**Table 4.** Interest Questionnaire Results

	<i>Pre-Test</i>	<i>Post-Test</i>	<i>gain</i>
<b>Total</b>	4722.00	5919.00	27.96
<b>Average</b>	58.30	73.07	0.35

3. Motivation questionnaire: conducted to determine the changes in student motivation after using applications built.

**Table 5.** Motivation Questionnaire Results

	<i>Pre-Test</i>	<i>Post-Test</i>	<i>gain</i>
<b>Total</b>	4766.00	5878.00	26.90
<b>Average</b>	58.84	72.57	0.33

## 3. CLOSING

### 3.1 Conclusion

Based on the results of software implementation and testing of math learning application development with the concept of gamification can be concluded that the application was able to increase the interest, motivation and understanding of the students as well as a variety of learning media.

### 3.1 Suggestion

Math learning app with gamification concept built still has shortcomings, as for suggestions for the development of this application is the material provided can be developed into a dynamic by adding gamification to manage the materials and

components there can be redeveloped and added variety.

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