ANDROID BASED MOLECULER EDUCATION GAME DEVELOPMENT CASE STUDY OF SMPN 3 BANDUNG

Nadicky Luthfi Haridhi[1], Rani Susanto[2]

[1,2] Informatics Engineering – Universitas Komputer Indonesia
Jl. Dipatiukur 112-114 Bandung
E-mail : haridhi96@gmail.com[1], rani.susanto@email.unikom.ac.id[2]

ABSTRACT

SMPN 3 Bandung is the same school as other junior high schools in Indonesia, which have chemistry subjects which are a branch of Natural Sciences. Chemistry is considered as one of the difficult subjects by most students. Submission of material that still uses the lecture method often makes students feel bored. The lack of interactive and engaging teaching aids makes students uninterested in learning chemistry. Based on the results of previous research by Yogi Siswanto (2013) with the title Design and Application of Natural Science Education Mobile Games for Children of Class VI Elementary Schools, that learning with educational games can make the learning atmosphere of students more enjoyable and can provide more motivation for learning.

Moleculer educational game has the concept of action platformer accompanied by chemistry learning material, as well as a quiz game mode as an evaluation. The method used to build this application is the Luther-Sutopo version of MDLC. The results of research conducted in the form of educational games "Moleculer" which is used as a media companion to student learning outside school hours.

Based on user test results obtained the overall results of student respondents in the very positive category of educational information received from the game being played. But this application still does not meet the standards as a medium of learning aids that can improve student understanding.

Keywords: *Game*, *Game* Edukasi, Kimia, *Game* Android.

1. INTRODUCTION

1.1 Background

Junior High School is a formal level of education after graduating from elementary school. SMPN 3 Bandung is a Public Junior High School in West Java Province with its address at Jalan Raden Dewi Sartika No. 96, Bandung, like other junior high schools in Indonesia in general, the education period of SMPN 3 Bandung takes 3 years, starting from grade VII to grade IX.

The application of teaching in the 2013 curriculum demands that learning patterns that were initially centered on teachers turn into student centered learning. The 2013 curriculum prioritizes student centered information gathering, so students are required to be able to play an active role in teaching and learning activities in the classroom, where the teacher only acts as a guide for students in the process of finding and extracting information.

Chemistry is a branch of natural science that we often encounter in daily life. One of the materials in chemistry is the particles that make up living things. In this chapter describes the interactions that occur between atoms with other atoms, which thus form a molecule. Based on the results of interviews conducted with class IX teachers of SMPN 3 Bandung, that the learning methods used are still using conventional methods such as lectures, discussions and exercises. Based on the results of the interview, students usually have difficulty understanding the concepts of atomic arrangement and molecular formation. Based on the results of student test scores, out of 108 students, 101 students got scores below the KKM, and based on the results of the questionnaire that had been distributed to students, as many as 73% claimed difficulties in chemistry lessons. Submission of material that still uses the lecture method often makes students feel bored and bored. The lack of interactive and compelling teaching aids makes students reluctant to learn chemistry.

To overcome student difficulties, it is necessary to make innovations in the learning process. One way that can be done is the use of other alternative media in the learning process that is appropriate to the student's situation. To realize this expectation, the appropriate media must be chosen to be used. The unavailability of computer labs at SMPN 3 Bandung, so we need other media that can be used as learning aids, one of which can be used is an Android mobile device, because it is flexible so that it can be used anywhere and anytime. Based on the results of previous research by Yogi Siswanto (2013) with the title Rancang Bangun Aplikasi Mobile Game Edukasi Ilmu Pengetahuan Alam Untuk Anak Kelas VI Sekolah Dasar, that learning with educational games can make students' learning atmosphere more

enjoyable and can provide more motivation for learning [1]. Based on previous research, an Android based educational game will be built that can be a media for student learning beyond school hours in chemistry lessons for class IX junior high school students, titled Android Based Moleculer Education Game Development.

1.2 Formulation of the Problem

Based on the description on the background of the problem, then what becomes the problem can be formulated as follows :

1. How to build a chemical educational game by presenting interactive and interesting educational content ?
2. How to build educational games that are can help students understand about atoms and molecules ?

1.3 Purpose and Objectives

1.3.1 Purpose

The purpose of this research is to build an Android based educational game application with chemistry subject content with atomic and molecular material as a companion media for learning outside school hours.

1.3.2 Objectives

The goals in the construction of this educational game application, namely :

1. Produce a chemical educational game with presentation of interactive and interesting education.
2. Produce educational games that can help students understand about atoms and molecules.

1.4 Scope of Problem

In this study, several boundaries of the problem are made so that the discussion is more focused in accordance with the objectives to be achieved. The limitations of the problem are as follows :

1. The game will be built based on mobile for the Android platform..
2. Games that will be built can only be played by one player (Single Player).
3. Games that will be built using display animation in the form of two dimensions (2D).
4. Media delivery of information in this game includes text, images, animation and sound.
5. The game application to be built is intended to students of class IX in SMPN 3 Bandung.
6. The type of game that will be built is a combination of 2D Platformer and Trivia Quiz.
7. Modeling the design of the system using Unified Modeling Language (UML).

1.5 Research Methodology

Research methodology is a process used to solve a logical problem, which requires data to support the implementation of a study. The research methodology used is descriptive analysis method. Descriptive analysis method is a method that describes the facts and information in a situation or event now systematically, factually, and accurately.

1.5.1 Software Development Method

The software development method used in this research is using the Luther-Sutopo version of the Multimedia Development Life Cycle (MDLC) [2]. This method is used because each stage is carried out in accordance with the activities carried out during the construction of the Molecular game, the method used can be seen in the picture below :

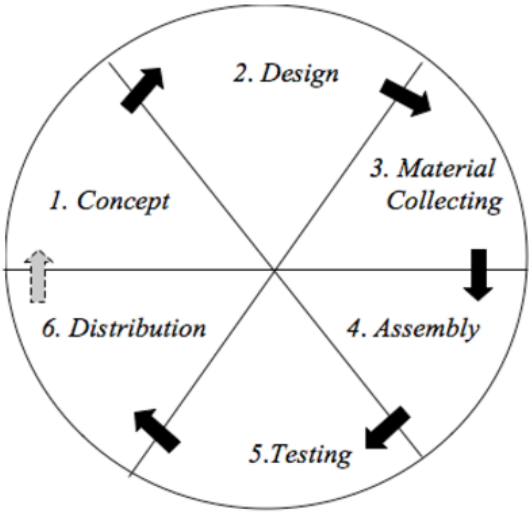

Figure 1. Multimedia Development Life Cycle

2. Research Contents

2.1 Analysis of the Game to be Built

The game to be built is titled "Moleculer". This game is an educational game about the arrangement of atoms and formation of molecules. The game to be built has a platformer genre with animation style in 2D (Two Dimensions). The description of the game to be built is as follows :

1. The game that will be built is of type 2D Platformer, where the action of the game is viewed from a two-dimensional perspective and characters can only move right and left.
2. The level consists of three types of platformer types which are distinguished based on learning material, and one level Quiz which is a type of trivia quiz containing multiple choice questions.
3. Learning consists of drafting material atoms, molecular formation, and chemical properties.
4. In the game there is a treat information

education about the learning material used.

5. In the game there are various kinds questions with answer selection options.
6. Games that will be built are play while learning, because in addition to having to pass through enemies and obstacles, in the middle of the game there are material explanations about the atoms, molecules, and chemical properties contained in the game.

2.2 Material Analysis

The material used in the game that will be built is the material in the particle chapters that make up living things that are taught in class IX of SMPN 3 Bandung based on syllabus and curriculum 2013. The following is material that will be used at each level contained in the game being built.

Table 1. Material Analysis

Level	Material	Material Discussed
1	Atom	Subatom particle
2	Molecule	Molecular formation
3	Chemical Properties	Corrosivity

The material used at each level is based on the order of the teaching subsections in the particle chapters making up living things, in the first section discussing atoms, the second section discussing molecules, and the third section discussing the properties of matter. The following is an explanation of the material to be conveyed :

1. At level 1 will be explained about subatomic particles, subatomic particles are particles that make up atoms consisting of neutrons (n), electrons (e), and protons (p).
2. At level 2 will be explained about molecular formation, molecular formation occurs when there is an interaction between one atom and another atom, at this level an example of the reaction between two nitrogen (N) and one oxygen (O) atom and its usefulness in daily life will be exemplified..
3. At level 3 will be explained about the nature corrosivity of a substance, corrosive is one of the damaging chemical properties and is very dangerous if there is direct contact with the substance, at this level one corrosive compound, namely sulfuric acid (H_2SO_4) will be exemplified along with its building blocks.

2.3 Storyline

Moleculer Education Game tells about a scientist who is an expert in the field of particle matter who is conducting research on the constituent particles of living things. However, one day the results of his research were stolen by someone and the scientist went after the thief to prevent something bad from happening if the results of the scientist's research were misused by the thief. Here is a storyline on three levels of platformer type gameplay.

1. Level 1 Cyber City

The scientist had just returned to his apartment from work, but the scientist was surprised because the results of his research had been lost, the scientist went to find out who had brought the results of his research. Along the way the scientist was confronted by several reconnaissance turrets that were deliberately laid by someone to harm him. The scientist needs the strength of subatomic particle loads to be able to avoid surveillance of reconnaissance turrets. These subatomic particles consist of electrons (e) which are negatively charged, protons (p) positively charged, and neutrons (n) which are uncharged (neutral).

1. Level 2 Underground Pass

The scientist found a secret access road leading to an underground area, but he was surprised because there were strange monsters in there, the scientist also needed N_2O compounds that could be used to escape quickly from the monsters. N2O (nitrous oxide) is a combination of two N (Nitrogen) atoms and one O (Oxygen) atom, N_2O is commonly used as a combustion engine to increase the energy expended.

4. Level 3 Deep Forest

The scientist has managed to pass a mysterious underground road, and it turns out that at the end of the road is connected to the forest near the city filled with creatures that have never met him, the scientist also needs H_2SO_4 compounds that can be used to defeat these creatures. H_2SO_4 (Sulfuric Acid) is a combination of two H (Hydrogen) atoms, one S (Sulfur) atom, and four O (Oxygen) atoms. H_2SO_4 is a corrosive compound, direct contact can cause skin damage, respiratory problems, and eye irritation.

2.4 Non Functional Requirement Analysis

Non functional requirements analysis consists of three parts, namely the analysis of needs to determine the specifications of the software, hardware and user users.

2.4.1 Software Requirement Analysis

The software used to build the game "Moleculer" is as follows :

1. Windows Operating System 10 64 bit
2. Construct 2
3. Aseprite
4. Adobe Photoshop CS6

The software used to run this game application is a mobile device that has an Android operating system of at least version 5.0.

2.4.2 Hardware Requirement Analysis

Hardware analysis aims to determine the specifications of the requirements of the devices used in building the game Moleculer, the hardware specifications used are as follows :

1. Processor AMD A10-5750M 2.5 Ghz
2. Memory 4 GB
3. Harddisk 1 TB
4. Display Resolution 1366 x 768
5. Keyboard
6. Mouse

The hardware needed by the user in running this game application is a smartphone. Smartphone specifications required to play this game are as follows :

1. Processor 1,00 Ghz
2. RAM capacity 1 GB
3. Storage capacity 500 MB
4. Touchscreen

2.4.3 User Requirement Analysis

Analysis of user needs is done to determine the needs and specifications of users who will use the game to be built in order to run this game application. The user specifications required :

1. Junior High School Students 14-15 years of age.
2. Understand the use of Android based smartphones.
3. Understand in operating a game.
4. Knowing how to install android applications.

2.5 Functional Requirement Analysis

Functional Requirement aims to describe the design of the system in the game "Moleculer". The tools used in describing the system use Unified Modelling Language (UML), which consists of Use Case Diagrams, Activity Diagrams, Sequence Diagrams, and Class Diagrams.

2.5.1 Use Case Diagram

Use Case Diagram is a diagram that illustrates the use of the system to be built. Use Case Diagrams explain the relationship between actors and activities that occur in the system. The design of the use case diagram in the game "Moleculer" is as follows :

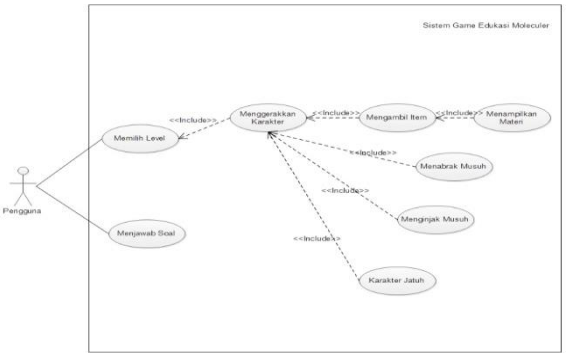

Figure 2. Use Case Diagram

2.5.2 Class Diagram

Class diagram illustrates the structure of the system in terms of defining the classes that will be made to build the system. Classes have what are called attributes and methods or operations.

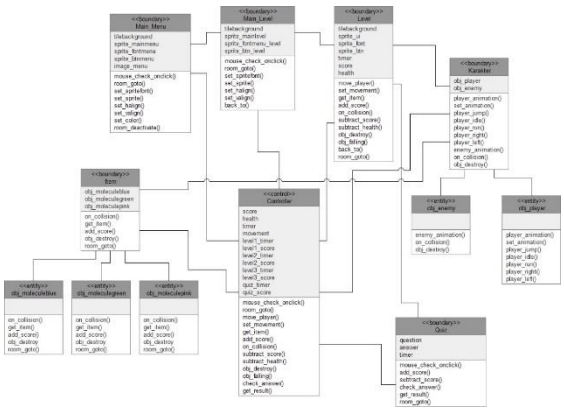

Figure 3. Class Diagram

2.6 System Design

System design is the stage of explanation of the activities that describe in detail about the running system. The design of the system aims to make it easier to implement applications and facilitate the development of applications.

2.6.1 Menu Architecture Design

The design of the menu architecture aims to help facilitate the making of the system and find out which parts can be accessed in the game being built. The design of the menu architecture in the game "Moleculer" is as follows :

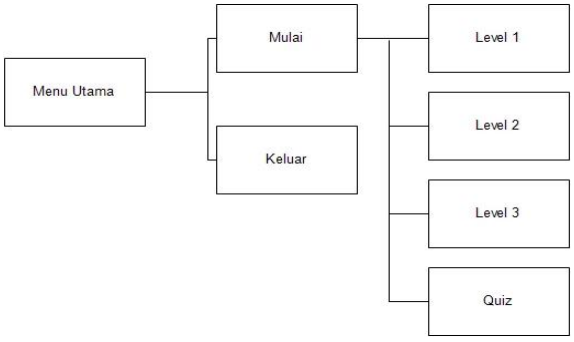

Figure 4. Menu Architecture

2.7 Interface Implementation

The interface implementation is carried out with each program page created in the form of a program file. The following are the results of implementing the interface from the design that was made before.

2.7.1 Main Menu Interface

Main Menu Interface can be seen in image 5.

Figure 5. Main Menu Interface

2.7.2 Level Selection Menu Interface

Level Selection Interface can be seen in image 6.

Figure 6. Level Selection Menu Interface

2.7.3 Level 1 Interface

Level 1 Interface can be seen in image 7..

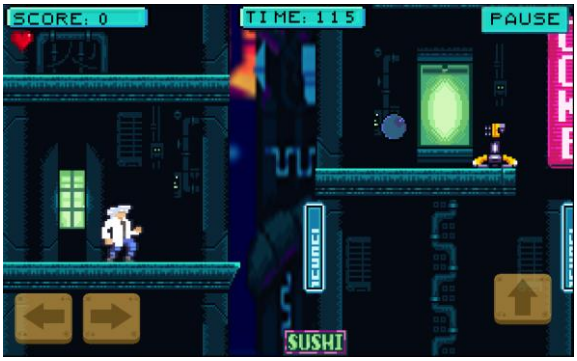

Figure 7. Level 1 Interface

2.7.4 Level 2 Interface

Level 2 Interface can be seen in image 8.

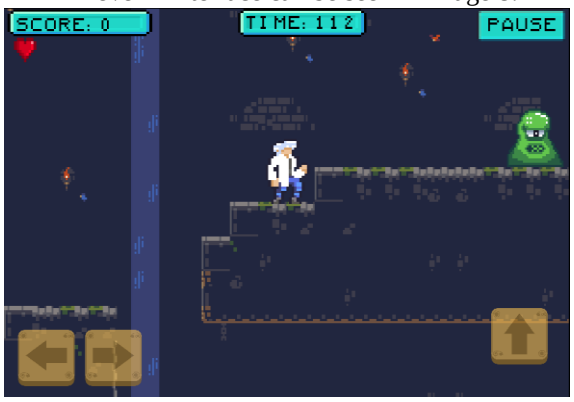

Figure 8. Level 2 Interface

2.7.5 Level 3 Interface

Level 3 Interface can be seen in image 9.

Figure 9. Level 3 Interface

2.7.6 Level Quiz Interface

Level Quiz Interface can be seen in image 10.

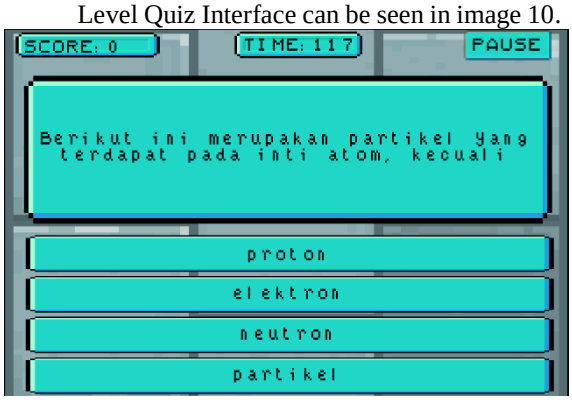

Figure 10. Level Quiz Interface

2.7.7 Level Complete Interface

Level Complete Interface can be seen in image 11.

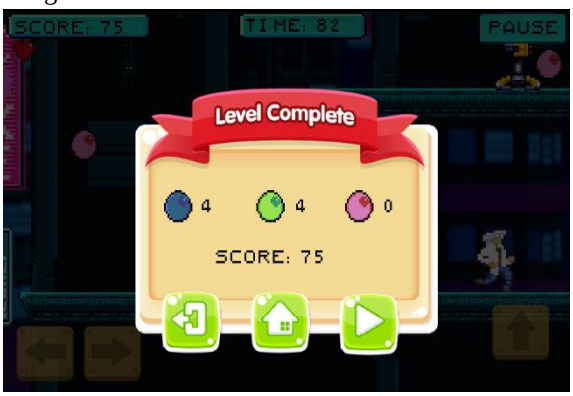

Figure 11. Level Complete Interface

2.7.8 Game Over Interface

Game Over Interface can be seen in image 12.

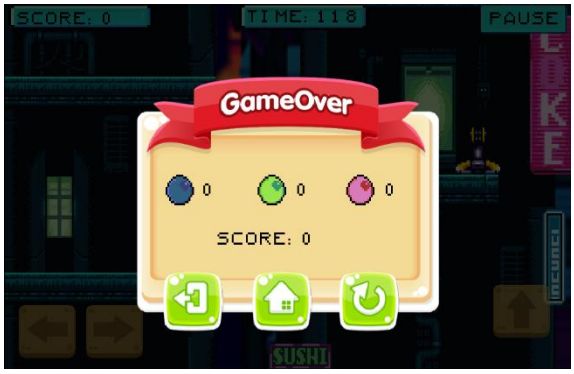

Figure 12. Game Over Interface

2.8 Testing

Software testing is the most important thing to do to find deficiencies or errors in the software being tested. Testing intends to find out the software that is made has met the criteria in accordance with the purpose of software design.

2.8.1 Alpha Testing

The test is carried out on the application to ensure that the application can run properly in accordance with the needs and expected goals. Alpha testing focuses on the functional requirements of the software.

2.8.1.1 Alpha Testing Scenario

The test scenario describes testing of the system that exists in the Moleculer game application. The full test scenarios performed in this application can be seen in table 2.

Table 2. Alpha Testing Scenario

No	Tested Components	Testing Method
1	Main Menu	*Black box*
2	Level Selection Menu	*Black box*
3	Level 1	*Black box*
4	Level 2	*Black box*
5	Level 3	*Black box*
6	Level Quiz	*Black box*
7	Pause Menu	*Black box*
8	End Game Menu	*Black box*

2.8.1.2 Alpha Testing Cases and Results

The test cases and results contain an explanation of the test plan that has been prepared in the test scenario. This test is done in a black box with only attention to the input into the system and the output at the input. The following is an explanation of each test item contained in the test scenario.

1. Main Menu Testing

Main menu testing with cases and test results that produce conclusions can be seen in the table 3.

Table 3. Main Menu Testing

Cases and Results			
Input	**Expected**	**Observation**	**Conclusion**
Push "Play" Button	Displays the level selection menu	The button can function as expected	(✓) Accepted ( ) Denied
Push "Exit" Button	Displays exit message	The button can function as expected	(✓) Accepted ( ) Denied

2. Level Selection Menu Testing

Level selection menu testing with cases and test results that produce conclusions can be seen in the table 4.

Table 4. Level Selection Menu Testing

Cases and Results			
Input	**Expected**	**Observation**	**Conclusion**
Push "Level 1" Button	Displays level 1	The button can function as expected	(✓) Accepted ( ) Denied
Push "Level 2" Button	Displays level 2	The button can function as expected	(✓) Accepted ( ) Denied
Push "Level 3" Button	Displays level 3	The button can function as expected	(✓) Accepted ( ) Denied
Push "Level Quiz" Button	Displays level quiz	The button can function as expected	(✓) Accepted ( ) Denied
Push "Back" Button	Displays main menu	The button can function as expected	(✓) Accepted ( ) Denied

2.8.2 Beta Testing

Beta testing is a testing conducted objectively, which conducts testing directly to the field with the aim to find out the extent of the quality of Molecular game applications against respondents or prospective users of the system. Testing is done to determine user ratings of the application.

2.8.2.1 Beta Testing Scenario

Beta testing is done objectively where the application is tested directly on several users. Where users will be given a questionnaire along with the application. From the results of the questionnaire will be calculated to later be drawn the conclusion of the assessment of the users of the Moleculer game application. The number of samples taken was 30 respondents. Data on the results of the questionnaire that has been given to several respondents will be sought percentage of each answer that has been given. In calculating the percentage using a Likert scale.

Table 5. Questionnaire Answer Score

Answer Scale	Information	Score
STS	Sangat tidak setuju	1
TS	Tidak setuju	2
RG	Ragu-ragu	3
ST	Setuju	4
SST	Sangat setuju	5

The results of the questionnaire that has been given can be searched for the percentage of each answer by using the formula :

$$P = \frac{\sum s}{ideal\ score} \times 100\% \qquad (1)$$

Information :

P = Percentage value sought.

∑s = The number of scores obtained from each answer choice is multiplied by the predetermined value.

Ideal score = Highest score on selection points multiplied by the amount respondent (5 x 30 = 150).

Criteria for interpretation of scores based on intervals can be seen in the table 6.

Table 6. Likert Scale Interval

Category	Weight	Interval	Conclusion
Sangat tidak setuju	1	0% - 20%	Sangat tidak tercapai
Tidak setuju	2	21% - 40%	Tidak tercapai
Ragu-ragu	3	41% - 60%	Cukup tercapai
Setuju	4	61% - 80%	Tercapai
Sangat setuju	5	81% - 100%	Sangat tercapai

2.8.2.2 Beta Testing Cases and Results

Based on the results of the percentage of each respondent's answer to questions raised on the beta testing questionnaire obtained an average result of 86.52% which means the respondent responded very positively to the application built, and based on the post test results obtained an average value of 68.7 which means that the application built cannot improve student understanding.

3. CLOSING

3.1 Conclusions

The conclusions that can be drawn from all the processes that have been carried out in building this educational game application are as follows :

1. This educational game can be used as chemistry learning media that is more interesting and interactive.
2. This educational game is still not fulfilled standards as learning aids that can enhance students' understanding of the learning of chemistry of atoms and molecules.

3.2 Suggestions

Based on the conclusions above, the suggestions that can be put forward to become input and consideration are as follows :

1. Educational material displayed inside the game is recommended to be reproduced.
2. Educational content in the game is recommended for further details.

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