

## CHAPTER I INTRODUCTION

### 1.1. Background of The Study

The Periodic Table of Chemical Elements, commonly known as the Periodic Table, is a table used to organise chemical elements based on their chemical properties. The table consists of rows, referred to as periods, and columns, known as groups. Each chemical element is placed at a specific position in the table based on the number of protons in the atomic nucleus and the number of electrons contained in the atom. This table serves to help students identify patterns among chemical elements and facilitates the prediction of the properties of these elements. Pharmacy students are required to take an advanced course in Organic Chemistry, which is an essential subject as all living organisms are made up of organic compounds that interact with each other to form substances vital for life.<sup>1</sup>

In general, chemistry education in the classroom often faces challenges, particularly in understanding the concepts of the periodic table of elements. The complexity of the periodic structure and the patterns of element properties frequently become obstacles in the learning process, especially when students begin exploring advanced subjects such as organic chemistry. Although the material has been well explained by the lecturer, not all students can fully grasp the information. Based on the questionnaire results, which consist of opinion-based questions regarding the periodic table learning media, as presented in Appendix 1, 21 out of 34 respondents who are Pharmacy students—stated that they are familiar with the periodic table. However, only one student indicated that they have a very good understanding and knowledge of the periodic table. Their methods of learning and

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<sup>1</sup> Yelfira Sari, “Analisis Pendahuluan Sebagai Dasar Pengembangan Modul Kimia Organik Bermuatan Hasil Riset Untuk Mahasiswa Pendidikan Kimia”, no. 11 Desember (2023): 959-68.

comprehension vary, and creating new learning media, according to them, is an interesting approach that is expected to assist students in studying the periodic table, thereby making it easier to understand both basic chemistry and advanced subjects such as organic chemistry. All molecules present in any substance, or atoms that make up the molecules on Earth, are ultimately created with their specific purpose.

The atom is a term used by chemists, which has become very popular in modern times, while in the Qur'an, the atom is referred to as "*zarrah*," which means "small particle" or "grain." The atom is considered the fundamental unit of matter that cannot be further divided, similar to the concept of "*zarrah*," which refers to a tiny particle that cannot be divided any further. Modern chemistry studies the structure and composition of atoms, including how atoms combine and interact to form various chemical compounds. This verse emphasizes that nothing is hidden from Allah, even the smallest "*zarrah*" in the heavens and the earth, reminding us of the complexity and existence of atoms that make up the matter in the universe and that their existence is part of a divine plan. This is as stated in *Surah Saba'* (34:3):

وَقَالَ الَّذِينَ كَفَرُوا لَا تَأْتِينَا السَّاعَةُ قُلْ بَلَىٰ وَرَبِّي لَتَأْتِيَنَّكُمْ عَالِمِ الْغَيْبِ لَا يَعْزُبُ عَنْهُ مِثْقَالُ ذَرَّةٍ فِي السَّمَاوَاتِ وَلَا فِي الْأَرْضِ وَلَا أَصْغَرُ مِنْ ذَلِكَ وَلَا أَكْبَرُ إِلَّا فِي

كِتَابٍ مُبِينٍ

"And those who disbelieve say, 'The Hour will not come to us.' Say, 'Yes, by my Lord, it will surely come to you. [Allah is] the Knower of the unseen.' Not absent from Him is an atom's weight within the heavens or the earth or

[what is] smaller than that or greater, except that it is in a clear register." (Q.S. Saba':3).

This research aims to develop a 3D desktop-based periodic table game focusing on groups 1-8A. A 3D game provides better and more engaging visualisation compared to traditional paper-based media. The high interactivity within a 3D game enhances student engagement, making learning more active and participatory. Furthermore, 3D games offer virtual experiences that were previously difficult to achieve. The desktop-based 3D game to be developed as a learning medium for Pharmacy students is grounded in the policy that students use laptops as their primary devices for daily learning activities.

The use of laptops as devices enables the implementation of desktop-based learning media to be more effective. By utilising laptops, students can access and engage with educational games at any time, by their learning needs. The focus of the periodic table in the development of this learning media will be on groups 1-8A, as the elements in these groups are commonly used in pharmaceutical chemistry. These include hydrogen, carbon, nitrogen, and oxygen, as well as alkali metals and alkaline earth metals, which are crucial in drug formulation and biochemical reactions. This research targets undergraduate Pharmacy students, particularly those in their first-semester at UNIDA Gontor, to enhance their understanding of chemical elements, especially in organic chemistry. This research employs the Waterfall research method in the form of the System Development Life Cycle (SDLC) model and the gamification method, namely the Mechanic, Design, and Aesthetic (MDA) Framework. The study utilizes the MDA framework, which is commonly applied in academic research and the game industry. By using the MDA framework, the research becomes more standardized and facilitates easier measurement of the impact of design on the player's experience.



## **1.2. Problem Formulation**

Based on the background outlined, the research problem formulated in this study is as follows:

The learning media used in the teaching of the periodic table consists of manual media in the form of paper tables, which results in the learning process being less effective and engaging.

## **1.3. Purpose of The Study**

The objective of this study is to:

Develop 3D game-based learning media for the periodic table material using the gamification method, specifically the MDA framework..

## **1.4. Benefit of Research**

From the research conducted, it is expected to provide benefits to several parties, as follows:

### **1.4.1. For Students**

- a. Improve skills in developing 3D games using Unreal Engine and Blender 3D.

### **1.4.2. For the Community**

- a. Provide a learning medium for the periodic table (groups 1-8A).
- b. Serve as a platform to enhance the understanding of first- and second-year Pharmacy students at UNIDA Gontor.

### **1.4.3. For the University**

- a. Improve the quality of education by incorporating the outcomes of this research into the curriculum.
- b. Enhance the university's reputation through the publication of this research in scientific journals.

### **1.5. Scope of The Study**

This research has the following problem limitations:

- a. The object of this research is the periodic table, limited to groups 1-8A.
- b. This research is confined to the development of a 3D desktop game created using Unreal Engine and Blender.
- c. The target participants are first- and second-year Pharmacy students at UNIDA Gontor.
- d. The methodology used is the System Development Life Cycle (SDLC).

### **1.6. Systematization of The Study**

This research follows the structure of discussion outlined as follows:

#### **CHAPTER 1 INTRODUCTION**

- 1.1. Background
- 1.2. Problem Formulation
- 1.3. Benefit of Research
- 1.4. Scope of the Study
- 1.5. Research Benefits

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- 2.1. Previous Research
  - 2.1.1. Warningsih Nanang Iriadi (2021)
  - 2.1.2. Melati Muliatul Hikmah, Sri Yamtinah Lina Mahardiani (2022)
  - 2.1.3. Anis Inawati Durinta Puspasari (2021)

2.1.4. I Gede Suardika, IGKG Puritan Wijaya ADH, I Made Budi Adnyana (2024)

2.1.5. Ahmad Harianto, Elvi Yenti (2021)

## 2.2. Theoretical Framework

2.2.1. Chemistry

2.2.2. Periodic Table

2.2.3. 3D Games

2.2.4. Learning Media

2.2.5. First-Person Shooter (FPS)

2.2.6. Blender 3.5

2.2.7. Unreal Engine

## CHAPTER 3 RESEARCH METHODOLOGY

3.1. Activity Plan

3.2. Research Materials and Tools

3.3. Research Stages

3.3.1. Data Collection

3.3.2. Analysis

3.3.3. Design

3.3.4. Coding

3.3.5. Testing

## CHAPTER 5: CONCLUSION AND SUGGESTION

5.1. Conclusion

5.2. Suggestion

REFERENCES



## **CHAPTER II LITERATURE REVIEW**

### **2.1. Previous Research**

#### **2.1.1. Anis Inawati Durinta Puspasari (2021)**

This research is titled "Development of Interactive Learning Media Using 3D Unity-Based Snakes and Ladders Game for Archival Studies in Class X OTKP at SMKN 4 Surabaya." This journal presents an innovative approach to the development of interactive learning media that can enhance students' learning quality. The use of Unity 3D-based technology in developing learning media offers a more interactive and engaging way for students to learn. The research includes an analysis of both teacher and student competencies, as well as an analysis of learning objectives, to understand student needs and improve the effectiveness of the learning process.<sup>2</sup>

#### **2.1.2. Ahmad Hariant, Elvi Yenti (2021)**

This research, titled "Design and Trial of Chemistry Educational Game Based on Role Playing Game (RPG) for Reaction Rate Material," uses the Research and Development (R&D) development method. The study results in an educational chemistry game based on Role Playing Game (RPG) for reaction rate material, designed using the RPG Maker Vx Ace software. The validation and practicality assessments of the RPG-based chemistry educational game are as follows: (a) Subject matter expert validation with a total percentage of 80%, categorized as valid; (b) Media validation with a total percentage of 75%, categorized as valid; (c) Teacher feedback through practicality testing obtained a percentage of 92%, categorized as very practical;

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<sup>2</sup> Anis Inawati, "Pengembangan Media Pembelajaran Interaktif Game Ular Tangga Berbasis Unity 3D Pada Mata Pelajaran Kearsipan Kelas X OTKP Di SMKN 4 Surabaya," *Jurnal Pendidikan Administrasi Perkantoran (JPAP)* 9, no. 1 (2020): 96–108.



(d) Responses from students in class XI MIPA 2 SMAN Dharma Pendidikan Kempas regarding the overall design of the RPG-based chemistry educational game showed a percentage of 92%, rating it as very good. This indicates that the RPG-based chemistry educational game media can be tested for implementation.<sup>3</sup>

#### **2.1.3. Warningsih, Nanang Iriadi (2021)**

This research, titled "Interactive Animation for Introducing the Periodic Table of Chemical Elements Based on Android for High School," aims to create a learning media for the periodic table in the form of an interactive animation introducing the elements found on Earth. It offers an alternative learning system for high schools, shifting from traditional lecture-based methods to interactive animation in line with the latest curriculum. The limitation of this research is that it is restricted to high school students. The study uses Android-based audiovisual multimedia and 2D animation. The use of this application has a positive impact on students' learning patterns, making them more engaged in learning about chemical elements and also helping students familiarize themselves with Android-based smartphones.<sup>4</sup>

#### **2.1.4. Melati Muliatul Hikmah, Sri Yamtinah, Lina Mahardini (2022)**

This research, titled "CHEMAR (Chemistry Augmented Reality) for the Periodic System of Elements as an Interactive Media to Enhance Students' Abstract Thinking Abilities," aims to develop interactive learning media for the periodic system of elements using Augmented Reality technology. The development model used is the ADDIE model (Analyze, Design,

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<sup>3</sup> Ahmad Harianto, "Desain Dan Uji Coba Game Edukasi Kimia Berbasis Role Playing Game (Rpg) Pada Materi Laju Reaksi," *Jedchem (Journal Education and Chemistry)* 3, no. 1 (2021): 4–10.

<sup>4</sup> Warningsih, "Animasi Interaktif Pengenalan Tabel Periodik Unsur Kimia Berbasis Android Untuk Sekolah Menengah Atas," *IJNS - Indonesian Journal on Networking and Security* 10, no. 3 (2021).