

VC.LAB (Virtual Chemistry Laboratory): DESIGN AND BUILD AN ANDROID-BASED ACID-BASE TITRATION GAME APPLICATION AS A CHEMISTRY INTERACTIVE LEARNING MEDIUM IN HIGH SCHOOL

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ABSTRACT

Acid-base titration material is difficult for most students because it is abstract. According to Sheppard [17], students describe the neutralization process as the physical mixing of acids and bases that do not produce products and do not have a reaction equation. From these problems, researchers designed the VC.LAB (Virtual Chemistry Laboratory) application: Design and Build an Android-Based Acid-Base Titration Game Application as a Chemistry Interactive Learning Medium in High School. This application can make it easier for students to understand the acid-base titration material. In addition, the existence of various cool features available can attract students to learn it. The method used in this study is the prototype method. This method is carried out in stages, namely by developing a simple prototype first and then being developed from time to time until the software is finished being developed [16]. The results of the design of making this game are carried out by creating a model that explains the material and practical simulation activities in the form of a special smartphone application to make it easier for users to carry out individual learning virtually.

Keywords: Technology, Education, Game & Chemistry

1. INTRODUCTION

Chemistry is one of the branches of Natural Sciences that is very important and has direct links and contributes to the development of other sciences. Until now, chemistry is still not in demand, especially for high school, junior high school students, and university level students because they consider this subject as a difficult subject because it uses too many formulas and the material contains a lot of abstract concepts. This perception results in the basic knowledge of chemistry possessed by students when continuing their studies at the tertiary level being very minimal, so it has an impact on the lack of ability to master the concept of chemistry [2].

Acid-base titration material is difficult for most students because it is abstract. According to Sheppard [17], students describe the neutralization process as the physical mixing of acids and bases that do not produce products and do not have a reaction equation. Some students explained titration curves at times before the equivalence point, at the equivalence point, and after the equivalence point are fundamental properties for interactions between acids and bases that do not react to chemical speciations.

The way to achieve this is that teachers must be creative in choosing the right learning media. The success of the learning process is influenced by the use of media that is following the goals to be achieved. Good learning media is media that uses technology to access information needed by students from teachers, peers, and device applications [8].

Facing the era of the industrial revolution 5.0, the world of education also requires various innovations. The development of technology continues to increase along with the increase in human needs, technology is also developing to help to facilitate every human job in various fields. One of the applications of technology that continues to increase and is in demand by various circles of society today is the use of gaming applications.

Games are fun activities, and invite players to try to complete the game to a higher level. To cultivate skills in solving problems in various challenges that will train one's critical thinking skills. These circumstances allow players to carry out critical thinking activities in pleasant circumstances [13].

Games can condition an environment in which players are actively interested and can continue their activities individually, as well as be able to carry out learning by doing. Games can also be a valuable tool in enriching education, as they can facilitate some of the situations and conditions that drive the learning process: learner motivation, active learning, adaptiveness, collaboration, and simulation. In addition, it can give instructors the ability to collect learning paths quite easily [10].

Massachusetts Institute of Technology (MIT) managed to prove that games are very useful for improving the logic and understanding of players to a problem through a game project called Scratch. Based on the results of previous research, there is no doubt that educational games can support the educational process [22].

Games can have several positive impacts on players including children aged 3-6 years, such as introducing computer technology, learning how to follow the rules of a game, training the brain in solving problems and logic, training motor nerves, and establishing relationships between parents when playing together [7]. Games can also help someone to learn something easier with the different elements of animation, challenges, and atmosphere contained in the game so that learning looks more interesting.

From the above problems, the author will design the VC.LAB (Virtual Chemistry Laboratory) application: Design and Build an Android-Based Acid-Base Titration Game Application as an Interactive Learning Medium for Chemistry in High School. This

application makes it easier for students to understand the acid-base titration material. In addition, the existence of various cool features available can attract students to learn it.

2. LITERATURE REVIEW

2.1 Learning Media

2.1.1 The Concept of Learning Media

Learning media is everything to channel messages so that they can stimulate the attention, interest, thoughts, and feelings of learners in learning activities to achieve learning objectives [3]. Furthermore, Arsyad [4] explained that learning media is a tool in the learning process both outside and in the classroom.

Based on the description of the experts above, it can be concluded that learning media is an auxiliary tool in conveying messages in the learning process activities to achieve learning objectives.

2.1.2 Benefits of Learning Media

The media component as a learning system has a different function from the function of other components, namely as an intermediary means in the learning process that contains messages from educators to be conveyed to students.

According to Daryanto [5] explaining the media should be useful as follows: Clarify the message so as not to be too verbalises.

- 1) Overcome the limitations of space, time, energy, and sensory power.
- 2) Allows children to learn independently according to their visual, auditory, and kinesthetic talents and abilities.
- 3) Gives the same stimulation and gives rise to the same perception.
- 4) The learning process contains five components of communication, namely communicators, communicants, learning materials, learning media, and learning objectives.

Sudjana and Rivai [18] revealed the benefits of learning media in the student learning process, including:

- 1) Educators will attract more attention from students so that they can foster learning motivation.
- 2) The teaching material will have a clearer meaning so that it can be better understood by the learner, and allow the learner to better master the learning objectives.

- 3) Teaching methods will be more varied, not merely verbal communication through the teaching of words by educators, so that learners are not bored and educators do not run out of energy.
- 4) Students do more learning activities, because they not only listen to explanations from the educator's description, but also other activities such as observing, doing, demonstrating, and others.

From some of the opinions of experts above, the benefits of learning media are as follows:

- 1) The existence of learning media can foster student learning motivation.
- 2) Teaching materials make the message clearer so that it is easy to understand.
- 3) Allow students to learn independently.
- 4) Make it easier to manage time, space, and energy in the learning process.

2.1.3 Types and criteria for Choosing Learning Media

According to Sudjana and Rivai [18], several types of learning media can be used in the teaching process.

- 1) Graphic media or often called two-dimensional media such as photos, graphs, diagrams/charts, posters, comics, and others.
- 2) Three-dimensional media, namely in the form of models such as solid models, container models, work models, mock-ups, and others.
- 3) Projection media such as slides, movies, and others.
- 4) The use of the environment as a teaching medium.

In choosing learning media, you should pay attention according to Sudjana and Rivai [18] to the following criteria:

- 1) Its accuracy with learning objectives, meaning that the learning media is selected according to the instructional goals that have been set.
- 2) Support for the content of learning materials, meaning that subject matter that is factual, principle, concept, and generalization need media assistance so that students can easily understand it.
- 3) Ease of obtaining media, meaning that the media needed is easy to obtain, at least easy for teachers to make in teaching time. For example, graphic media that is easy to make without expensive costs, simple and practical to use. The teacher's skill in using it, no matter what kind of media is required the main requirement is that the teacher can use it in the teaching process. The expected

value and benefit is not in its medium, but the impact of its use on the time of interacting the student's learning with his environment. No matter how sophisticated and practical the tools used if teachers cannot use them in teaching to improve the quality of learning, it will not mean anything. There is time to use it so that the media can be useful to students during teaching.

- 4) There is time to use it so that the media can be useful to students during teaching.
- 5) Following the level of thinking of students, choosing media for education must be following the level of thinking of students so that the meaning of the learning can be understood by students.

With the media selection criteria above, teachers can more easily use media that is considered appropriate to help facilitate their tasks. The existence of media in the teaching process should not be forced to complicate the teacher's task, but in contrast, it must simplify the teacher's task.

2.2 Game

2.2.1 The History of Game

Games are of English origin. In the dictionary Indonesian the term Game means “permainan”. According to Zamroni [21], the game is a system in which players are involved in artificial conflicts. Players interact with the system and conflicts in the game. In the game, there are rules that aim to limit the behavior of players and determine the game.

2.2.2 Game Concept

According to Clark [6], games are activities that involve the decisions of the player, seeking to achieve goals by being limited by a specific context. According to Arief S. Sadiman [3], games are competitions between players who interact with each other by using certain rules to achieve certain goals as well. In a game there must be a competition so that the player is aroused to continue playing, the competition can take the form of winning and losing. Players must be able to find strategies or ways to solve problems so that they can win the game.

Games are activities that use electronic media, is entertainment in the form of multimedia that is made as attractive as possible so that players can get something so that there is inner satisfaction. Playing games is one of the learning tools. Games are more often

played by children, but nowadays adults also like to play games and follow the development of games that exist now. The type of game is very dependent on the times. When viewed from the graphics used in game applications, game applications can be classified into two types, namely 2D (two-dimensional) and 3D (three-dimensional) game applications.

2.2.3 Educational Games

Educational games are practices designed or created to stimulate thinking power including improving concentration and solving problems [9]. Educational Games are one type of media used to provide teaching and increase the knowledge of its users through unique and interesting media. Educational games are made with a specific purpose as an educational tool, to learn to recognize colors, recognize letters and numbers, mathematics, and learn foreign languages.

Educational games are games that are used in the learning process and the game contains elements of education or educational values. The educational game that will be developed is the Arcade genre, which trains users' dexterity in classifying garbage. And it has the essence of simulation in it so that it accustoms users to throw garbage in its place and type.

2.2.4 Use of Educational Games

Games with educational purposes like this can be used as one of the educational media that has learning by doing learning patterns. Based on the pattern owned by the game, players are required to learn so that they can solve existing problems. The game status, instructions, and tools provided by the game will guide players actively to dig up information so that they can enrich their knowledge and strategies while playing.

Based on the results of previous research studies, there is no doubt that educational games can support the educational process [6]. Educational games excel in several aspects when compared to conventional learning methods. One of the significant advantages is the existence of animations that can improve memory so that children can store the subject matter for a longer time compared to conventional teaching methods [6].

2.3 Acid-base Titration

Determination of acid and alkaline solution levels can be done through an experimental procedure called an acid-base titration. The term titration means the determination of the level. An acid-base titration is a titration based on an acid-base neutralization reaction. In a titration, the substance to be determined by its concentration is titrated by a solution whose concentration is found precisely and accompanied by the addition of indicators. A solution

that has been found to be of proper concentration is called a standard solution or solution, while an indicator is a substance that gives a sign of change at the time of titration ends which is known as the end of the titration [14].

Based on the notion of titration, an acid-base titration is a method of determining the level of an acid solution with a peniter agent (acid titrating agent) of an alkaline solution or determining the level of an alkaline solution with a penitent agent (penitrating agent) of an acid solution. In the characteristics of the solution in the learning process, practicum activities are needed in the dissolution of acid-base substances carried out by students. This process involves a solution of a known concentration (titrant), which is derived from the burette into the solution to which its concentration (titrate) will be determined to the point of equivalent, which is usually characterized by a change in the color of the indicator.

3. METHOD

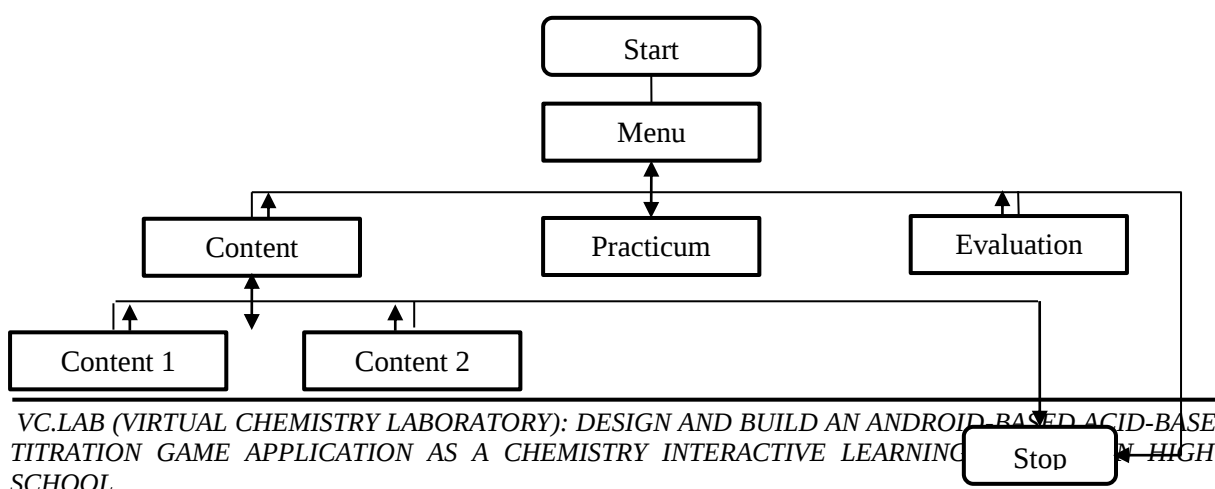
Based on the topic that will be examined in this study, namely using the Prototype method. The prototype model provides an opportunity for program developers and research objects to interact with each other during the system design process [19]. Meanwhile, according to Yurindra [20] the prototype model is "a process that allows developers to create a software model, this method is good to use if the client cannot provide maximum information about the needs he wants".

This method is carried out in stages, namely by developing a simple prototype first and then being developed from time to time until the software is finished being developed [16]. Broadly speaking, there are several stages in the prototyping method, namely first is the design stage, program creation, and the last is evaluation stage [15].

4. RESULTS AND DISCUSSION

4.1 Product Design Stage

To describe the design of the game, it is necessary to have a sketch of the display design. Sketches formed in a flowchart, flowcharts are useful for simplifying the explanation of the flow process of the program for easy understanding.



4.2 Initial Design of The Application

Picture 1. VC-LAB Display



Showing VC-Lab Logo

Picture 2. VC-LAB Menu Display



1. Showing VC-Lab Logo
2. There are Tools, About, and Sound
3. The background is made as attractive as possible
4. Consists of 3 menu options (Content, Practicum and Evaluation)

Picture 3. Material Menu Display



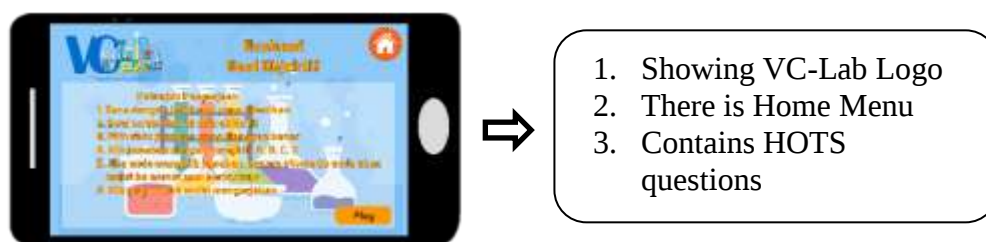
1. Showing VC-Lab Logo
2. There is Home Menu
Acid-base Titration
Content Presented in
Detail and Clearly

Picture 4. Practicum Menu Display



- 5 Things in Practicum Menu:
1. Examination of Laboratory Equipment
 2. How to rinse the burette
 3. How to introduce the substance into the burette
 4. Correct sitting position during titration
 5. How to Titrate

Picture 5. Evaluation Menu Display



4.3 Relevant Research

An acid-base titration is one of the materials that can be applied in everyday life, but because this material is usually taught only for understanding concepts, students do not know the benefits of studying this material. To overcome this problem, a learning method is needed that can relate the concept of acid-base titration to events that occur in everyday life. One of them is using a practical learning method that is expected to improve students' ability to analyze and solve a learning problem that is active, interesting, inspiring, and fun [1].

The results of a research according to Nawzad, et al [12] stated that science learning supported by technology has been proven to increase student interest in learning and improve student learning outcomes, while also helping students in doing homework more easily than when just using traditional methods. The results showed that students' interest in using technology in science learning was 75% and 95% for third and fifth grades. In addition, the graduation rate of third and fifth-grade students when using technology to support learning is 57% and 83%, different from when using traditional methods, namely 43% and 17% also for third and fifth grades in science subjects. The results are based on the Indonesian Journal of Curriculum and Educational Technology Studies with the title The Effectiveness of Technology for Improving the Teaching of Natural Science Subjects by Lezan Nawzad, Dana Rahim, and Karzan Wakil. The conclusion of the study is that science learning supported by technology or media can increase student learning requests so that it can improve learning outcomes. In addition, the use of technology in lessons is considered better than traditional learning methods.

5. CONCLUSION

The conclusion that can be drawn from the design of this game is that this game can help students in the practicum of acid-base titration material. This "VC-LAB" game has been designed to build is an educational game that focuses on chemistry subjects. This game is made as simple as possible so that learners can play it easily.

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