Using Android-based learning game on the concept of buffer solution

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Abstract. In the digital era it is now necessary to develop android-based learning media. Important buffer concept developed through android games because it includes abstract concepts, memorization and calculations. The research method used is the stages of developing the ADDIE model (analysis, design, development, implementation, and evaluation). This research only reaches the development stage which produces an Android-based learning game product. The results of the validation carried out on 3 expert lecturers, namely material experts, media experts, and learning experts showed that the Android-based buffer solution learning game is valid with a calculated value of 0.78. The results of a limited trial analysis of 10 students as respondents showed a percentage of 94.2%. Android characteristics that has an interesting visualization, practical and flexible and varied questions that students can develop their thinking skills by using android based learning media. Based on the results of the validation and trial, the Android-based learning game was declared feasible to be used as a learning medium on the concept of buffer solution.

1. Introduction
Chemistry is a subject that is considered difficult by some students, because the material contained in chemistry subjects includes abstract, memorized, and calculated things so that it is difficult for students to understand [1,2]. One concept of chemistry a is a buffer solution. This material is related to the concept of acid base. The many concepts in buffer solutions often cause difficulties for students, especially in the ability of chemical representation [3]. The concept of buffer solution consists of several concepts including the understanding of buffer solution, working principle, buffer capacity, pH calculation using the Handerson-Hasselbalch equation and buffer solution in daily life [4].

The learning process with the help of learning media can improve understanding and retention of knowledge if the media is designed and made appropriately [5]. Learning media in the form of games have the advantage that the game allows active participation from students to learn. Good learning is active learning. The game has the ability to involve students in an active learning process [6]. In understanding the concepts contained in buffer solutions, active learning is needed and can improve thinking skills [7].

The development of science and technology has progressed. This can encourage more applicative and interesting learning to improve the quality of education. The right innovation and methods can help students understand the process so that it can be applied in everyday life [8]. Learning media created by utilizing Android-based technology, namely mobile the phone. One that can be used in learning and has
not been widely used is the application learning games (Education Game). Learning game is an application in the form of a game that contains learning material that is built according to the level of education [9]. Learning Media created aims to evaluate student learning outcomes through practice questions contained in the game. Learning evaluation is usually on paper with the existence of this Android-based game learning evaluation conducted by students becomes fun.

Previous research was conducted [10] that an Android-based game learning media can increase learning motivation in atomic structure material. Students learn in a fun way with image visualization. Android characteristics that have an interesting visualization, practical and flexible and varied questions that students can develop their thinking skills by using android based learning media [11]. Questions that are visualized into a game can help students measure their learning abilities on a chemical concept. Students who use android-based learning media can study anytime and anywhere without an internet connection (offline) with the help of their smartphone [12].

2. Method
The study was conducted by using ADDIE Model. The ADDIE model used until the ADD (Analysis, Design, and Development). The subjects of this research were 3 expert lecturers and 10 chemistry education students Islamic University of Sunan Gunung Djati state.

2.1. Techniques of data collection and data analysis
Data collection techniques in this study were using questionnaires given to expert lecturers and students to be answered in accordance with responses to game products. Then processed and draw conclusions. The questionnaire analysis used to determine its validity uses a ratio of r count and critical. If r count is greater than r critical which is 0.3, it can be declared valid [13]. R count can be searched using the following formula:

\[ r = \frac{x}{N \times n} \]

Which are:
- \( r \) = Value of Eligibility
- \( x \) = Weight of respondent answer
- \( N \) = Number of Item
- \( n \) = Number of Respondent/ Validator

due diligence is carried out to students in the same form as the validation test. Questionnaires that have been filled out by students are then collected and then processed with the same steps as in the validation test, namely as follows:

\[ \% = \frac{\Sigma n}{N} \times 100\% \]

Which are:
- \( \Sigma n \) = Number of respondent who answered yes or no
- \( N \) = Number of Respondent

3. Result and discussion
Based on the results of research on the Android based learning game on the concept of buffer solution, can be seen in figure 1, figure 2 and figure 3 as follows:
Based on figure 1, this game provides images or objects that are included in buffer solutions in everyday life. The cognitive process that occurs when working on this problem is that students will execute the correct answer based on what students have learned in class or outside the class. The second game is buffer grouping which consists of playing acid buffer solution and base buffer as shown in figure 2 below:

**Figure 1.** Buffer jump page.

**Figure 2.** Buffer grouping page.

Based on figure 2, this game develops the ability to classify the characteristics of acid buffer solutions and base buffer solutions. The cognitive process that occurs when working on this game is that students can recognize the concept of an acid or base buffer solution by detecting the characteristics of the patterns that correspond to the examples and concept or principles. In order to work in this game, students have studied the chemical equations of acids and bases along with examples of their reactions. Next, the third game which is the mission buffer is a question that must be done as shown in figure 3 below:

**Figure 3.** Mission buffer page.
Based on Figure 3, the practice questions contained in this game are measuring students' memory in learning the buffer solution material that contains the application of a buffer system to the body of living things, simple pH calculation, and displays a picture of the phenomenon of pH changes based on solution concentration. This is in line with Slamet and Hidayah where games can keep learners interested in repetitive tasks [14]. Game learning media can be examples of problems and exercises related to question indicators [15].

The validity test was carried out on three expert lecturers with four aspects assessed, namely in the learning aspect obtaining \( R = 0.81 \) the substance aspect of the material obtained \( R = 0.74 \) the visual communication aspect obtained \( R = 0.80 \) and aspects of software engineering obtain \( R = 0.75 \) as in Table 1.

| No | Validated aspects                  | \( R \) count | \( R \) critical | Results |
|----|-----------------------------------|----------------|-----------------|---------|
| 1  | Learning aspect                    | 0.81           | 0.30            | Valid   |
| 2  | Material substance aspect          | 0.74           | 0.30            | Valid   |
| 3  | Visual Communication aspect        | 0.80           | 0.30            | Valid   |
| 4  | Software Engineering Aspects       | 0.75           | 0.30            | Valid   |
|    | \( R \) count average             | 0.78           | 0.30            | Valid   |

This shows that all aspects are assessed against game products has been valid because it is more than \( R \) critical that is 0.3. So that the average \( R \) is calculated obtained from all aspects, namely 0.78 and is feasible to use. Comments and suggestions obtained from the three experts are found in the aspect of visual communication can be seen in Table 2.

| Aspect                                      | Recommendation for Improvement                                      | Repair Results                                                                 |
|---------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Writing on the main menu changes using English | It has been improved by replacing the main menu language into English |                                                                              |
| Sort the main menu according to the hierarchy of needs | It has been improved by changing the order in the main menu according to the hierarchy of needs |                                                                              |
| The duration in game buffer grouping is slowed | It has been fixed by slowing down the duration of the game buffer grouping type |                                                                              |
| All questions in mission buffer games must be able to be done by students not directly game over | Improved by reprogramming game mission buffer into all the problems in this game can be done by all students |                                                                              |
| Add a timer in each question in the game mission buffer | It has been fixed by adding a timer on each question |                                                                              |
| The background in the game doesn’t match the colour of the writing | It has been improved by changing the writing colour to be sharper so that the writing can be seen clearly |                                                                              |

After validating the material expert lecturers, media representatives, and learning experts, limited trials were conducted on students. This limited trial was conducted to test the level of practicality of the media which is then feasible to use or not. The selection of students is done randomly as many as people who have an android application on the smartphone.

In this Android-based learning game application there are several main menus available, namely play menu, learning indicator, profile, instruction, score, setting and exit. The play menu contains the games.
that will be played including buffer jump which contains practice questions about the application of buffer solutions in daily life, buffer grouping which contains characteristics and examples of acid or base buffer solutions, and the last is mission buffer containing quiz questions as many as five questions about solution buffers such as pH calculation, buffer solution in living organisms, and comparison of concentrations in making buffer solutions. Game maker identity, content and design are in the profile menu. The instruction menu contains instructions on how to play the game. After playing the game points collected can be seen on the menu score. In addition, to control music is available in the settings menu and to end the game an exit menu is provided. With the existence of these menus can make it easier for students as users to choose their own content to learn. This is in line with the opinion [16] that games can help create new inventions and knowledge that builds up.

Making this android game most of the materials used are made by themselves with the help of various applications CorelDRAW X6, Ms. Power Point, and Adobe Flash. In addition, there are several images downloaded from various internet sites. After all the ingredients have been collected, the next game is making a buffer solution by using the unity application assisted with the android studio application with the two applications the learning games that have been created can be exported into an Android program with the .apk format and easily installed on a smartphone. The application uses the programming language c# or c ++ to produce an Android-based learning game on the concept of buffer solution.

The results of the trial are limited to self-knowledge obtained by a percentage of 94.2%. Based on these results, the Android-based learning game on the concept of buffer solution is feasible to be used as a source of independent learning and training.

4. Conclusion

The results of the validation test and the results of due diligence on Android-based learning games on the concept of buffer solutions are declared valid with r count obtained 0.78 which shows that the average r count is higher than r critical. Improvements provided by the validator are on aspects of visual communication that are related to the appearance of the game. The feasibility test of android-based learning media on the concept of buffer solutions get valid results with good categories, while the results of the trials conducted on the learning media are stated to be strong with a percentage of 94.2%.

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