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Android-based Animation for Chemical Elements and Experiments as an Interactive Learning Media

Dedi Saputra[1]*, Burcu Gürbüz[2], Haryani Haryani[1]

[1]Sistem Informasi, Universitas Bina Sarana Informatika, Jakarta, Indonesia
[2]Johannes Gutenberg-University of Mainz, Germany; ˙Usk¨udar University, ˙Istanbul, Turkey

*Corresponding Author. dedi.dst@bsi.ac.id

ABSTRACT The use of smartphone technology with various operating system platforms and Android is also widely used in education. Various types of applications were created to support the learning process at school and outside of school. The purpose of this research is to create an alternative learning media in the form of an interactive animation application that utilizes smartphone technology on material or topic discussion of elements and chemical experiments in the eyes of chemistry lessons. This android-based interactive animation application is focused on periodic table material that provides necessary information about elements and chemical experiments that include PH solutions, electrolyte solutions, and synthetic reactions in them. The application is designed using the Construct 2 application software, HTML 5 programming language, the Intel XDK compiler with the waterfall software development method, and BlackBox testing as a software testing method. This study's results are in the form of an Android-based learning application to test chemical elements hoped that this application could be implemented for chemistry subjects. Especially for high school students, as an attractive alternative learning media to make it easier to understand chemistry.

Keywords Interactive Animation, Smartphone, Android, Construct 2

1. INTRODUCTION

The learning process should make students enthusiastic about participating in learning to participate in learning activities thoroughly and continuously. The most comfortable learning atmosphere is one of the essential factors in improving the classroom's effectiveness; learning possible to take place optimally (Syafaruddin, Mesiono, Butar-Butar, & Assingkily, 2020). The development of information technology and communication significantly impacts instructional media learning in schools and other educational institutions. During the Covid-19 pandemic, where the education process switches to online methods, information technology, and communication change the learning location from class to anywhere and anytime students can study. Communication technology encourages the evolution of learning locations and times. Learning no longer only occurs in school and class, but learning can occur anywhere as long as there are teaching materials and students feel comfortable with the situation (Rusdi & Yunus, 2016).

Many students at every level of education consider chemistry to be a lesson containing quite tricky concepts because of the many elements and abstract reactions. Chemical elements that consist of many elements often make students lazy with chemistry, especially in terms of memorizing the periodic system of chemical elements., studying the composition and nature of an object as well as changes in the formation of that substance. Chemistry comes from the Egyptian "Keme" which is means "earth" is the study of composition, structure, and properties of matter, and all changes that accompany chemical reactions (Pratama, Yuanita, & Susantini, 2016). Chemistry is the study of the composition and properties of an object and its changes and formation. Chemistry is a branch of natural science (IPA). Among branches of science has a close relationship. As technology advances, chemistry continues to develop into a new, more specialized science. According to Schwartz et al. (Rahayu, 2017), Chemistry is an experimental discipline. Chemists conduct scientific inquiry, make generalizations, and propose theories to explain natural phenomena. It can be concluded, chemistry is the study of the composition, structure, composition,

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and properties of substances to find answers to how natural phenomena are related to a composition, the structure, properties, change, dynamics, and substance energetics. Abstract chemical concepts will be a problem when these concepts are the key concepts used to understand a phenomenon that occurs (Eliyawati, Agustin, Sya'bandari, & Putri, 2014). Solving problems result in low student interest in learning even though chemistry as basic science is considered to have essential values applied in various life spheres. Students would better understand chemistry and understand difficult chemistry concepts if they could make deeper connections between concepts and realities (Rastegarpour & Marashi, 2012). Students can improve their understanding of chemistry and like chemistry as fun learning through learning media (Lubis & Ikhsan, 2015). One way to help these students can be done by utilizing gadget technology that is already widely owned (Hafidha, 2014).

The development of science, information technology, and communication provides significant changes to the learning process development. Information and communication technology (ICT) in education continues to evolve in various strategies and patterns. It can be grouped into an e-Learning system as a form of learning that utilizes electronic devices and digital media and mobile learning (m-learning) as a particular form of learning to utilize mobile communication technology and devices (Kurniawati & Priyanto, 2018). That was also followed by mobile phone technology (mobile phone), which is currently known as a smartphone with practical characteristics and can be carried anywhere. A mobile application is a software or a program that runs on a mobile device whose job is to perform specific tasks for its users (Sunarya, Prima, & Wihardi, 2020). With the increasing number of mobile device users or smartphones, especially among students in Indonesia, the mobile learning method can be used as an alternative to solve problems in education. This research refers to previous research that discusses (1) the Design of an Android-Based Telecommunication Quiz Application (Budiharjo & Yulianto, 2014), (2) the Making of an Android-Based "Pontianak Punye" Quiz Game Application (Saputra & Rafiqin, 2017; Aksad, 2018), (3) Solar system based Android (Nuqisari & Sudarmilah, 2019), (4) Atwood machine-based Android (Shabrina, Warsono, & Kuswanto, 2017), (4) Android Based Math & Trash Educational Game Using Scirra Construct 2 and Adobe Phonegap (Widaningrum, Prasetiyo, & Astuti, 2020), (5) Arduino-Android Based Game (Yasin, Prima, & Sholihin, 2018), and (6) Smartchem: An Android Application for Learning Multiple. Representations of Acid-Base Chemistry (Eliyawati, Agustin, Sya'bandari, & Putri, 2014). Based on the problem mentioned above and relevant research to make chemistry learning media in the form of an android-based interactive animation application, it can also be used as a learning method (mobile learning). Hence, the two terms discussed in this article are mobility and learning. The two terms under consideration in this article are therefore mobility and learning.

On the one hand, "mobility" refers to the technology's capabilities within the students' physical contexts and activities as they participate in higher learning institutions. On the other hand, it refers to the learning process's activities and the learners' behavior as they use the technology to learn. It also refers to students' highly mobile attitudes as they use mobile technology for learning purposes (El-Hussein & Cronje, 2010; Busran & Yunanda, 2015). The purpose of mobile learning is to make learning easier for students wherever and whenever they are so that they are not limited to space, time, and place (Nasution, 2016; Fudholi, 2015). The design of an interactive animation application for learning chemical elements based on Android.

2. METHOD

The methodology used in this research is the descriptive analysis method, which aims to get a clear description of what is needed. The needs for completing this research are functional needs and non-functional needs.

The summary of some of these opinions is that a storyboard is a series of illustrations or images displayed sequentially containing story ideas to visualize a story in detail from each scene. Some examples of the design of the storyboard in this study can be seen in Figure 1 and Figure 2

Creating the Program Code: Stages in making Chemical Elements Learning Animation: (1) Defining the problem by analyzing the problem and then solving the problem through a program or application based on the need of view. (2) Planning and system design. At this stage, the researcher makes a program flowchart to describe the animation display and program logic. (3) Implementation. At this stage, the researcher makes program codes using the Construct 2 programming language. (4) Documentation Stage. At this stage, the programming code

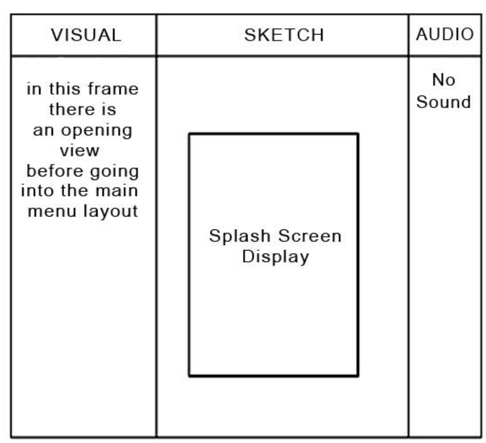

Figure 1 Storyboard splash screen design

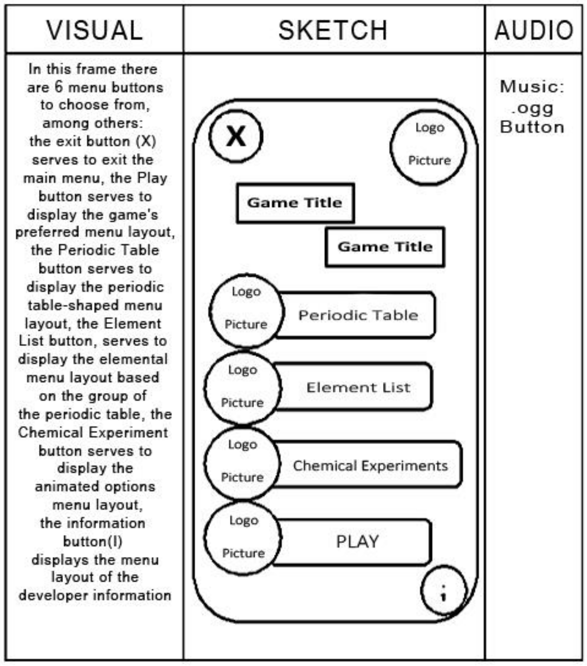

Figure 2 Main menu storyboard design

has reached 80%. Furthermore, documentation or comments are made on the program. (5) Testing. This stage tests the unit or program module and tests the program input. At this stage, the software design is realized as a series of programs or program units. Then unit testing involves verification that each program unit meets its specifications. The test method used is BlackBox Testing. "Black-Box Testing is testing the software in terms of functional specifications to find out whether the functions, inputs, and outputs of the software are by the required specifications (Rosa & Shalahuddin, 2013). At the test stage of the program, researchers use Black Box Testing by testing the program's function, testing the program's validation, whether the input is by its output. The logic of the program has been described through flowchart diagrams. It can be concluded that Black box testing is testing software by running programs with unknown internal performance and finding out whether the functions, inputs, and outputs of the software match the required specifications.

Support or Maintenance: The support or maintenance stage can repeat the development process from specification analysis to existing software changes, but not to create new software.

3. RESULT AND DISCUSSION

Mobile learning is defined by Clark Quinn (Fujiawati & Raharja, 2019) as The intersection of mobile computing and e-learning: accessible resources wherever you are, robust search capabilities, rich interaction, powerful support for effective learning, and performance-based assessment. The mobile learning method is a learning

Figure 3 Splash screen view

model that utilizes flexible information and communication technology in both time and place, contains many multimedia content features, material exploration capabilities, multi-interaction, effectiveness, and performance-based assessments. E-Learning is independent of location in time or space. Mobile learning can perhaps be defined as 'any educational provision where the sole or dominant technologies are handheld or palmtop devices. This definition may mean that mobile learning could include mobile phones, smartphones, personal digital assistants (PDAs), and their peripherals, perhaps tablet PCs and perhaps laptop PCs, but not desktops in carts and other similar solutions (Traxler, 2005). The conclusion from this definition is mobile learning is a learning model that utilizes information and communication technology. In the concept of mobile learning, its utilization includes the availability of teaching materials that can be accessed at any time and the visualization of exciting material. M-Learning or Mobile Learning refers to using handheld devices such as PDAs, smartphones, laptops, and other information technology devices that will be widely used in the learning process; this study focused on cell phones (cellphones) or smartphones (smartphones). The goal is that the long-life learning process of students/students can be more active, time-efficient and can increase student interest in learning with an exciting application.

Cognitive, affective, and psychomotor students are taught multi-representation learning better than conventional (Meidayanti, Sunyono, & Tania, 2015). The use of android-based interactive animation as a learning medium has changed the learning paradigm, starting from how a person learns, how to obtain information, and adjust information. This Android-based interactive animation learning media also makes it easier for students to understand and practice to achieve the learning process's objectives.

The application design results can be explained with several display samples implemented to explain the basic learning material and chemical experiments to achieve the expected objectives.

The application's design has been created and explained by several display samples that are implemented to explain

Figure 4 Main menu view

necessary learning materials and chemical experiments so that the expected goal can be achieved.

3.1 Application Display

3.1.1 Splash Screen Display

This display contains a splash screen image for a few seconds to enter the main menu layout page. The splash screen display is an initial description of the menu in this application to get an overview of this application. The image shown is symbolic of the application. The splash screen display can be seen in Figure 3.

3.1.2 Main Menu Display

This main menu layout contains (a) a title, (b) a periodic table button to display the periodic table layout, (c) an element list button displays the element layout based on a group from the periodic table, (d) a chemical experiment button to display animated layout options, (e) a play button to display game layout menu options such as quizzes and guess the picture that will be played. Exit button to display the exit confirmation options. The main menu display can be seen in Figure 4.

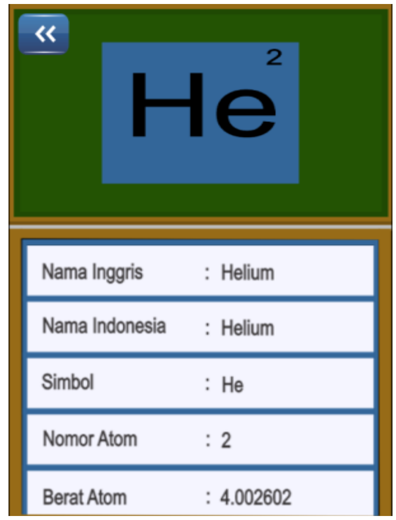

Figure 6 Periodic table explanation view

3.1.3 Periodic Table Menu Display

The periodic table menu layout contains the periodic table where each box contains a picture of each element, the shape of the periodic table position is landscape. If this box is selected, it will go to the following layout, which contains an explanation of the periodic table elements. The back button functions to return to the main menu layout. The periodic table menu display can be seen in Figure 5.

3.1.4 Explanation of the Periodic Table Display

In this periodic table, the explanation layout contains images of the elements selected from the periodic table. Then there is an explanation of each element selected from the periodic table. Explanation of drag-drop-shaped elements can be pulled down and up. The back button returns to the periodic table menu layout. The periodic table explanation display can be seen in Figure 6.

3.1.5 Element List Display

The element list layout contains a list of elements based on the periodic element group, where each box contains an image of the element based on its respective group. If this box is selected, it will go to the following layout, which contains an explanation of the elements. The next button

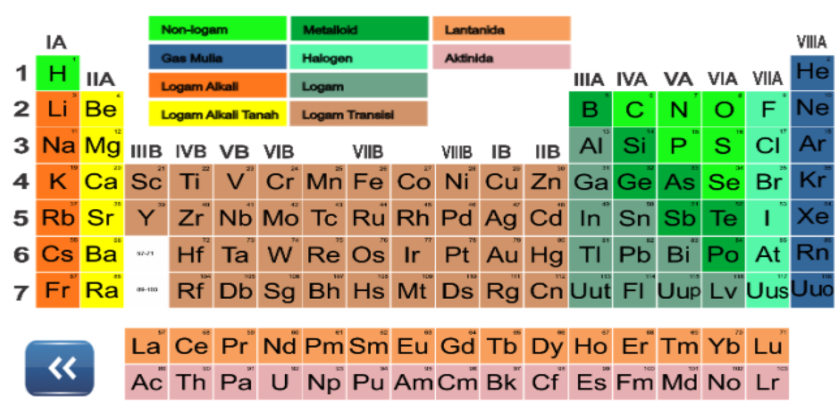

Figure 5 Periodic table menu view

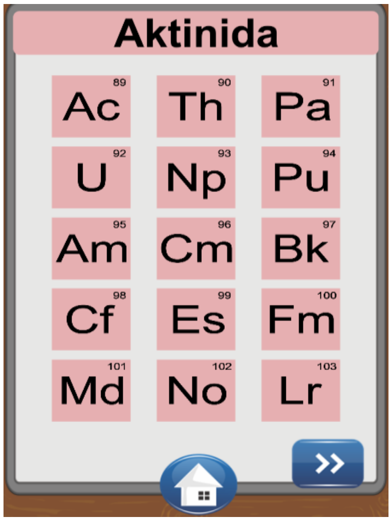

Figure 7 Element list menu view

(>>) goes to the other group elements layout. The back button functions to return to the main layout. The display of the elements list can be seen in Figure 7.

3.1.6 Chemical Experiment Display

In this chemical experiment menu layout, three animation buttons can be selected where each animation has a different animation. Each animation has its animation characteristics—the back button (<<) functions to return to the main menu layout. The chemical experiment menu display can be seen in Figure 8.

3.2 Testing

Testing in this study was conducted to obtain validation of the application design and its use. Testing on the application aims to determine whether the application is running correctly according to its function before the respondent carries out an assessment. Testing is part of system development that has been planned and very systematic to test or evaluate the desired truth of software quality (Aziz, Setiawan, Khanh, Nurdiyansyah, & Yulianti, 2020). Testing of application designs that are made using BlackBox testing focuses on the process of program input and output. Black Box Testing focuses on software's functional specifications (Mustaqbal, Firdaus, & Rahmadi, 2015). The test results can be seen in Supplementary Information Table S1 .

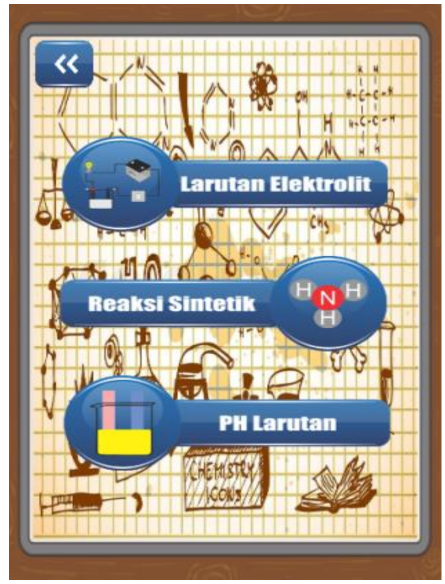

Figure 8 Chemical experiment menu view

Testing of use in its implementation is carried out by distributing questionnaires to users, namely high school students with 30 respondents. Ten questions are divided

Table 1 Application view questionnaire answer recapitulation

App View	Strongly Agree	Agree	Disagrees	Very Disagree	Number
Q 1	24	6	0	0	30
Q 2	26	4	0	0	30
Q 3	26	4	0	0	30
Total	76	14	0	0	90
Percentage	84.44%	16%	0	0	100%

Table 2 Application purpose questionnaire answer recapitulation

Application Objectives	Strongly Agree	Agree	Disagrees	Very Disagree	Number
Q 4	24	5	1	0	30
Q 5	28	2	0	0	30
Q 6	25	4	1	0	30
Q 7	28	2	0	0	30
Total	105	13	2	0	120
Percentage	87.50%	11%	2%	0	100%

Table 3 Recapitulation of user ease questionnaire answers

User Friendly	Strongly Agree	Agree	Disagrees	Very Disagree	Number
Q 8	27	3	0	0	30
Q 9	28	2	0	0	30
Q 10	28	2	0	0	30
Total	83	7	0	0	90
Percentage	92.22%	8%	0	0	100%

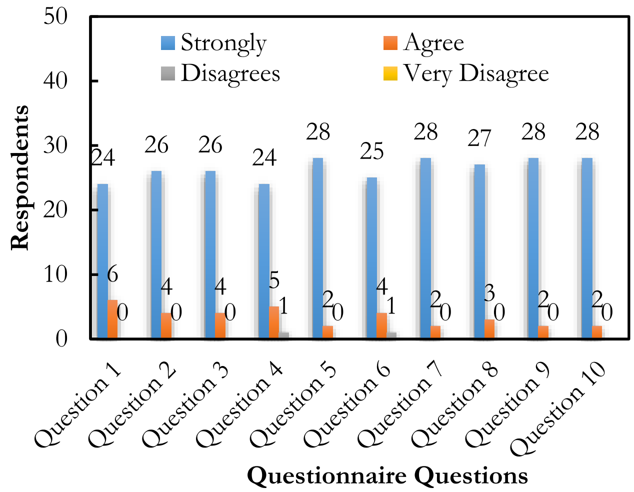

Figure 9 Questionnaire data processing graph

into three groups of questions: three questions about Application Views, four questions about Application Objectives, and three questions about Ease of Use. The questionnaire results can be seen in Tables 1, 2, 3 and the graph of the processing results shown in Figure 9.

4. CONCLUSION

From the description of the results and discussion of research on interactive animation applications and chemical experiments on an Android-based learning media with a mobile learning model and its implementation it can be concluded: (1) This application can be an alternative solution for learning media, especially for high school students in learning and understanding the basic material of chemistry; (2) The features in the interactive animation application and chemical experiments based on Android such as the periodic table, list of elements, chemical experiments, and games are made very interactive, exciting and user-friendly, (3) Based on the category of the interactive animation application of elements and chemical exper iments android-based, it is obtained an average value of 84.44% strongly agree and 16% agree; This means that the appearance of the application is considered very good by the user (4) In the recapitulation of the objective of interactive animation applications of elements and chemical experiments based on Android, the average value of strongly agree is 87.5%, agrees 11%; and disagree 2%, this means that the objective of the application is considered good by the user (5) The ease of user application of interactive animation of elements and chemical experiments based on Android obtained an average value of 92.22% strongly agree and 8 % agree, this means the applications are very user-friendly.

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