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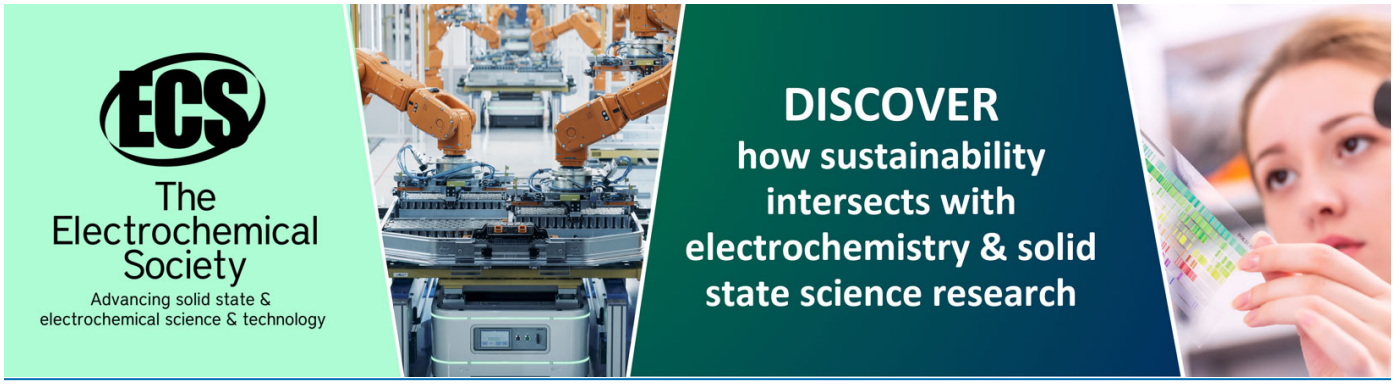

Development of android-based chemistry learning media for experimenting

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Abstract. Learning media is an important component in the learning process. Technology and computer-based media is one of the media needed. It aims to attract students to learn chemistry material, especially material that need more efforts to understand. This research aims to develop android-based chemistry learning media for experimenting by using simulation models in Senior High School 2 Palangka Raya. The methods of this study are a research and development (R & D) by Alessi and Trollip. Product testing consists of an alpha test and a beta test to determine the level of product feasibility and test the effectiveness of products on student learning outcomes. The instruments that used to collect data were observation sheet, interview guidelines, scoring questionnaires, and test. The data that have been collected were analysed by qualitative descriptive technique. The results of this study can be concluded: 1) Learning media is very good. 2) Learning material is very good. 3) The individual test result is very good. 4) The small group test result is very good. 5) The final product trial result is very good. The android-based chemistry learning media produced is worthy to be used and effectively used in upper class students and middle class students, but it is not yet effective to be used in lower class students.

1. Introduction

Chemistry is commonly portrayed at three different levels of representation – macroscopic, microscopic and symbolic – that combine to enrich the explanations of chemical concepts [1]. Compared with other subjects, chemistry is commonly believed to be more difficult, at least at the introductory level. There is some justification for this perception. For one thing, chemistry has a very specialized vocabulary [2]. The purpose of chemistry learning is to make student think like a chemist, to look at the macroscopic world —the things we can see, touch, and measure directly—and visualize the particles and events of the microscopic world that cannot experienced without modern technology and imaginations.

Effective teacher often use visual representations to promote conceptual understanding, but the macroscopic representations remain insufficient for conveying adequate information to novice learners about motion and dynamic processes in chemistry [3]. The advent of microscopic representations has created new possibilities for more fully supporting visualization of atoms, molecules and ions. The use of computer and internet technology as a medium for developing digital version of teaching materials needs to be done by educators to produce appropriate learning media products [4][5].

In revolution industry 4.0 the emerging advances in Information and Communication Technology (ICT) for manufacturing opens new possibilities for lifelong learning utilizing data from production [6], where Internet of Things (IoT) and its supporting technologies function as the backbone for Cyber-Physical Systems (CPS) [7]. Android plays an important role in the digital era. Android is a mobile operating system based on a modified version of Linux. The Android operating system was first developed by the company Android Inc., which eventually was used as the name of the mobile operating system project. Android is a new generation of mobile platforms, a platform that gives developers to develop according to what they expect [8].

In chemistry, android can be used for developing learning chemistry teaching media based on an android application to conduct experiments by using a simulation model. The simulation model is basically one of the learning strategies that aim to provide a more concrete learning experience through the creation of imitations of forms of experience that approach the real atmosphere and take place in an atmosphere without real risk [9].

Kemp and Dayton [10], stated that Computer Based Instruction refers to any application of computer technology to the instructional process, there was a contribution to the use of instructional media in the implementation of learning, namely to shorten teaching time. At least reduce the teacher's time to write on the board and reduce students' time to take notes. The quality of learning outcomes can be improved if the integration of words and images as learning media can communicate elements of knowledge in a way that is well-organized, specific, and clear. With Android, the mobile learning process can take place whenever and wherever needed. The positive attitude of students towards learning materials and the learning process can be improved [11][12]. The results of the study [13] show that understanding students' concepts when treated using android-assisted media can be categorized as good.

In general, multimedia is defined as a combination of text, images, graphic art, animation, sound and video. Various kinds of media are combined into one work unit to produce information that has meaningful communication value. That is, information can not only be seen as a printout, but also can be heard, form simulations and animations that can arouse interest and have meaningful graphic arts in its presentation [14]. According to [15], multimedia (multiple media, user control over the delivery of information, and interactivity) [16] is the use of computers to create and combine text, graphics, audio, moving images (video and animation) by combining links and tools that allow users to navigate, interact, create and communicate. Interactive multimedia learning is multimedia designed to accommodate students' responses to material. To produce a multimedia needed research and development.

According to [17], research and development methods are research methods used to produce certain products, and test the effectiveness of these products. To be able to produce a particular product starting with a needs analysis (used survey or qualitative methods) and to test the effectiveness of the product an experimental method is needed. Development research or often called Research and Development (R & D) usually produce products that are the result of analysing the needs of students and to test the effectiveness of these products so that they can be used by the user community.

According to [18], the development research method contains three main components, namely: development model, development procedure, and product trial. Alessi & Trollip [19] developed a research and development model consisting of three phases, namely: planning, design, and development. The purpose of this study was to develop and test the feasibility of android-based interactive learning media in the form of experimental simulation of electrolyte and nonelectrolyte solutions.

2. Research Methodology

This study used a research and development (R & D), which was used to produce a specific product and test the effectiveness of these products [20] [21], which refers to Alessi and Trollip models (Planning, Design and Development) as can be seen in Figure 1. The planning phase includes: 1) Define the scope of the content. 2) Identity characteristics of learners and other users. 3) Establish

constraints. 4) Cost the project. 5) Produce a planning document. 6) Produce a style manual. 7) Determine and collect resources. 8) Conduct initial brainstorming. 9) Define the look and feel of the project. 10) Obtain client sign-off. The design phase includes: 1) Purpose of design. 2) The audiences for design documents. 3) Develop initial content ideas. 4) Task and concept analyses. 5) Preliminary program description. 6) Detailing and communicating the design. 7) Prototypes. 8) Flowcharts. 9) Storyboards. 10) Scripts. 11) The importance of on-going evaluation. 12) Client sign-off. The development phase includes: 1) Project management. 2) Prepare the text components. 3) Write the program code. 4) Create the graphics. 5) Produce video. 6) Record the audio. 7) Assemble the pieces. 8) Prepare support materials. 9) Alpha testing. 10) Making revisions. 11) Beta testing. 12) Final revisions. 13) Obtaining client sign-off. 14) Validate the program. The steps for developing learning media adopted from [20]. This research was carried out to the tenth grade of Senior High School 2 (SMAN 2) Palangka Raya. The data obtained from this research was in forms of qualitative and quantitative data. The qualitative data obtained from observations in the classroom during the try out, while the quantitative data obtained from a questionnaire given to subject matter experts, learning experts, and students. The instruments used to collect the data were: observation sheets, interview guidelines, scoring questionnaires, and test (pre-test and post-test) to determine the effectiveness of teaching media. The collected data will be analysed with descriptive qualitative.

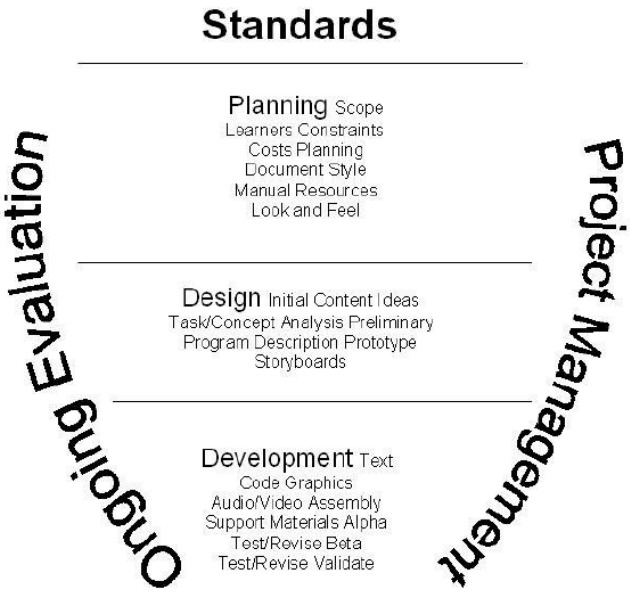

Figure 1. Development Learning Device Alessi & Trollip Models

3. Result and Discussion

3.1. The Procedure of Learning Media Development

Research has been carried out following the Alessi & Trollip research and development procedures and has produced products in the form of android-based chemical learning media. The process of research and development has been carried out through the planning stage, the design stage and the development stage.

3.1.1. Planning

The planning phase begins by identifying the scope of the material for electrolyte and nonelectrolyte solutions. This stage is carried out by identifying core competencies and basic competencies in the syllabus of the X-MIPA class of SMAN 2 Palangka Raya chemistry subjects. Syllabus is used as a reference in the learning process which is poured into interactive multimedia products. The chemistry

teacher of SMAN 2 Palangka Raya was interviewed to determine the scope of the material and find out the media needs of Android-based learning. The results of the interview to the chemistry teacher of SMAN 2 Palangka Raya obtained the following information: (1) the importance of developing an android-based chemical learning media; Identification of user characteristics was carried out by conducting interviews with two students of class X-MIPA-1 of SMAN 2 Palangka Raya. The conclusions obtained from the identification process are: (1) Students still experience difficulties and obstacles in learning electrolyte and nonelectrolyte solution material, (2) The use of instructional media conducted by teachers is less varied, so students tend to get bored, (3) Students are motivated when using media in learning and can arouse interest in learning chemistry, (4) Students are interested in using android-based chemistry learning media in chemistry learning, (5) most students are android smartphone users, (6) Students are easier to understand material when using learning media based on android, (7) Students love to learn using practical learning media, such as android-based interactive multimedia so it needs to be developed. Source collection and boundary determination consists of 6 parts, namely: (1) collection of teaching material, (2) identification of the software used in the form of adobe animate CC 2018, adobe AIR, MediBang Paint, and Windows Paint, (3) determine the source of collection starting from material sources, animations, sounds, and drawings, (4) create development timelines, (5) discussion of initial ideas and (6) designation of display plans.

3.1.2. Design

This stage is carried out with the following steps: (1) Developing the initial content idea by identifying the learning outcomes of the subject matter of electrolyte and nonelectrolyte solution then making indicators based on the learning outcomes and determining the sub concepts that will be included in the media. Sub concepts include electrolyte and nonelectrolyte solutions, symptoms of electrical conductivity of electrolyte and nonelectrolyte solutions, properties and groupings based on their electrical conductivity, causes of the ability of electrolyte solutions to conduct electricity and electrolyte-forming compounds. (2) Do concept and task analysis. The analysis of the concepts of electrolyte and nonelectrolyte solution materials and task analysis flowcharts was made to get the right steps for students in understanding the concept of electrolyte and nonelectrolyte solutions as a whole. (3) Do instructional analysis using a simulation model, (4) Making a flowchart to describe the course of the program made and facilitate media production. (5) Making a storyboard to describe the interface of a media created. Storyboards are designed and produced using the Adobe animate CC 2018 application.

3.1.3. Development

At this stage the activities carried out include: (1) the production of media that starts from preparing the text, preparing audio files, making images, making animations, making navigation, and making programs. (2) Alpha tests carried out by 4 experts (chemistry lecturers) and 1 education practitioner (chemistry teacher) to assess the media produced. The alpha test was carried out by media experts and material experts. (3) Revision of the initial product is based on suggestions and comments given by experts on alpha tests. (4) Beta testing is done by individual trials of 3 students representing the upper, middle and lower classes (5) Final product revision is carried out based on the results of product trials, (6) Final product trial is carried out with a small group trial of 9 students representing each of the upper, middle and lower classes. The end result of the product developed is Interactive Multimedia Based on Android in the Form of Electrolyte and Nonelectrolyte Solution Trial Simulation which is packaged in the form of an android application with the APK format. Multimedia display includes, among others: (1) Initial display, (2) Greetings, (3) Pre Test, (4) Multiple Choice Question, (5) Home, (6) Instructional, (7) Preparation, (8) Implementation, (9) Experimenting.

3.2. The Result of Alpha Tests

Validation by media experts consists of two aspects, namely the display and programming aspects. The display aspects are very good. The programming aspects are very good. The application product

can be used, because it meets the display and programing criteria. The results of the assessment carried out by two media experts are summarized in Table 1.

Table 1. Data of Assessment Results by Media Experts.

Assessment Aspect	Score Media Experts		Average	Category
	1	2		
Display Aspects	5	5	5	Very good
Programming Aspects	5	5	5	Very good
Average	5	5	5	Very good

Validation by material experts consists of two aspects, namely aspects of learning and content. The learning aspects are very good. The material contents are very good. Learning material for electrolyte and nonelectrolyte solutions developed was declared feasible, because it meets the learning and content criteria. The results of the assessment by two material experts and one education practitioner are summarized in Table 2.

Table 2. Data of Assessment Results by Material Experts.

Assessment Aspect	Score by Experts			Average	Category
	1	2	3		
Learning Aspects	5	5	5	5	Very good
Content Aspects	5	5	5	5	Very good
Average	5	5	5	5	Very good

3.3. The Result of Beta Tests

Beta test consists of three aspects, namely aspects of learning, material contents and appearance. The results of the trials conducted on students of SMAN 2 Palangka Raya are very good for the learning aspect, very good for the material aspects, and very good for the aspect of appearance. The android-based chemistry learning media that developed is suitable for individual use at SMAN 2 Palangka Raya, because it meets learning, material contents and appearance criteria. The beta test results are summarized in Table 3.

Table 3. Data of beta test results.

Aspects	Score			Average	Category
	1	2	3		
Learning	5	5	4.17	4.72	Very Good
Material	5	5	5	5	Very Good
Display	5	5	4	4.67	Very Good
Average	5	5	4.39	4.80	Very Good

Final product trial was conducted on a group of students at SMAN 2 Palangka Raya. The results of the trial Products are very good for the learning aspect, very good for the material aspect, and good for the appearance aspects. These results indicate that the android-based chemistry learning media developed are appropriate to be used for groups learning in SMAN 2 Palangka Raya. The results of the final product trial are summarized in Table 4.

Table 4. Data of Trial Results of Final Product.

Aspects	Score			Average	Category
	1	2	3		
Learning	3.89	4.44	5	4.44	Very Good
Material	5	5	5	5	Very Good
Display	3.67	4	3.33	3.67	Good
Average	4.19	4.48	4.44	4.37	Very Good

3.4. Effectiveness of Teaching Media

The learning outcomes are good for upper class students, good for middle class students, and enough for lower class students. This result shows that the android-based chemistry learning media developed is good for upper-class students and middle-class students, but not yet good to be used in lower-class students. Student learning outcomes are summarized in Table 5.

Table 5. Data of Students Learning Outcomes.

Student Class	Score Post-test			Average	Criteria
	I	II	III		
upper class	3.2	4	2.8	3.33	B+(Good)
middle class	3.2	1.2	3.2	2.53	B-(Good)
lower class	2.8	0.4	2	1.73	C-(Enough)
Average	3.07	1.87	2.67	2.53	B-(Good)

4. Conclusion

Learning media that have been generated in the form of interactive multimedia applications based on Android. This media is used to carry out simulation experiments of electrolyte and nonelectrolyte solutions. The media developed includes questions about pre-test, competency standards, basic competencies, learning indicators, learning objectives, learning materials, experiments, and evaluations.

The resulting product is suitable to be used as one of learning media. The results of the media expert's assessment were obtained on average 5.00 (Very Good). The results of the material expert assessment obtained an average of 5.00 (Very Good). The results of individual trials at the beta test stage were obtained at an average of 4.80 (Very Good). The results of the final product trial obtained an average of 4.37 (Very Good). The product of the development of android-based learning media produced is effectively used in upper class students and middle class students, but it is quite effective to be used in lower class students.

Acknowledgments

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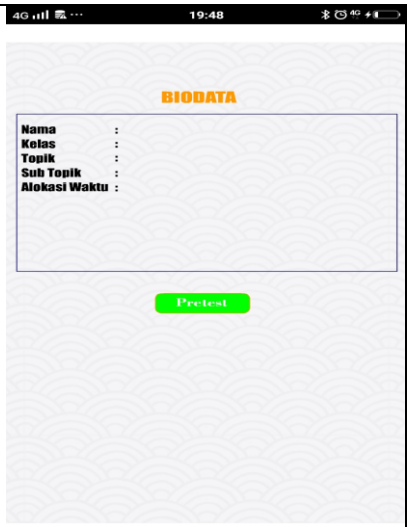
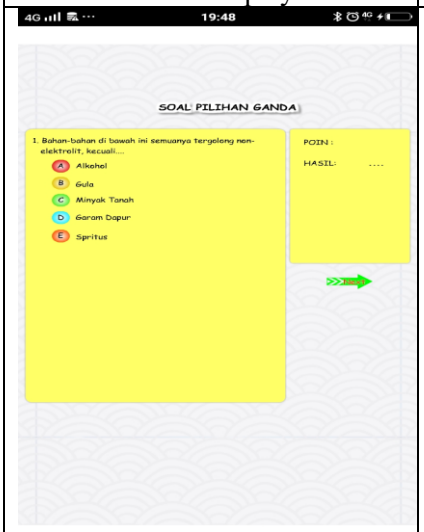
Appendix: Chemistry Multimedia Instructional

Initial Display

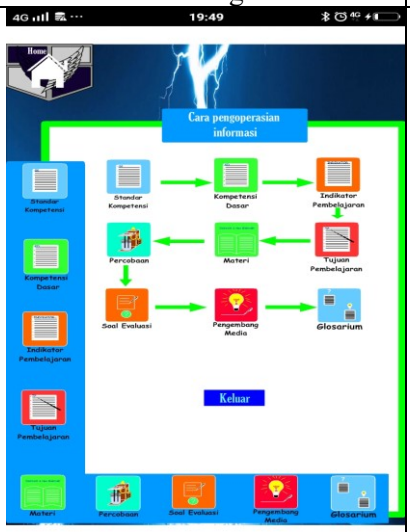
Greetings



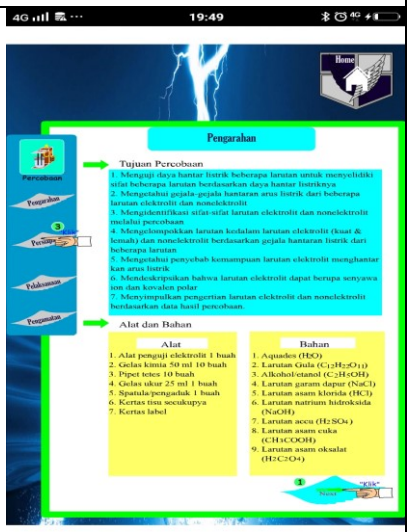
Pre Test



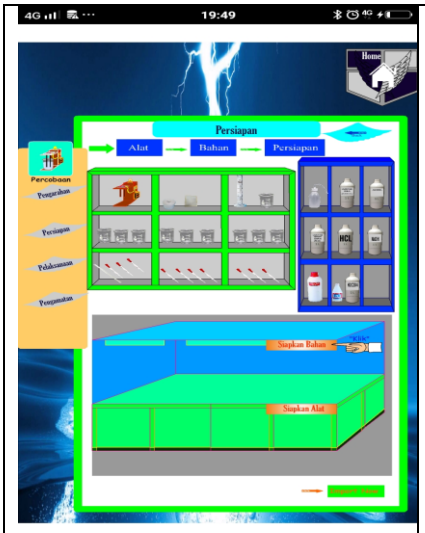
Multiple Choice Question



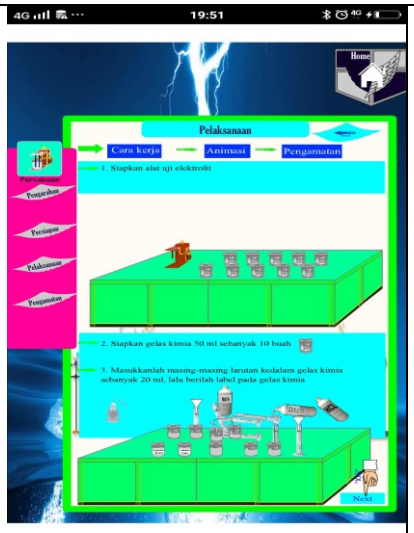
Home



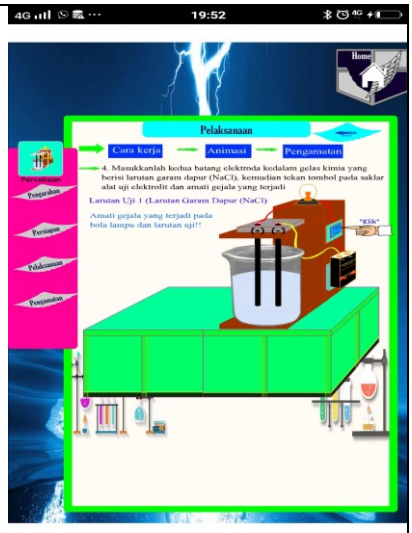
Instructional



Preparation



Implementation



Experimenting