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Development of Android-Based Learning Media Applications on Chemical Equilibrium Materials for Class XI SMA/MA

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Abstract:

This study aims to develop a product in the form of an Android-based learning media application on valid chemical equilibrium material. This study used the Plomp development model which was carried out until the validity stage or prototype III. The expert review validity test was carried out by eight experts including; two Chemistry Lecturers at FMIPA UNP, three Chemistry teachers at SMAN 3 Padang, and three Information Technology Lecturers at FT UNP. The one-to-one evaluation test was carried out by three students of SMAN 3 Padang. The research instrument used was questionnaire data and interview results. The results of the validity test that had been analyzed using the Aiken's V index obtained a V value with high categories including; V of material experts (content validity and construct validity) is 0.91; V media experts (programming and utilization components) of 0.95. The conclusion from the research results is that the android-based learning media application on the chemical equilibrium material developed has been valid.

Keywords **— Android, Applications, Chemical Equilibrium, Learning Media, Plomp**

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I. INTRODUCTION

Based on Ministry of Education and Culture of the Republic of Indonesia Number 65 of 2013 concerning Education Process Standards, it is explained that the learning process in educational units is interactive, fun, entertaining, useful, motivating students and able to participate actively and provide the freedom to take initiative, be creative, and independent, and can improve interest in learning, support talents, and promote the physical and psychological development of students [1]. Efforts can be made to realize the learning process by using standard educational processes, so the use of Information and Communication Technology (ICT) is needed. ICT can be used as a tool to improve learning outcomes, student performance, collaboration, and learning experiences [2].

One of the information technology tools that can be used in learning chemistry is a smartphone. Smartphones are capable of high performance on operating systems such as Android. The use of android in learning media has the benefit of improving students' memory by improving the learning experience [3].

The use of android, for now, is close to student life. Based on the results of processing information data from questionnaires distributed in several high schools in the city of Padang, namely SMAN 3 Padang, SMA Pembangunan Laboratorium UNP, and SMAN 7 Padang, it was found that 96% of students used Android in learning. The use of android in learning is also due to the COVID-19 pandemic from 2019 to the present which makes face-to-face learning actions not conducive to implementation. Therefore, a learning application is

needed to help interaction between students and teachers.

Information obtained from observations made to teachers and students in several high school schools in the city of Padang shows that the teaching materials used are dominated by printed teaching materials, PowerPoint, and learning videos. However, the use of these teaching materials has not fully helped students in finding concepts due to several problems encountered during the learning process. Some of the problems faced by teachers include; the use of teaching materials that have not encouraged student activity in learning, has not been able to make students learn independently, and the teaching materials or media used being less flexible. In addition, it is known that 75% of the teaching materials used by teachers do not display multiple chemical representations. Whereas students' understanding of chemistry learning will be better if students can connect macroscopic, submicroscopic, and symbolic phenomena [4].

Chemical equilibrium is one of the chemical materials studied in class XI SMA. Chemical equilibrium includes abstract material, therefore it needs a strong understanding of concepts by students [5]. Based on the results of a questionnaire given to students when making observations in several high school schools in the city of Padang, as many as 74% of students experienced problems in the chemistry learning process, especially on chemical equilibrium material. Therefore, it takes intermediate media such as images, videos, and animations to visualize the material so that abstract concepts can be understood by students into concrete concepts.

Guided Guided Inquiry Learning is one of the effective learning models that can be applied to the chemistry learning process. Learning by applying the inquiry model allows students to be directly involved in the scientific learning process in a relatively short time[6]. In the application of guided inquiry, students learn actively and are involved in analyzing data, discussing ideas, and understanding concepts for problem-solving, as well as interacting with teachers who function as learning facilitators[7]. By applying the guided inquiry model in the learning process, it will create an interactive relationship between students and teachers so that this guided inquiry model is very suitable to be applied in learning media.

This research has objectives including; 1) Produce android-based chemistry learning media application on chemical equilibrium material for class XI SMA/MA students. 2) Testing the validity of android-based learning media applications for chemical equilibrium material.

The research that is relevant to this research is the research conducted by Gucci, which shows the very high average value of validity and practicality of the multiple representation-based learning media developed are 0.89 and 0.80. The development of multiple representation-based learning media can improve student learning outcomes[8]. Next is the research by Shukra, where the results of the research on the guided inquiry-based E-module that was developed showed the average value of validity was 0.84 and practicality by teachers and students was 0.86 and 0.81. The benefit of the developed product is that it can increase the students' ability to master concepts[9]. Furthermore, the results of research by Rinza regarding the development of android-based mobile learning media showed the average value of the validator was 0.85, the results of the percentage of student responses obtained were 70.70% agreed, and the results of the percentage of students' completeness were 94.16%. The development of this mobile learning media can generate motivation and stimulation for student learning[10]. Research conducted by Subhan, et al on the effect of animation media in the guided inquiry model. The results showed that the guided inquiry learning model applied to animation media affected students' critical thinking skills and learning activities[11]. Likewise with Yuniyanti's research on chemistry learning using guided inquiry with module media and E-Learning in terms of reading comprehension ability and abstract thinking ability. The results of the study concluded that abstract thinking skills affect student learning achievement, as well as the influence of the

application of guided inquiry in the interaction of chemistry learning on abstract thinking skills and student achievement [12].

II. METHODOLOGY

According to Plomp, this type of research is Design Research (D&R) research. Design research is included in the type of developmental studies because it is related to the development of teaching materials and materials[13]. In this study, an Android-based learning media application will be developed by applying a guided inquiry model (Guided Inquiry Learning). According to Hanson, there are five stages in the guided inquiry learning model, namely: 1) orientation, 2) exploration, 3) concept formation (concept formation), 4) application (application), 5) closure (drawing conclusions/closing)[7].

The development model used is the Plomp development. The Plomp development model includes three major steps, namely: 1) preliminary research; 2) prototype approach (prototyping phase); 3) assessment (assessment phase) [14]. This study was carried out to the stage of validity.

$$\mathbf{V= \sum s / [n(c-1)]}$$

$$\mathbf{S = r-lo}$$

The evaluator/rater agreement on the validity of the item is denoted by V, where s is the score given by each evaluator minus the smallest score from the category used, r is the score for the evaluator's choice of category, and lo is the smallest score in the scoring category, n is the number of evaluators/ rater, and c is the number of categories that can be selected by the evaluator[15].

III. RESULT AND DISCUSSION

A. *Preliminary Research*

1) Needs Analysis **:** Based on the results of the needs analysis conducted by distributing questionnaires to teachers and students at SMAN 3 Padang, SMAN 7 Padang, and SMA Laboratorium Pembangunan UNP, information was obtained: 1) the types of teaching materials used in schools were dominated by printed teaching materials; 2) the teaching materials used have not made students active during learning, have not been able to make students independent in learning, and the teaching materials used are less flexible; 3) there are obstacles experienced by students and teachers in the learning process, especially the chemical equilibrium material; 4) the teaching materials used, especially in the chemical equilibrium material, do not yet display the form of three levels of representation; 5) it is difficult for teachers to check student assignments/practices/evaluations during the online learning process; 6) students do not respond to the teaching materials used; 7) the constraints of teachers in making learning media are caused by the availability of inadequate facilities, lack of ability to make, and requires a long time in making learning media.

Based on the information obtained from the needs analysis, an Android-based learning media application for chemical equilibrium material was developed based on the 2013 revised 2018 curriculum. The learning media application developed was designed according to student needs and is more flexible because it can be used anytime and anywhere.

2) Context Analysis **:** At this stage, an analysis is carried out on the abilities that students must master based on the 2013 revised 2018 curriculum. This analysis starts from examining the syllabus so that basic competencies (KD) are obtained which can be reduced to indicators of competency achievement (IPK), which are then formulated into learning objectives. Basic Competencies of chemical equilibrium analyzed are KD 3.8 Explaining the equilibrium reaction in the relationship between reactants and reaction products, KD 4.8 Presenting the results of data processing to determine the value of the equilibrium constant for a reaction, and KD 3.9 Analyzing the factors that influence the shift in the direction of the equilibrium and its application in industry.

3) Study of Literature **:** The literature study used in this research is (1) the components of teaching materials developed are referred to from the book "Development of Media and Learning Resources Theory and Procedures" by Cahyadi, (2019)[16]; (2) the content or content of the learning media application referred to from high school and college chemistry books; (3) the guided inquiry model referred to from the book "Innovation of Learning Models" by Nurdyansyah and Fahyuni (2016) [17], the international article "Designing Process-Oriented Guided-Inquiry Activities" by Hanson (2005)[7], as well as several relevant studies; (4) Plomp's development model is referenced from Plomp (2013) [14].

4) Conceptual Framework Development **:** In this stage, the product developed is designed based on needs and context analysis as well as literature study. The conceptual framework refers to all the ideas that underlie product development[14].

B. Prototyping Phase

1) Prototype I **:** The results of the design and realization of the preliminary research stage are prototype I. The results of a prototype I am android-based learning media application products for chemical equilibrium materials designed using Kodular. Kodular is a website, where there are tools for designing android applications using drag and drop programming concepts.

The designed learning application consists of several components including (1) Cover, containing the application title, application target, supporting image, start button, application developer name, and the name of the application developer supervisor; (2) Log in, consisting of a textbox containing the name, class, and school that must be filled in by students as users, then if each textbox has been filled in, students can press the log in button to enter the main menu display of the application; (3) Home (application main menu); (4) Developer profile; (5) Student absences; (6) Instructions for use (for students and teachers); (7) Competencies (KI, KD, IPK, learning objectives, concept maps); (8) Activity sheets, compiled based on the syntax of guided inquiry; (9) Evaluation, containing questions based on the IPK on the application; and (10) References.

2) Prototype II **:** The results of the prototype were then evaluated by self-evaluation (self-evaluation). If there is a revision in the self-evaluation, a revision/improvement will be made. Based on the results obtained from the self-evaluation, it was found that the application components were complete and prototype II was obtained.

3)Prototype III **:** After obtaining the evaluation results on prototype II, the next step is to carry out a formative evaluation in the form of an expert review (expert assessment) and a one-to-one evaluation (one-on-one trial) to obtain the validity of the developed product.

i) Expert Review **:** This stage is carried out by five material expert validators and three media expert validators. The validity test carried out consisted of content validity, construct validity, and media expert validity. The validity questionnaire was used as an instrument to investigate the validity test. The content validity, construct validity, and media expert validity instruments were arranged based on a Likert scale.

For the validity that is carried out by material experts, namely content validity and construct validity. Based on the results of the analysis of content validity data on the developed product, the average Aiken's V value for content validity is 0.87 with a valid category. Based on the value of the validity of the content obtained, it reveals that the application product developed is by 2013 revised 2018 curriculum which consists of KD, IPK, and learning objectives as well as the suitability of the application with the characteristics of the chemical equilibrium material. Teaching material can be said to be feasible to use in terms of content components if the material presented is by KI, KD, IPK, and the learning objectives achieved by students [18].

The next validity test is the construct validity test. Construct validity includes several components including; construct/presentation component, linguistic component, and graphic component. The indicators assessed on the validity of the construct

components are the clarity of learning objectives and achievement, the making of systematic applications according to the components of the preparation of learning media, the systematic preparation of applications based on the stages of guided inquiry syntax, and the ease of use of applications in learning. The results of the data analysis of the construct components of the developed product are valid with the average Aiken's V value of 0.89 with a valid category.

The results of the assessment on the linguistic component were obtained with a high validity category, namely V of 0.94. The indicators assessed on the validity of the linguistic component are the clarity of information in the application, the suitability of writing rules with good and correct Indonesian language rules, and the use of effective and efficient language. Good teaching materials are teaching materials that can explain something and students understand the use of the language used depending on their age and level of knowledge[19].

Next is the result of the assessment on the graphic component, the value of V is 0.95 with a valid category. Generally, the validity of the graphic component concerns the design of the application. According to Gagnon and Colley, design means the existence of a whole, framework or outline, structure, and systematics of activities as well as meaningful depiction[20]. Students will be interested in studying teaching materials if the teaching materials are arranged systematically [16].

The results of Aiken's V assessment of the graphic components obtained indicate that the learning application developed has used the right size and type of letters, the legibility of writing on the content, videos, and images in the application is legible, the layout of the content arrangement in the application is legible. the application is correct, the video and image quality is good, the background display in the application does not interfere with writing, and the design and color of the application content are attractive.

Based on the results of processing Aiken's V index data obtained from the validity of material experts, namely content validity and construct validity, the average value of V is 0.91 with a high level of validity category. The results of data analysis from the validity of material experts can be seen in Table 1.

TABLE I
RESULTS OF MATERIAL EXPERT VALIDITY DATA ANALYSIS

No.	Rated Aspect	V	Validity
1.	Content Component Aspect	0,87	Valid
2.	Component Aspect Of Construct	0,89	Valid
3.	Aspects Of The Linguistic Component	0,94	Valid
4.	Aspects Of Graphics Component	0,95	Valid
***V* Material Expert Validity**		**0,91**	**Valid**

Furthermore, the validity test was carried out by media experts. The validity test of media experts consists of several components, namely; the programming component and the utilization component. The results of the assessment of the validity of the programming part of the media expert obtained were 0.96 with a valid category. This shows that the application product is easy to use, the instructions for using the application are easy to understand, the efficiency of the media presented is efficient, the application file size is not too large, and the composition of text, images, and videos in the application is balanced.

The results of the expert assessment of the validity of the utilization component media obtained that Aiken's V value was 0.95 with a high validity category. This means that the illustrations presented in the application can clarify the understanding of the material by students, and the application products developed are interactive. Based on the results of the evaluation of the validity of the programming and utilization component media experts, the average Aiken's V index value was 0.95 with a high level of validity category. The

results of the media expert validity data analysis can be seen in Table 2.

TABLE III
RESULTS OF MEDIA EXPERT VALIDITY DATA ANALYSIS

No.	Rated Aspect	V	Validity
1.	Programming Aspect	0,96	Valid
2.	Utilization Aspect	0,95	Valid
***V* Media Expert Validity**		**0,95**	**Valid**

ii) One-to-One Evaluation **:** This one-to-one evaluation test was carried out by interviewing three students with high, medium, and low abilities. The results of this one-to-tone evaluation formative evaluation resulted in prototype III. Based on the analysis of the results of interviews conducted, it was found that the resulting product was attractive in terms of display design, color, images, and videos. The use of font type and font size is clear and legible, video and image display can be seen clearly. The use of writing on the content, videos, images in the application is legible and clear, as well as the delivery of the concept of each material in this learning application using easy-to-understand language. Instructions for use in the learning application are easy for students to understand, and the learning stages presented in the learning application are structured and easy for students to understand so that it guides students in finding the concept of chemical equilibrium.

IV. CONCLUSION

This study concludes that the android-based learning media application on the chemical equilibrium material developed is valid.

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