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DEVELOPMENT OF ANDROID-BASED LEARNING MEDIA APPLICATIONS ON MOLE CONCEPT TOPICS FOR HIGH SCHOOL STUDENTS

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Abstract: This study aims to develop a product in the form of an Android-based learning media application based on the mole concept material for class X SMA/MA that is valid and practical. The study uses the Plomp development research model, which consists of three steps: preliminary research, prototyping phase, and assessment phase. This research is limited to the prototyping phase for the practicality stage of the small group evaluation. Three chemistry lecturers carried out the product validity test at the Faculty of Mathematics and Natural Sciences, Padang State University, two Al-istiqamah High School chemistry teachers as material experts, and two lecturers of informatics engineering at Padang State University as media experts. Fifteen students and two chemistry teachers carried out the practicality test. The validity data analysis technique uses Aiken's V index. The validity test results showed that the Android-based learning media application developed belongs to the valid category with an average V value of 0.86 for material experts and an average V value of 0.93 for media experts. The practicality data analysis technique uses a percentage formula. The results of the practicality test in small groups are classified as "very practical," with a practicality percentage value of 90% for students' practicality and a practicality percentage value of 92% for teachers' practicality. Based on the results of the validation and practicality tests, it was found that applying android-based learning media to the mole concept material was valid and practical.

Keywords: *Application, Learning Media, Android, Mole Concept*

INTRODUCTION

The rapid development of information and communication technology has a lot of influence in the field of education which requires the use of technology as an innovation in education. One of the uses of technology in education is using smartphones in the learning process. Based on the questionnaire distributed to students at high schools SMA Al-Istiqamah, SMAN 1 Pasaman, and SMAN 2 Pasaman, it was found that students have android-based smartphones. Still, the use of android by students for learning is only for 1-2 hours per day. Even then, the use is only limited to searching and doing school assignments. It indicates that the use of android by students in the learning process has not been maximized.

The questionnaire results show that in the learning outcomes of students, especially on the mole concept material, only 50% meet the minimum completeness criteria (KKM). It is also supported by the results of a questionnaire showing that 74% of students have difficulty understanding the concept of mole material. Mole concept material is material studied in class X SMA / MA. Mole concept material is abstract material with many concepts, laws, and formulas that must be mastered by students [1]. The mole concept examines the number of particles. A mole is used as a quantity that connects units of mass of substances, number of particles, and volume of gases involved in chemical reactions. The mole concept will make chemical calculations easier to apply [2]. In addition, the media used by the teacher at the school in the process of learning chemistry mole concept material is difficult to understand, has not been able to make students learn independently, learning media that is not interesting and does not make students active in the learning process.

Learning media that are expected or preferred by students, that is, they have learning videos, can be used for practice questions (concept consolidation), can be used anywhere and anytime, either online or offline, are easily obtained and carried by students and can present submicroscopic, macroscopic and symbolic systems. The learning media can be designed by utilizing information and communication technology development. Learning media developed based on technology and information can make learning more interesting and have a positive impact in the form of increased learning motivation and student learning outcomes [3].

The expected media can be packaged as android-based learning media applications that can increase motivation and make learning more interesting [4]. The learning media also has unique characteristics, which can be used anywhere and anytime and is also supported by interesting visualizations [5]. However, based on the questionnaire results, android-based learning media applications for mole concept material are not yet available. Teachers have never used android-based learning media applications in their lessons.

Some literature states that android-based learning media applications have been developed on electrolyte and non-electrolyte solutions, thermochemistry, basic laws of chemistry, atomic structure, periodic system, and chemical equilibrium [6,7,8,9,10,11]. It is concluded that the android-based learning media application is valid for learning. The development of android-based learning media was also carried out by Muzayyanna Dasilva et al. (2019) stated that the media was very interesting and not boring, so it helped students to stay focused [12]. In addition, android-based learning media is effective in improving student learning outcomes and allowing students to increase learning motivation [13]. Learning media can also be used independently both at and outside school because it is easy to obtain [14].

Based on these data and problems, this study aims to develop an android-based learning media application titled "Development of Android-Based Learning Media Applications on Mole Concept Material for Class X SMA / MA.

RESEARCH METHODS

The type of research used is educational design research with the Plomp development model. The Plomp development model consists of 3 stages, namely (1) preliminary research, (2) prototyping phase, and (3) assessment phase [15]. The subjects of this research were chemistry lecturers FMIPA UNP, Informatics Lecturers FT UNP, Al-istiqamah high school chemistry teachers, and Al-istiqamah high school students. The research object used is an android-based learning media application on the material of the mole concept. This research was conducted until the practicality stage in forming prototype IV stage small group evaluation. Product development of android-based learning media applications is developed based on the 2013 curriculum using a scientific approach in which there are activities of observing, questioning, reasoning (collecting), associating, and communicating, which aims to develop students' thinking skills and curiosity so that students are motivated to observe the surrounding phenomena [16]. This study aims to develop a product in the form of an android-based learning media application on the concept of mole material for class X SMA / MA that has been valid and practical.

Preliminary research was carried out by conducting a need and context analysis, literature review, and conceptual development. Need analysis was conducted by distributing questionnaires to teachers and students in several schools, namely at SMA Al-Istiqamah, SMAN 1 Pasaman, and SMAN 2 Pasaman, which was carried out to see the description of conditions in the field to find obstacles/problems faced by educators and students. The context analysis stage was carried out by identifying the abilities that must be mastered by students based on the 2013 curriculum. A review of the literature is done by searching for references related to research and development of a conceptual refers to all the ideas that underlie the development of products that are carried out based on needs analysis, context analysis, and literature studies by drafting the research process, a series of studies that will be carried out through identifying the essential concepts in the material to be discussed. The material that has been determined is adjusted to the skills that students must achieve and connect one concept with other appropriate concepts so that it becomes a systematic concept.

The prototyping stage involves a formative evaluation. In the resulting prototype, I carried out a formative evaluation in the form of self-evaluation. After being revised, prototype II was produced. Prototype II was then formative evaluated by an expert review and one-to-one evaluation. An expert review was conducted on material and media experts, and a one-to-one evaluation was conducted on students with different ability levels. Prototype II, which has been revised, then produced prototype III. Prototype III was evaluated by formative evaluation of small group evaluation, to 15 students who have high, medium, and low abilities and two chemistry teachers of SMA Al-istiqamah. The instrument used was a practicality questionnaire. The aspects assessed are aspects of convenience, aspects of efficient learning time, and aspects of benefits. Prototype III, which has been revised, then produced prototype IV. Tessmer's formative evaluation stages can be seen in Figure 1 [15].

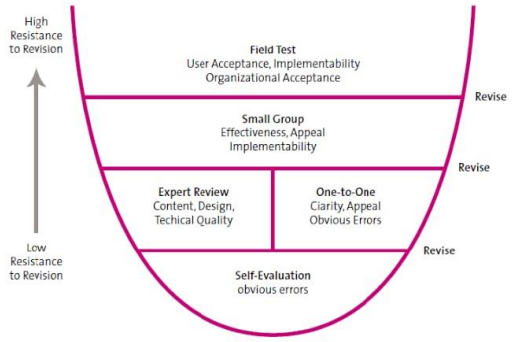

Figure 1. Tessmer evaluation stages

The data obtained were then processed to determine the validity and practicality of the media. The validity analysis technique uses Aiken's V formula [17]. Aiken's V formula is as follows:

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

V = validator agreement index regarding item validity, s = the score assigned by the validator minus the lowest score in the category, r = the

validators' preferred category score, lo = the lowest score in the scoring category, n = a number of validators and c = the number of categories that can be selected by the validator. The results obtained were then interpreted in Aiken's V index [16]; information can be seen in Figure 2.

No. of Items (m) or Raters (n)	Number of Rating Categories (c) 2		3		4		5		6		7	
	V	p	V	p	V	p	V	p	V	p	V	p
2							1.00	.040	1.00	.028	1.00	.020
3							1.00	.008	1.00	.005	1.00	.003
3			1.00	.037	1.00	.016	.92	.032	.87	.046	.89	.029
4					1.00	.004	.94	.008	.95	.004	.92	.006
4			1.00	.012	.92	.020	.88	.024	.85	.027	.83	.029
5			1.00	.004	.93	.006	.90	.007	.88	.007	.87	.007
5	1.00	.031	.90	.025	.87	.021	.80	.040	.80	.032	.77	.047
6			.92	.010	.89	.007	.88	.005	.83	.010	.83	.008
6	1.00	.016	.83	.038	.78	.050	.79	.029	.77	.036	.75	.041
7			.93	.004	.86	.007	.82	.010	.83	.006	.81	.008
7	1.00	.008	.86	.016	.76	.045	.75	.041	.74	.038	.74	.036
8	1.00	.004	.88	.007	.83	.007	.81	.008	.80	.007	.79	.007
8	.88	.035	.81	.024	.75	.040	.75	.030	.72	.039	.71	.047
9	1.00	.002	.89	.003	.81	.007	.81	.006	.78	.009	.78	.007
9	.89	.020	.78	.032	.74	.036	.72	.038	.71	.039	.70	.040
10	1.00	.001	.85	.005	.80	.007	.78	.008	.76	.009	.75	.010
10	.90	.001	.75	.040	.73	.032	.70	.047	.70	.039	.68	.048
11	.91	.006	.82	.007	.79	.007	.77	.006	.75	.010	.74	.009
11	.82	.033	.73	.048	.73	.029	.70	.035	.69	.038	.68	.041
12	.92	.003	.79	.010	.78	.006	.75	.009	.73	.010	.74	.008
12	.83	.019	.75	.025	.69	.046	.69	.041	.68	.038	.67	.049
13	.92	.002	.81	.005	.77	.006	.75	.006	.74	.007	.72	.010
13	.77	.046	.73	.030	.69	.041	.67	.048	.68	.037	.67	.041
14	.86	.006	.79	.006	.76	.005	.73	.008	.73	.007	.71	.009
14	.79	.029	.71	.035	.69	.036	.68	.036	.66	.050	.66	.047
15	.87	.004	.77	.008	.73	.010	.73	.006	.72	.007	.71	.008
15	.80	.018	.70	.040	.69	.032	.67	.041	.65	.048	.66	.041
16	.88	.002	.75	.010	.73	.009	.72	.008	.71	.007	.70	.010
16	.75	.038	.69	.046	.67	.047	.66	.046	.65	.046	.65	.046
17	.82	.006	.76	.005	.73	.008	.71	.010	.71	.007	.70	.009
17	.76	.025	.71	.026	.67	.041	.66	.036	.65	.044	.65	.039
18	.83	.004	.75	.006	.72	.007	.71	.007	.70	.007	.69	.010
18	.72	.048	.69	.030	.67	.036	.65	.040	.64	.042	.64	.044
19	.79	.010	.74	.008	.72	.006	.70	.009	.70	.007	.68	.009
19	.74	.032	.68	.033	.65	.050	.64	.044	.64	.040	.63	.048
20	.80	.006	.72	.009	.70	.010	.69	.010	.68	.010	.68	.008
20	.75	.021	.68	.037	.65	.044	.64	.048	.64	.038	.63	.041
21	.81	.004	.74	.005	.70	.010	.69	.008	.68	.010	.68	.009
21	.71	.039	.67	.041	.65	.039	.64	.038	.63	.048	.63	.045
22	.77	.008	.73	.006	.70	.008	.68	.009	.67	.010	.67	.008
22	.73	.026	.66	.044	.65	.035	.64	.041	.63	.046	.62	.049
23	.78	.005	.72	.007	.70	.007	.68	.007	.67	.010	.67	.009
23	.70	.047	.65	.048	.64	.046	.63	.045	.63	.044	.62	.043
24	.79	.003	.71	.008	.69	.006	.68	.008	.67	.010	.66	.010
24	.71	.032	.67	.030	.64	.041	.64	.035	.62	.041	.62	.046
25	.76	.007	.70	.009	.68	.010	.67	.009	.66	.009	.66	.009
25	.72	.022	.66	.033	.64	.037	.63	.038	.62	.039	.61	.049

Figure 2. Criteria for the validity assessment of Aiken's V

The technique of analyzing practicality uses a percentage formula [17], with the formula:

$$\%P = \frac{\text{skor item yang diperoleh}}{\text{skor maksimal}} \text{x} 100\%$$

Practicality scores can be interpreted according to the criteria in Table 1.

Table 1. Practicality criteria

No	Category	Evaluation (%)
1	Very practical	81-100
2	Practical	61-80
3	Less practical	41-60
4	Impractical	21-40
5	Very impractical	0-20

RESULT AND DISCUSSION

Preliminary research

The results of data analysis obtained from the questionnaire are: 1) printed teaching materials dominate the types of teaching materials used in schools; 2) the teaching materials used do not make students active in learning, have not been able to make students learn independently, and lack of flexibility in the teaching materials used; 3) students and teachers experience obstacles in the learning process, especially the concept of mole material; 4) lack of student response to the teaching materials used; 5) constraints on teachers in making learning media that are following the development of information technology and communication today are due to inadequate facilities, lack of ability to make media, and long time needed in making

learning media. The constraints on teachers in making learning media that are following the development of information technology and communication today are due to inadequate facilities, lack of ability to make media, and require a long time to make learning media. The context analysis stage analyzes the abilities that must be mastered by students based on the 2013 curriculum. This analysis begins by examining the basic competencies to obtain indicators of competency achievement (IPK) which can be derived into learning objectives from the mole concept material. Based on the information obtained, an android-based learning media was developed on the mole concept material based on the 2013 curriculum.

Prototyping stage

Prototype 1 is produced in the form of an android-based learning media application product on the material of the mole concept, which consists of several components, including a cover and home (main menu of the application). This main menu consists of a list of attendees, competencies (core competencies, basic competencies, GPA, and learning objectives), material, evaluation, instructions for use (teachers and students), developer profiles, references, and feedback.

The cover of the android media application contains the application's identity, which consists of the application title. The home view of the application consists of several icons that can be accessed, such as an attendance list, competence, instructions, material, evaluation, profile, reference, and feedback. The home view has an attendance list feature that aims to allow students to report their attendance which is connected to a google form that the teacher can access. The competency feature aims to present core competencies (KI), basic competencies (KD), competency achievement indicators (IPK), and learning objectives related to the concept of mole material. The instructions feature consists of instructions for teachers and students. Furthermore, the material feature uses the syntax of the scientific approach.

The home view also contains an evaluation feature containing questions and discussions related to the mole concept material presented using a quiz platform directly connected to this application. The quiz platform is a web tool for creating interactive quiz games used in classroom learning [20]. In this quiz, students will be able to see the score ranking based on the accuracy and speed in answering questions. It aims to increase the motivation and enthusiasm of learners to answer questions. Learners can see the discussion by using the code given by the teacher after doing the evaluation. The profile feature contains the identity of the application developer and supervisor. The reference feature contains the sources used in compiling the application. Application users can also download several references regarding the mole concept material. The last feedback feature is intended so that users can provide reviews and input regarding learning media applications so that they are better for the future, which will be sent via a google form.

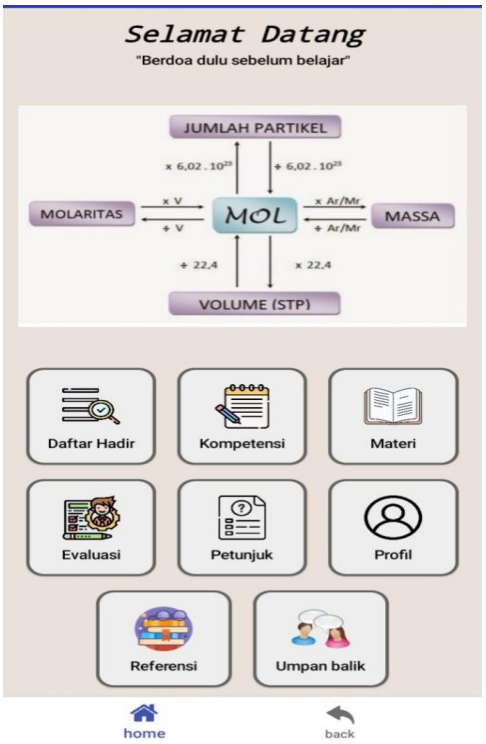

Figure 3. Home View

The results of prototype 1 were then evaluated by self-evaluation, which was presented in the form of a questionnaire sheet with a checklist system. Based on the results obtained from the self-evaluation, it is found that the application components are complete.

After obtaining the results of prototype 2, the next step is to conduct a formative evaluation through an expert review and one-to-one evaluation. The validity assessment was carried out by experts based on material and media aspects. The material validity value obtained an average of 0.87 with a valid category. This information can be seen in Table 2.

Table 2. Result of validity by material experts

NO	Assessed aspect	V	Validity
1	Content Component	0,89	Valid
2	Construct Component	0,86	Valid
3	Linguistic Component	0,86	Valid
4	Grammatical Component	0,87	Valid
Average		0,87	Valid

Based on the validity test conducted on the content component, it shows that the android application developed is following the core competencies (KI) and basic competencies (KD), such as the 2013 curriculum syllabus, the components in the application are also in accordance with the indicators of learning objectives that must be achieved. Content eligibility tests must follow the ability to be measured [17]. The construct component (presentation) of the android-based learning media application shows that the application developed is systematic, following the syntax of the scientific approach. The scientific approach involves observing, questioning, collecting, associating, and communicating [21]. Furthermore, the language component is related to the use of language and readability of writing on the content, videos, and images contained in the application. The linguistic aspects should follow Indonesian rules, use communicative language, not use the local language, and answer choices do not repeat the same word/group [17]. Then the graphical component shows that the learning media displayed must be the selection of the size and type of font that can be read easily by students, and the images used can be observed clearly. Learning media with an aesthetic appearance, harmonious and appropriate size, with an attractive color combination can attract the attention and interest of students to use it [22].

The media validity value obtained an average of 0.93 with a valid category. This information can be seen in Table 3. The media efficiency component shows that the developed learning media application is easy to use both in terms of installation, selecting menus, ease of entering and exiting the application, and balanced use of background, text, images, and videos. In making learning media, one must pay attention to text writing, animation, graphics, audio, and video [23]. Learning media should also refer to four main categories: display format, navigation, ease of use, and interaction [24]. The button function component shows that the learning media application uses navigation and symbols/icons that are easy to understand, the right button reaction, easy-to-understand application usage instructions, and complete menu facilities. Learning media must contain navigation that is made as easy and clear as possible so that users have no difficulty accessing the program, and navigation must be consistent [23]. And for the physical quality component shows that the application developed has good program strength/durability, manageable application size capacity, and ease of duplication of learning media applications. In making media, it must be considered that the product's or media's durability is needed. The media should never fail or error [23].

Table 3. Result of validity by media experts

NO	Assessed aspect	V	Validity
1	Media Efficiency	0,91	Valid
2	Button function	0,925	Valid
3	Physical quality	0,96	Valid
Average		0,93	Valid

Based on the analysis of the results of the one-to-one evaluation interviews that have been conducted, the content component obtained that the resulting product is attractive because the home display already represents the contents of the application, the instructions for using the application are easy to understand, the concepts conveyed in the application are easy to understand. In the construct component, it is found that students easily understand the learning stages because they have been explained in detail. Students are also helped in exploring initial knowledge at the observation stage, and students have no difficulty in formulating problems at the questioning stage. Students are helped by illustrations provided in the form of videos and images to answer questions on practice questions contained in the application so that students easily make conclusions based on learning objectives in the application based on the syntax of the scientific approach. The scientific approach is a learning process designed so that students actively master concepts, laws, or principles [25]. In the linguistic component, it is found that the writing on the model is easy to read and also uses language that is easy to understand. In the graphical component, it is found that the font and font size used can also be read, images and videos can be observed as well as the design and colors used in the learning media application are attractive. ICT-assisted learning media can organize learning interactively, inspiring, fun, challenging, and motivating students [3].

The revised Prototype III resulted in a valid Prototype IV. Prototype III, which is already valid, a formative evaluation is carried out, namely a small group evaluation in the form of a practicality test. The results of the practicality value by the teacher obtained an average value of 92% with a very practical category. This information can be seen in Table 4.

Table 4. Results practicality by teacher

NO	Assessed aspect	Value P	Practicality Category
1	Simplicity of use	89%	Very practical
2	Time efficiency	95%	Very practical
3	Benefits	91%	Very practical
Average		92%	Very practical

The results of the practicality value by students obtained an average value of 90% with a very practical category. It can be seen in Table 5.

Table 5. Practical results by students

NO	Assessed aspect	Value P	Practicality Category
1	Simplicity of use	91%	Very practical
2	Time efficiency	92%	Very practical
3	Benefits	86%	Very practical
Average		90%	Very practical

The simplicity of use component shows that the learning media application is easy to use, and the instructions for using the learning media application are easy to understand. The language used is also easy for students to understand. The learning steps in the learning media application are easy to understand, and the questions given are clear and easy to understand. Learning media applications are easy to carry and access because they can be stored in smartphones that can be used repeatedly. It follows the characteristics of android-based learning media that provide opportunities for students to learn independently based on the practicality of media that can be used repeatedly, anytime, and anywhere [26]. The time efficiency component shows that by using learning media applications, students can learn according to their learning speed and make learning time more efficient. Learning media can increase learning motivation and cognitive learning outcomes because they are developed according to the student's level of thinking [27-29]. Finally, the benefit component shows that the android-based learning media application is easy to understand, so it helps students to learn actively and independently.

CONCLUSION

Based on the research conducted, the android-based learning media application on the mole concept material has been developed using the Plomp development model. The learning media application developed has been validated with an average value of 0.86 for the material. Media validity obtained an average value of 0.93 with a valid category and has been practiced with an average value of 92% by teachers and students with an average value of 90%. Based on the results of the validation and practicality tests, it is found that the android-based learning media application on the mole concept material is valid and practical. Teachers and students are expected to be able to use android-based learning media applications on mole concept material for class X SMA / MA as an alternative teaching material in the learning process to make it easier to find and understand concepts in mole concept material.

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