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Development of the Android-Based Chemical Snakes and Ladders Game as a Learning Media for Colloidal Materials for Class XI SMA/MA

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Abstract — This study aims to develop an android-based chemical snake and ladder game as a learning medium for colloid material for class XI SMA/MA and determine its validity and practicality level. This type of research is educational design research with the Plomp development model. The Plomp development model has three stages , namely (1) preliminary research, (2) prototype stage, (3) assessment phase . The validity test using a research instrument in the form of a questionnaire was conducted on three chemistry lecturers at FMIPA UNP as material expert validators, three FT UNP lecturers as media expert validators, and two chemistry teachers at SMAN 8 Padang as material expert validators. The practicality test used an instrument in the form of a questionnaire with a sample of two chemistry teachers and six grade XII students of SMAN 8 Padang. The analysis of the results of the validity test used the Aiken's V formula index and the analysis of the practicality test used the percentage formula. The conclusion of this research is the development of an android-based chemical snake and ladder game as a learning medium for colloid material for class XI SMA/MA which was developed to be valid and very practical.

Keywords—Chemical Snakes and Ladders Game based on Android, Colloid, Plomp Model.

I. INTRODUCTION

Colloid is one of the chemistry materials in the 2013 curriculum which is studied in class XI SMA/MA in the even semester . Colloidal material contains factual, conceptual, and procedural knowledge. In the learning process of koloid material , it requires reading, understanding, discussion, and a lot of exercise. According to (Smaldino, Sharon E, 2012) the consolidation of students' concepts on the material being studied regarding facts, concepts, and procedures can be done by providing exercises.

Based on the results of the questionnaire given to each of the two chemistry teachers at SMAN 8 Padang, SMAN 7 Padang, SMAN 13 Padang, it was found that the teacher always gave practice to the students at the end of the material. The practice questions given by the teacher come from printed books, LKPD, modules, and questions made by the teacher themselves. The work on the practice questions by students is individual and the form of the exercises given is still not varied, so students do not participate actively in doing the exercises. Meanwhile, according to (Mulyasa, 2004) the activeness of students in doing the exercises is very important because it is one of the determinants of the success of learning.

The results of the questionnaire given to 50 students were obtained 70% of students are still less active in doing the exercises. Therefore, a strategy is needed to increase student activity when doing exercises. One strategy that can be done is to use the game as a variation practice. Game-based learning media will make students more active while learning (Sadiman, 2012) .

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Games have the ability to actively involve students in the learning process (Sadiman, 2012) . This is in accordance with the opinion (Indriana, 2011) that game media can be developed based on learning fun. Exercise activities using games highlight the interaction between students in their study groups. This is in accordance with the expression (Maryati, 2015) that one of the characteristics of students is happy to play and in groups. Learning media in the form of games that can be used as an alternative exercise is the game of chemical snakes and ladders.

Research results (Sufyanto et al., 2014) revealed that the game of chemical snakes and ladders as a medium of learning on the material of the periodic system of elements is effective on student learning outcomes in the high category , (Anggraeni et al., 2018) revealed that the game of chemical snakes and ladders on the material of atomic structure and the periodic table of elements has a positive influence on students' motivation and learning outcomes , and research conducted by (Febriani & Iswendi, 2019) stated that the game of chemical snakes and ladders on household chemistry was effective on student learning outcomes in the high category.

The game of chemical snakes and ladders that has existed before is still available in conventional form. Along with the times, this has not met the demands of the 2013 curriculum which expects teachers and students to be skilled in using learning media and technology (Kemendikbud, 2017) . Then the chemical snake and ladder game can be integrated in digital form via an android *smartphone* . With the availability of the android-based chemical snake and ladder game, it is hoped that students can make maximum use of technological facilities in learning to obtain better results.

With the android-based chemical snake and ladder game, it will certainly make students interested in learning, this is evidenced by students already using android *smartphones* as learning resources such as searching for information from the internet. (Rogozin, 2012) , but students have not used android *smartphones* for variations of exercises in the form of games. With this android-based chemical snake and ladder game, it can be used as a variation of practice in the learning process .

Study (Kartini & Putra, 2020) states that the use of android-based learning media on solubility materials and solubility results can affect student learning outcomes by 60.16% , (Prasetyo , 2015) reveals the use of android-based chemistry learning media can have a significant effect on increasing high school students' learning motivation. In addition, according to (Rahmawati & Partana , 2019) states that students' confidence in learning is higher by using android-based learning media.

Based on this description , an alternative was developed to increase student activity in doing exercises to strengthen the concept of the material learned by using the android-based chemical snake and ladder game as a learning medium and to determine the validity and level of practicality. Then a research was conducted with the title "Development of an Android-Based Chemical Snakes and Ladders Game as a Learning Media in Colloidal Materials for Class XI SMA/MA."

II. RESEARCH METHODS

This type of research is *Educational Design Research* with the development model of the Plomp model. The Plomp model has three stages, namely (1) *preliminary research,* (2) *prototyping stage,* (3) *assessment phase.* This study was conducted to determine the validity and practicality of the android-based chemical snake and ladder game with a questionnaire assessment instrument.

The subjects of this study were three chemistry lecturers at FMIPA UNP and two chemistry teachers at SMAN 8 Padang as material expert validators, three informatics lecturers at FT UNP as media expert validators, and two chemistry teachers at SMAN 8 Padang and six students at SMAN 8 Padang as media experts. practitioner. The object of this research is an android-based chemical snake and ladder game as a learning medium for colloid material for class XI SMA/MA. The research instrument used is a validity questionnaire and a practicality questionnaire using data analysis techniques, namely the Aiken'V formula to determine validity and percentages for practicality.

III. RESULTS AND DISCUSSION

Preliminary research

1. Needs analysis

Filling out the questionnaire carried out by the teacher and students, it was found that the teacher always gave training to the students at the end of the material. The work carried out by students is still individual and the exercises provided have not varied

so that students do not participate actively in doing the exercises. To increase the activeness of students in doing the exercises, we need a learning media that is in accordance with the characteristics of students. One of the learning media that can be used is media in the form of games. According to (Nopianti, 2019) game learning media has the ability to involve students in the learning process actively. One of the games that can be used is the android-based chemical snake and ladder game.

2. Context analysis

The context analysis of the 2013 curriculum syllabus that has been carried out is in the form of an analysis of Basic Competence (BC) which is translated into Indicators of Competence Achievement (IAC). The decline in BC to IAC can be seen in Table 1.

Table 1. Basic Competencies and Indicators of Competence Achievement

Basic competencies	Indicators of Competence Achievement
3.14 Classify various types of colloidal systems, explain the properties of colloids and their applications in everyday life	**Supporting IAC** 3.14.1 Identify the characteristics of solutions, colloids, and suspensions 3.14.2 Identifying lyophobic colloids and lyophilic colloids **Key IAC** 3.14.3 Classify colloidal systems based on the dispersed phase and dispersion medium 3.14.4 Describe the properties of colloids (optic, kinetic, adsorption, electrical, and coagulation) 3.14.5 Explain how to make colloids 3.14.6 Explain the application of colloids in daily life

The purpose of learning is through the game of chemical snakes and ladders based on android as an alternative learning medium in providing exercises to strengthen the concept, it is hoped that students can do exercises on the game actively, and have fun, answer questions about colloid theory, classify colloid systems based on the dispersed phase and dispersion medium, explain the properties of colloids, make colloids and can apply them to everyday life.

3. Review of Literature

The results of a review of literature studies that have been carried out are obtained according to (Hamalik, 2008) that the provision of training serves to strengthen students' concepts of the material that has been studied. Android-based learning media is suitable for use in learning in terms of material aspects, media aspects, and student test results with good criteria and there is an increase in student motivation and cognitive achievement (Lubis & Ikhsan, 2015) . The chemical snake and ladder game on colloidal material is effective in improving student learning outcomes (Rahmadani & Iswendi, 2019) . Furthermore (Lukman & Ulfa, 2020) stated that the Android-based learning media developed were feasible to be applied and had good quality, judged from the material aspect as well as from the media aspect and the developed learning media could also increase students' cognitive abilities after being applied to learning.

4. Conceptual framework development

The results of the development of the conceptual framework are made in the form of a chart containing problems in the learning process until a solution is given. Problems obtained from needs and context analysis as well as a review of literature are

problems in the learning process with students being less active in learning so that learning media in the form of android-based chemical snakes and ladders is needed as a variation of the exercise and determines its validity and practicality.

Prototyping stage

1. Prototype I

At this stage it is a design or design that produces a product in the form of a chemical snake and ladder game based on Android on colloid material for class XI SMA / MA. This game is displayed in the form of an application which consists of a cover, game rules, game board, and winning page. This game is designed using the *Unity Game Engine application designer method.*

a. Cover

The display on the cover contains the title of the game material, player identity, *online play menu, offline* play menu , game rules, game board, *add friend menu, and quit* button . The cover of the chemical snake and ladder game can be seen in Figure 1.

Figure 1. Cover

b. Rule of the game

The rules of the game on the android-based chemical snake and ladder game consist of instructions for using the game. Rules are given so that teachers and students know the use of the android-based chemical snake and ladder game in learning. The rules of the android-based chemical snake and ladder game can be seen in Figure 2.

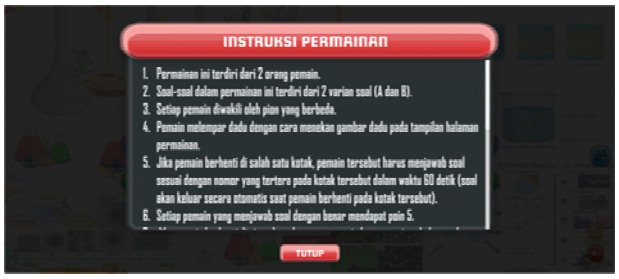

Figure 2. Rule of the game

c. Game board

The chemical snake and ladder board game based on Android consists of 49 boxes with the first box being the *start* to start the game, and the last box being the *finish* to end the game, while the other 47 boxes are numbered. In the android-based chemical snake and ladder game box, factual and conceptual knowledge is provided which serves to assist students in answering the questions contained in the android-based chemical snake and ladder game. On the right side of the android-based chemical snake and ladder game board there is a scoreboard, game rules, sound, exid and playing time. The android-based chemical snake and ladder board game can be seen in Figure 3.

Figure 3. Game Board

d. Winner page

The winning page is one component of the android-based chemical snake and ladder game. This winning page will display the results of the score obtained by the player. The player who gets the highest score will be declared the winner. The winning page for the android-based chemical snake and ladder game can be seen in Figure 4.

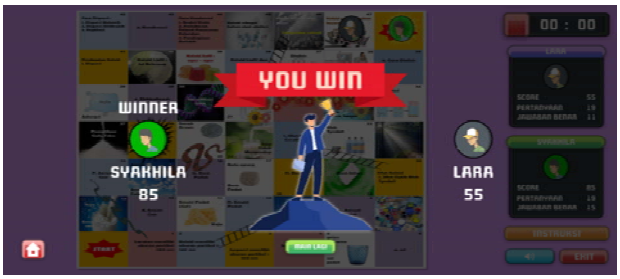

Figure 4. Winner Page

2. Prototype II

In prototype II, *self-evaluation was carried out* to improve the results of prototype I. Self-assessment was carried out using a *checklist system* in the questionnaire.

3. Prototype III

At the prototype stage III, a formative evaluation stage was carried out in the form of one-on-one trials and expert assessments to obtain the validity value of the developed android-based chemical snake and ladder game.

a. Expert Review

At this stage the validity of the android-based chemical snake and ladder game is carried out. The android-based chemical snake and ladder game was validated by three chemistry lecturers and two teachers in the field of material experts and three lecturers of informatics in the field of media experts. Based on the results of data processing, the content and construct validity assessments are categorized as valid. The results of the content and construct validity data analysis can be seen in Table 2.

Table 2. Content and Construct Validity Results

Rated aspect	V	Category
Content Eligibility	0.88	Valid
Content Component	0.86	Valid
Language Component	0.83	Valid
Components of Serving	0.83	Valid
Graphic Component	0.87	Valid
Average V	0.85	Valid

Meanwhile, the validity component of media experts is divided into two components, namely visual communication aspects and technical aspects. Based on the results of data processing, the validity of the media expert is categorized as valid. The results of data analysis from media expert validation can be seen in Table 3.

Table 3. Media Expert Validity Results

Rated aspect	V	Category
A. Visual Communication Aspect	0.94	Valid
B. Technical Aspect	0.93	Valid
Average V	0.94	Valid

b. *One to One Evaluation*

to-one formative evaluation stage, a one-on-one trial questionnaire related to the android-based chemical snake and ladder game was given to three students of SMAN 8 Padang with different ability levels. Based on the suggestions obtained from expert assessments and one-on-one trials were revised so as to produce a valid product, this stage resulted in prototype IV.

4. Prototype IV

At this stage, the assessment stage is carried out in the form of product trials through a practicality test questionnaire. The practicality of the android-based chemical snake and ladder game was carried out with two chemistry teachers and six students. Based on the results of data processing, the practicality assessment by the teacher is categorized as very practical. The results of the teacher's practicality data analysis can be seen in Table 4.

Table 4. Practical Results by Teacher

Rated aspect	P	Category
A. Ease of Use	93%	Very Practical
B. Learning Time Efficiency	93.3%	Very Practical
C. Benefit	94.2%	Very Practical
Average P	93.5%	Very Practical

Based on the results of data processing, the practicality assessment by students is categorized as very practical. For practicality results by students can be seen in Table 5.

Table 5. Practical Results by Students

Rated aspect	P	Category
A. Ease of Use	92%	Very Practical
B. Learning Time Efficiency	92%	Very Practical
C. Benefit	94%	Very Practical
Average P	92%	Very Practical

IV. CONCLUSION

Based on the research that has been done, it can be concluded that the android-based chemical snake and ladder game on colloid material for class XI SMA/MA developed with the Plomp model is valid and very practical. For further researchers, it is hoped that they can test the effectiveness of using the android-based chemical snake and ladder game that has been developed.

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