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Collaboration of Chemistry Instructional Games and Group Investigation (Gi) Model to Improve Learning Outcome in High School Students

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Abstract. The aims of this research are to: (1) develop chemistry instructional games on reaction rate matter; and (2) reveal the collaboration of chemistry instructional games and group investigation model to improvement learning outcome in high school student. This study is research and development (R&D). The procedure of developing product was adapted from Borg & Gall that modified into three principal steps: product planning, product developing, and product evaluating. The product planning step consist of field study, literature study, and manufacturing product. Product developing was developed product using Adobe Flash Professional CS 6 program. The last, product evaluating was performed by year XI of high school students, uses experimental methods nonequivalent control-group design by control class and experiment class. The results of this research show that: (1) a software of chemistry instructional games successfully developed using Adobe Flash Professional CS 6 and can be run on Android device; and (2) the test results of students showed that the collaboration of instructional games and group investigation model able to improvement learning outcome of high school student.

INTRODUCTION

Technology and education is two important thing that inseparable. There are many advancement in technology that useful to learning proces in the classroom. One of which is use intructional games on android device. [1] revealed that instructional games are the software specifically designed to increase motivation by adding game rules or competition into learning activities. Instructional games provide a challenging and fun learning environment. Instructional games have some characteristics such as motivational, having game structures and sensorially interesting. Another research [2] stated that 95% of the students who learn by using android apps mobile feel comfortable and easy for learning access. In addition, android is the operating system which is quite popular and widely used by the public, especially students. This is shown from the data of Counter Global Stats 2015 which put android as the first-ranked operating system used in smartphone and tablet reaching 50.61% on April 2015 of the total operating systems in Indonesia. Consistent with what was stated by [3] saying that intructional chemistry game on android device can to improvement student learning and motivation outcome.

Games are selected as the developed media in this study due to the high interest of students to games. This statement is in line with the information published by PT. Lyto Datarindo Fortuna (LYTO), that the users of online games have reached 6 million people. PT. Lyto Datarindo Fortuna (LYTO) is the largest publisher of online games in Indonesia. Another source said that the number of players of online games is almost 50% of all the students who are connected to the internet. This shows that students have interest in games [1]. [1] explained that when students know that they will play games, they expect fun and entertaining activities due to the challenge of competition and the potency to win the games. This situation, in turn, can motivate students to develop their creative thinking to win the games. This is consistent with what was stated by [4] saying that learners need to develop the way of their

thinking to be a concept. This requires the process that is able guide students through the steps of different exercises to enhance creativities as a part of the cognitive process. The subject matter of chemistry selected in the developed instructional games is rate reaction.

Therefore, in this study is developed collaboration of chemistry instructional games and group investigation model on android-operating-system mobile device to improve learning outcome in high school students. The inovation in this study from the proceeding study is to use collaboration with group investigation model. This is consistent with what was stated by [5], that Through the newest advances in a mobile device by approach learning collaborative possible to design systems to improve the ability to reflect a high level in the the learning environment.

RESEARCH METHODS

This study is a research and development (R & D). The procedure of developing product was adapted from the model of Borg and Gall [6] modified into three principal steps: (1) products planning, (2) product development, and (3) product evaluation. The product planning step consist of field study, literature study, and manufacturing product. Product developing was developed product using Adobe Flash Professional CS 6 program. The last, product evaluating was performed by year XI of high school students.

Data collection in this study was conducted using assessment tools. The assessment instrument in this media consists of (1) media validation sheets (2) subject validation sheets (3) assessment sheets of peer and chemistry teachers, and (4) sheets of student assessment. The assessment instruments of this media have been validated by expert judgments. The research was done in senior high during November 2015 in Yogyakarta, Indonesia.

In the field study, conducted pretest and posttest to see if there was a significant increase in study results after learning proces using collaborarion of instructional games GI model. In the field study uses experimental methods design apparent nonequivalent control-group design which can be seen in Table 1.

Table 1. R & D Nonequivalent Control-Group Design

| No | Class | Pretest | Treatment | Posttest |
|----|------------|---|----------------------------------|--|
| 1. | Experiment | Befero using intructinal games and GI model | Students use instructional games | After using instructional games and GI model |
| 2. | Control | Before using GI model | – | After using GI model whitout instructional games |

Data analysis used to research it will be analysis multivariate (MANOVA) to hypotheses test. In this case, prerequisite test do first before hypotheses test. Prerequisite test consist of two test, normality test and homogeneity test. Normality test in this research using comparison mahalonobis value. While, homogeneity test using Box's M test.

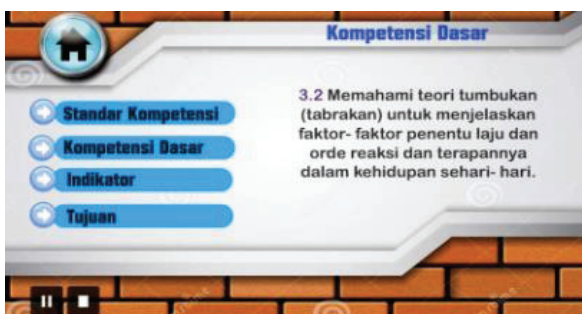
RESULTS AND DISCUSSION

Product Planning Steps

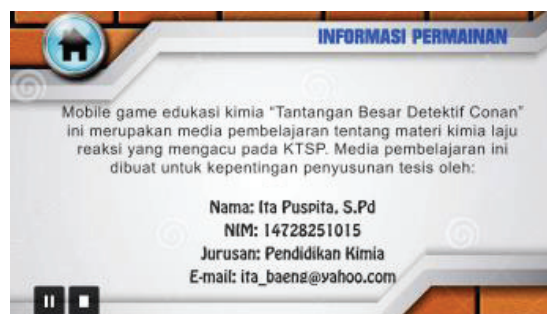
Product planning steps consist of three activities, field study, literature study, and manufacturing product. Based on the results of field study it was obtained information about learning process in the classroom and the characteristics of the material presented that need to be developed by instructional games. While, the learning process in 11th grade of MIA major of SMAN 7 Yogyakarta still led to teacher-centered model. But generally, the learning process was quite effective. The subject matter of rate reaction was selected in this case because it contains the concepts and quite abstract chemical reactions. By the product planning steps based on the result of literature study produce the current educational trends, one of which is the use of android- based-mobile instructional media that can increase the motivation and cognitive learning achievement of learners [7]. Then, by the last of product planning steps, manufacturing product, was resulted a flowchart and a storyboard of instructional games.

Product Development Steps

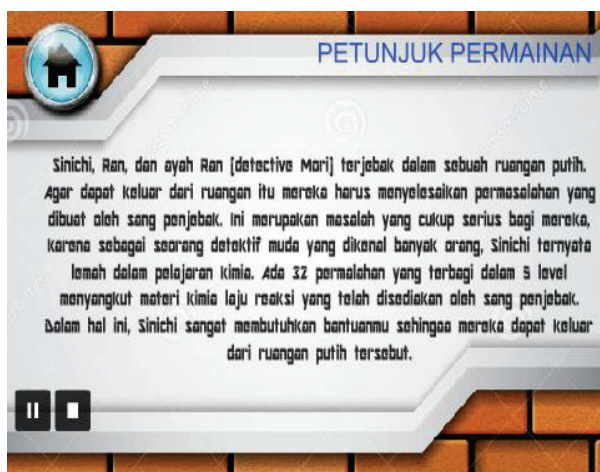
The development of chemistry instructional game used Adobe Flash Professional CS6 software with action script 3.0. Pricipal menu can be seen in figure 1.



(a)



(b)



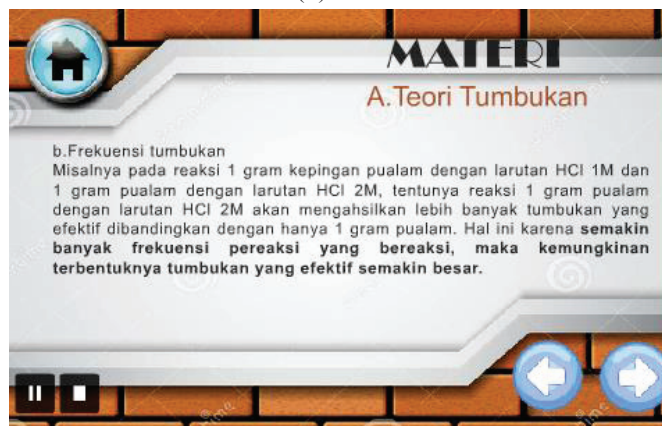
(c)



(d)



(e)



(f)

Figure 1. (a) Standard of Competency; (b) information; (c) instruction (d) games; (e) ranking; (f) material

Competency menu shown by Figure 1a consists of information about standard of competencies, basic competencies and learning indicators. Material shown by Figure 1b menu explains the material summary of rate reaction. Instruction menu as seen in Figure 1c consists of brief instructions of the game plot. Games shown by

Figure 1d menu consists of five levels according to the sub material of rate reaction. *Ranking* shown by Figure 1e menu contains the ranking achieved by the game users/ students after playing it out. *Information* shown by Figure 1f menu contains information about the developed media and the bio of its developers.

Product Evaluating Steps

Product evaluating steps consist of three activities, evaluation and assessment of materials aspects, evaluation and assessment of media aspects and evaluation and assessment testing products. Evaluation and assessment of materials and media aspects product was done by experts, peer reviewers, and high school chemistry teacher. Based the results on the assessment of materials aspects obtained an average score, namely 68.54 included in the very good category (SB) and of media aspects obtained an average score, namely 60.36 include in the good category (B).

Meanwhile, evaluation and assessment testing products consist of three activities, namely individual test, small groups test, and field test. Based the result of instructional games on the individual test obtained an average score, namely 55.89 include in the good category (B) and on the small group test obtained an average score, namely 52.63 also include in the good category (B) . While, by the field study, the application of collaboration instructional games and GI model on control class and experiment class can be seen in Table 2.

Table 2. Average Score Pretest and Posttest

| No | Class | Total students | Pretest | | Posttest | | <g> | Category |
|----|------------|----------------|---------------|------------------|---------------|------------------|-------|----------|
| | | | Average value | completeness (%) | Average value | completeness (%) | | |
| 1 | Experiment | 32 | 20.18 | 0 | 81.03 | 78.1 | 0.764 | Hight |
| 2 | Control | 33 | 23.39 | 0 | 80.48 | 75.67 | 0.745 | Hight |

The application of collaboration instructional games and GI model on experiment class was done by used GI model in learning process and used istructional games in evaluation process. In learning process, students who were divided into groups 4-5 students, held discussions and investigation on a topic about rate reaction matter. The investigation conducted using media games through the completion of problems in the games. After that, one student from every group to presentation the result of discussion. While, improvement of learning outcome of student, measure from pretest and posttest in final evaluation.

Analysis of Prerequisite Test

The normality test was conducted on the value N-gain of learning outcome on experiment class and control class. Calculated of mahalonobis test using SPSS on experiment and control class. Result of multivariate normality can be seen in Tabel 3. While, after normality test continued to homogeneity test. By the homogeneity test obtained information about Box's M test that showed the significance value greater than 0,05 ($p > 0.05$). So, this result showed that data provided from homogeneous population.

Tabel 3. Analysis of Multivariate Normality

| No | Class | Persentase (%) $d_i^2 \leq \chi_{p,0.5}^2$ | Conclusion |
|----|------------|--|----------------------|
| 1 | Experiment | 54 % | Normally distributed |
| 2 | Control | 51 % | Normally distributed |

Hypothesis Test

Based on result of normality test and homogeneity test, then the result of the hypothesis in this research was rejected H_0 . By Manova interpratation was conducted of significance value that is $0.000 < 0.05$. So, this result to be showed that there is difference increase of learning outcome between students on learning proces with collaboration

of instructional games and GI model, and students on learning proces whitout collaboration of instructional games and GI model.

CONCLUSIONS AND SUGGESTIONS

Based on the research results can be conclude: (1) android-based chemistry instructional media on rate reaction systems was successfully developed using Adobe Flash Professional CS 6 and can be run on android devices (2) collaboration of chemistry instructional games and group investigation model can to improvement learning outcome in high school student, in Yogyakarta, Indonesia.

Chemistry instructional games had already validated and evaluated so it is advisable chemistry teacher and students use in learning process. For futher work, need to be developed in multiple operating systems and to collaboration with the other cooperatif learning and with another subject matter.

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