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ANDROID APPLICATION SUPPLEMENT STRENGTHENING TECHNOLOGY FOR CHEMISTRY LEARNING CONSTRUCTION OF METACOGNITION ABILITY

Anggun Dwi Astiningsih[1i],
Crys Fajar Partana[2]
[1]Graduate Student,
Chemistry Education Graduate School,
Yogyakarta State University,
Indonesia
[2]Lecturer Dr.,
Faculty of Mathematics and Natural Science and
Graduate School,
Yogyakarta State University,
Indonesia

Abstract:
Science and technology are very important in life of learning and thinking for the future, no exception on chemical education. So this study to develop a learning application on Android for supplement strengthening chemical material specifically reaction rate to construction metacognition ability. This study aimed to know the feasibility of media developed using research development and experiment method. The instruments used in this study consist of Android application, response sheets, and also test with metacognition indicators. The data were analysed by using quantitative with ANOVA. The results of response sheets for the Android application media that average on good (worthy) from expert (content and media aspects), chemistry teachers, peer reviewers and students in small trial test. Analysis of empirical test on metacognition test, the results was fit and valid. The results of ANOVA media was significantly as given adequate effect and application Android in chemistry learning influence on students metacognition ability.

Keywords: Android application, supplement technology, strengthening learning media, chemistry learning, metacognition ability

1. Introduction

Era of 21st century and the 4.0 industrial revolution focuses on the shifting world towards digital and internet of things (Weyer, Schmitt, Ohmer, & Gorecky, 2015). This

[i] Correspondence: email anggunda15.2017@student.uny.ac.id

era will also be disruptive a wide range of human activities including the fields of science and technology as well as education. So does 21st century the development of the science and technology very rapidly and the effect on life (Avdeeva, Kulik, Kosareva, Zhilkina, & Beloguo, 2017). However, the next challenge is on the ability of the human resources that do not rely solely on the technical course, but the ability of how to prepare human resources which will not be replaced with a machine that is there are several competencies that are needed in 4.0 industrial revolution era and the 21st century include: the ability to solve problems (problem solving); adapt (adaptability); collaboration (collaboration); leadership (leadership); and the creativity and innovation (creativity and innovation) (Harususilo, 2018). One of the competencies required in the world of education that is creativity and innovation learning using additional technology-based media, but the reality is still a lot of educators who are less enthusiastic in making media learning because it is too busy hours of learning in school and other things. The Digital generation (generation of millennial doctrines) therefore, the role of educators is essential for giving birth to learners who continue to be the ' human learners ' or long life learner (Darmawan, 2018). Surely this old form education era become less relevant to be applied at the time of the generation of 'now' that directly impacted the smartphone gadget technology such as disruptive era which is currently almost all students have it (Abdelraheem & Ahmed, 2017). In accordance with the Government Regulation number 19 year 2017 stating that educators have the competence to use information and communication technology functionally corresponding to 2013 for more innovative curriculum. As well as on cultural Vision 2025 putting Indonesia in a very rapid technological innovation to increase the global competitive index (Sutopo, Prasetya, & Nizam, 2015), so that the need to create or modify the media technology as a supplement, a study in mass now to strengthen knowledge students in learning (Chen, Wan, Shu, Li, Mukherjee, & Yin, 2018).

The use of technology in learning can also be used in order to better attract the attention of learners to learn (Lesmono, Bachtiar, Maryani, & Muzdalifah, 2018), as well as the use of technology applications in the Android-based learning because it can be installed or downloaded on Smartphones each of these learners (Chen, Wan, Shu, Li, Mukherjee, & Yin, 2018). So the application of learning can be studied themselves wherever and whenever repeatedly (Jengathe, Dinesh, & Rojatkar, 2015). The Government is already doing various infrastructure facilities for good in school such as internet connection, other supporting facilities, and training technologies by educators in the region of the County, in the province as well as in Indonesia, but untapped to the maximum for some educators because it has not yet mastered the technology (Hanafi & Samsudin, 2012). In the present era, the need for more guidance and follow-up for the use of technology in order to support learning in the era of the 21st century and the era of the 4.0 industrial revolution (Arista & Kuswanto, 2018). One of the important in life learning that is related to science, the chemical was no exception. Most learners clumps of natural science (IPA) have difficulty in understanding the concept of chemistry. It is evident that in Indonesia the National Exam for chemical subjects rarely chosen due to the SMA level (Senior High School) or equivalent academic year 2017/2018 has

decreased because of a matter of higher-order thinking (HOTS = High Order Thinking Skills) changes the type of the National exam test from paper-based to computer-based (Regulation of the President of Republic of Indonesia, 2017). One of the mandatory national exams that is reaction rate which is the concept of material contains content that requires a way of thinking to complex factors such as the rate of the reaction, the reaction rate equation and order reaction rate (Sumargo & Yuanita, 2014). So it takes learning or supporting media to construct and exercise the learners to think in logical reasoning so that the material studied can be absorbed and studied in depth that can be useful in future lives (Aminah, Kusumah, Suryadi, & Sumarno, 2018).

Learning to exercise and foster ways of thinking gradually so that useful and meaningful in the future i.e. one of metacognition ability thinking (Zohar & Dori, 2011). Needs in learning science of chemistry learning was no exception for Metacognition has emerged 10 years (Abelita & Clores, 2018) but the fact learning to know the ability of Metacognition learners still less conditioned (Yusnaeni, Corebima, Susilo, & Zubaidah, 2017). This is because learners and educators coming from different backgrounds (heterogeneous environment) on the level of his thinking are still low (Ijiran & Supriadi, 2018). Metacognition means by which a person can control his mind by designing, monitoring and evaluating the judge what he had learned (Hacker, Dunlosky, & Graesser, 2009). Expected application of technology in learning is one attempt to deliver the learning content in a more meaningful material especially in this material. Like the research that has been done before by (Dewi, Kannpiran, & Wibowo, 2018) shows that with the use of digital technology or media in learning more meaningful in terms of Metacognition learners than non-digital. So this research is done developing Android-based applications for media learning material chemical rate content that requires thinking deeply to understand the content of the material and to know the ability of Metacognition learners.

2. Method

This research method using quantitative methods of research and development (R&D) which follow the step 4D of Thiagarajan (Thiagarajan, Semmel, & Semmel, 1974): Define; Design; Development and Disseminate

2.1 Procedure and Participants

Research development of Android apps for media learning chemistry using the procedure 4D by Thiagaradjan modified: 1) collecting data analysis needs in school **(define)**;2) planning the creation of storyboard media **(design)**; 3) making the development of media and media in limited trials and small scale trial **(development)** and; 4) revision as well as the dissemination of results, like **disseminated** via seminars in some schools or conference and also uploaded in Playstore / Googleplay If the already decent upload.

After the media is validated by material content expert and media expert, 8 chemistry teachers and 6 peer reviewers are then tested on a small scale 31 learners

class XII SMA N 3 Purwokerto (Central Java, Indonesia) and empirical test for all matter of Metacognition test (contains 7 essay description using Metacognition indikator) at 163 learners class XII SMA and SMA N 3 Purwokerto dan SMA N 1 Sokaraja (Central Java, Indonesia). The research subjects were on SMA (Senior High School) students: by means of probability sampling, 64 students at the SMA were selected and divided into two groups; first half as an experimental class and the second half as a control class, whom were yet to be given any lesson about Reaction Rate of the material content. The research was conduct at a Senior High School known as the SMA N 1 Sokaraja from November to December 2018.

2.2 Data Conducted Techniques

Techniques data collection using the method of observation, test method with independent variable, namely media developed in the form of chemical learning on Android applications, the dependent variable to know the Metacognition ability of test results (evaluation test be reserved 7 description essay of the indicator with Metacognition).

Research data sources include: the Android-based learning of reaction rate chemical material content assessment by the Validator (content expert, media experts, the chemical educator, peer reviewers), readability of media applications Android on a small scale trial. Assessment of the feasibility of using the eligibility validation instrument modified from (Crozat, Hu, & Trigano, 1999) through the EMPI (Evaluation of Pedagogical and Multimedia, Interactive Software) and LORI (Learning Objects Review Instrument) developed by (Nesbit, Belfer, & Vargo, 2002). The data obtained were analyzed using the validator from the data analysis of Aiken's to find out the validity of the content of an item (Aiken, 1985). Testing process of empirical test is analyzed Metacognition question test using QUEST program to know the number of the questions fit and valid. The large scale trials data i.e. test Android-based learning media effectiveness of reserved post-test evaluation using indicators of Metacognition using ANOVA tests with SPSS program (Pituch & Stevens, 2016).

3. Results

Android-based media development in the learning material chemical reaction rates compiled by the display of color and display animation and there is a chemical product, learning media back sound form applications on Android devices mobile in the Android format Package (apk) supporting applications using i.e. Construct 2 for coding made learning media application and Photoshop to make design drawings. Android applications in media learning developed contains information written in the Indonesian Language (information menu on the learning media and bioadata developers); the basic competencies and learning objectives; explanation of material reaction rate is divided into initial knowledge apperception, section later material in the form of understanding the reaction rate, the factors that affect the reaction rate associated with the theory of the collision, the order of the reaction, the reaction rate

equation and ordinances; There are examples of reserved and exercises as well as discussion of the matter; and there is some level of problem gaming are made to know how to think learners.

Android application that was developed to know thinking students with metacognition ability steps starting from the planning of the apperception material associated with everyday life, monitoring visits of material and statements animation of chemical reactions that are in the media the Android application, as well as the evaluation of the ability of thinking trained through practice Metacognition reserved and game problem on Android applications. Example of display media Android applications can be seen in Figure 1 and Figure 2. Android apps for learning media this chemical can be used without using the internet, so it can be used offline if the media is already installed on your Android phone.

Figure 1: One of the display material reaction rate factor

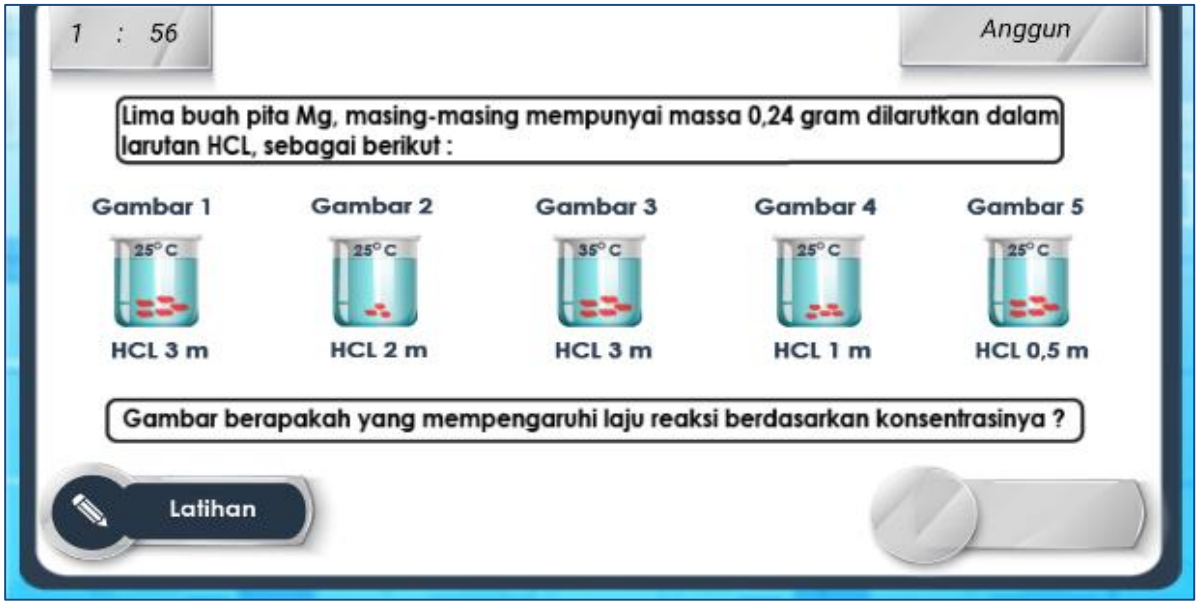

Figure 2: One of the exercises reserved reaction rates

The results of the validation of the feasibility assessment media recap of Android applications of chemical learning can be shown in Figure 3.

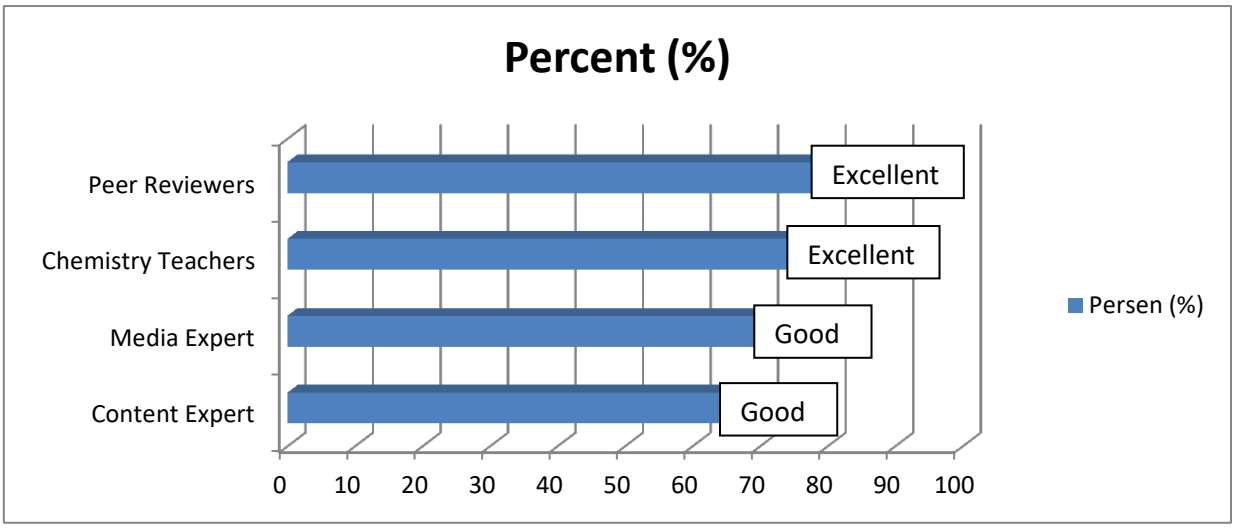

Figure 3: Media validation assessment of Android application material chemical reaction rates

Based on Figure 3 the results of the assessment indicate that the media Android applications for learning material content chemical reaction rates were included on the criterion of good grade by expert lecturer (average content aspect of total score = 37 from maximum score = 50 and average media aspect of total score = 41 from maximum score = 50) and excellent grade (by eight chemistry teachers the average of total score = 88 from maximum score = 100 and by six peer reviewers the average of total score = 91 from maximum score = 100) and then used in subsequent research used on a small scale trial. The results of the response to the 31 students on a small scale trial of 17 average learners provide excellent response and 14 average learners provide good response against the media are developed.

Once validated instruments such as questions essay evaluation test instruments Metacognition, next to know reliability of questions test the instrument using QUEST program of empirical test data on 163 learners (students) to metacognition test. Test instrument use indicators of Metacognition modified from (Paola, 2015) (Scanlon, 2010) (Anderson & Krathwohl, 2001) [17] there are 7 reserved essay tests. The results of the reliability of the test instruments metacognition = 0.73 and from 7 questions essay test that infit MNSQ between 0.77 to 1.33, this means it can be stated the question was reliability and Metacognition questions test was valid no matter which number is thrown.

Further research to find out the effectiveness of the use of media tested in a large-scale field test using artificial experiments with design post-test only which can be shown in Table 1. This research sample chosen at random in two classes, namely the experiment class and control class. The results of the average post-test Metacognition can be shown in Figure 4.

Table 1: Post-test group design

Class	Treatment	Post-test
Experiment	X_1	O_1
Control	X_2	O_1

Note: X_1 = using Android application chemistry learning media of reaction rate material; X_2 = not using Android application chemistry learning media; O_1 = post-test metacognition

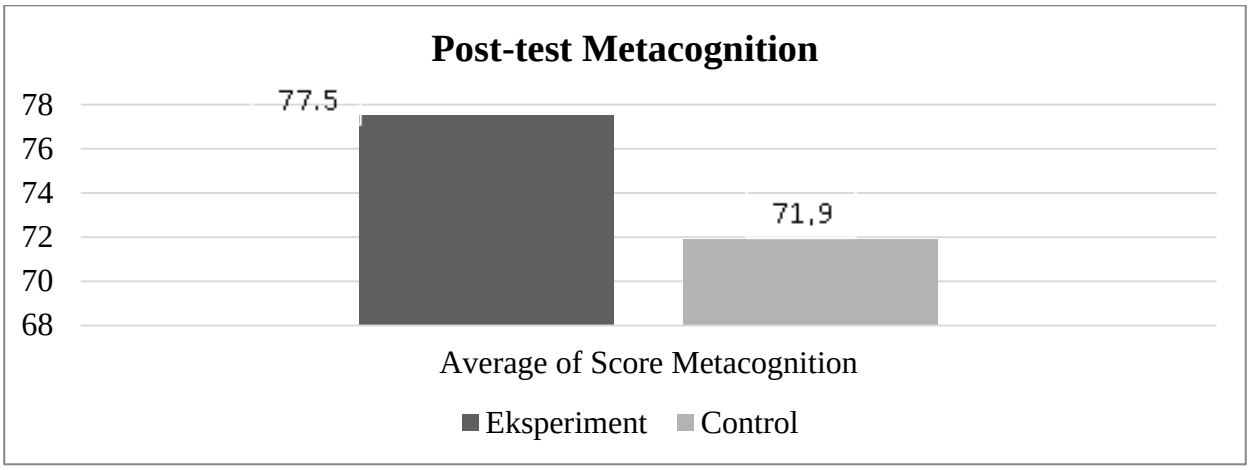

Figure 4: The results of post-test metacognition

Based on the average score post-test metacognition in Figure 4 shown that the class of experiments using media Android apps in a category higher than on an average value of control class refuses to use media Android applications. These results are in line with research (Arista & Kuswanto, 2018) that media use Android applications can improve the competency of thinking representative physics learning. Research conducted by (Aminah, Kusumah, Suryadi, & Sumarno, 2018) stating that the representation of the chemical to stimulate reading metacognition in solving a test problem associated with indicators of metacognition.

Test the collected statistics to find out the effectiveness of media material reaction rate Android application using the test ANOVA analysis with SPSS program 24 (Pituch & Stevens, 2016). Data from the ANOVA test entered score post-test metacognition. ANOVA test is performed if the prerequisites are met, namely for normality and homogeneity tests are met. The results of the analysis of its homogeneity and normality test can be shown in Table 2 and Table 3.

Table 2: Normality test result

Class	N	sig. of Shapiro-Wilk
Experiment	32	0,412
Control	32	0,075

The results in Table 2 indicated that the value of experimental class of sig. 0,412 > α (0,05) and the value of control class. sig 0,075 > α (0,05) which means that H0 is accepted > α stated data of normal distribution.

Table 3: Homogeneity test result

Variable		**Levene Statistic**	**sig.**
Metacognition	Based on Mean	0.005	0.946

Based on Table 3 produced its homogeneity test analysis Based on Mean values on Statistic of 0,005 Levene with sig. 0,946 > α (0,05) which means that H0 was accepted > α stated data variance the media types are equal (homogeneity data), so that test ANOVA using the F test can be performed. ANOVA test result can be shown in Table 4.

Table 4: ANOVA test result

	Sum of Square	**df**	**Mean Square**	**F**	**sig.**
Between Groups	495.063	1	495.063	13.506	0.000
Within Groups	2272.688	62	36.656		
Total	2767.750	63			

The results of the ANOVA shown that the value of F = 13,506 count with sig. 0,000 < α (0,05), it can be concluded that was significantly on effect size from F score was interpreted as given effect and application Android in chemistry learning influence on students metacognition ability. This was in line with previous research stated that the existence of technological or digital media use in learning more meaningful in terms of learner metacognition than non-digital (Dewi, Kannpiran, & Wibowo, 2018).

4. Discussion

The result of learners Metacognition ability known through the evaluation of the results of the post-test 7 reserved essay material chemical rate previously validated by expert judgement and empirical test is analyzed using the QUEST program shown the results of the analysis reserved traffic Metacognition is valid and used in post-test after the learning rate of the reaction. The results of the post-test the Metacognition ability in experiment class and control class shown the results of that experiment class was higher in the control class; it proclaimed that the media use Android application on a experiment class of influential positive can be shown students metacognition ability than in the control class without using an Android application media. These results are in line with research (Dewi, Kannpiran, & Wibowo, 2018) Android media that effectively used on the ability of students to think independently related to problems on the material being taught. Android media use on the learning process have a role as an intermediary between materials with learners and the media as one of the Android technology supplement strengthen reinforcement learners thinking ability. Purpose of use the Android media developed is one of the alternatives to lead learners to

understand the learning process of material as well as the learners thinking ability of Metacognition starting from the planning process, monitoring and evaluation (Yusnaeni, Corebima, Susilo, & Zubaidah, 2017).

Learning process of experiment class and control class can be shown in Figure 5 using Android application chemistry learning of reaction rates content and Figure 6 not using Android application learning media.

Figure 5: Learning Process of Experiment Class

Figure 6: Learning Process of Control Class

Based on learning process Figure 5 experiment class and Figure 6 control class to trained of thinking metacognition ability. Post-test results on the question of evaluation for the Metacognition ability on the class of the control class and experiments class shown that the learners were able to understand the material chemical rate learning through stages of problem post-test done. But from the results of a post-tests wants to grade steeper than the grade control due to the influence of the Android media developed in the experimental class, this means that the ability of Metacognition

learners experiment class was better than learners on the control class (Abelita & Clores, 2018). Constraints faced by the students in the control class to a lower post-test because there are few student thinking ability has not been fullest apply something like on the way as well as the concept with a different question or problem (for example already given an example of a question similar to the question of post-test different numbers but with different steps but learners experiencing difficult in answering the question of post-test) (Ijiran & Supriadi, 2018). The essay question using metacognition lattice material reaction rate is composed of several section later material i.e. the theory of collisions, factors of reaction rates, determining the order of reaction, reaction rate equations. The results of the analysis of the answers the learners metacognition ability still not the maximum (Parlan, Ibnu, Rahayu, & Suharti, 2018) and (Dewi, Kannpiran, & Wibowo, 2018), because on some questions with counting math skills is not yet right and having a hard time answering the question, but had previously taught with examples and steps are almost the same but the numbers of distinguished ability to the learners thinking (Sumargo & Yuanita, 2014).

Metacognition ability of students must be trained continuously in chemical material especially learning by becoming a habit of thinking on step by steps so that the useful material and more thought in the mind of each students (Sawuwu & Partana, 2018) and (Parlan, Ibnu, Rahayu, & Suharti, 2018). Because many students come from different backgrounds (Dewi, Kannpiran, & Wibowo, 2018). So does the teacher have to get used to his way of thinking ability of Metacognition, as to teach the ability of Metacognition of the students before the start of his teacher is also capable of Metacognition of learning started by making from planning, monitoring and evaluation (Abelita & Clores, 2018) and (Ijiran & Supriadi, 2018). Like making the existing essay question step by step of his thinking, the media used in learning, make learning way at each meeting, the grant of the duties against the students who teach the thinking metacognition ability can also be in the chemistry lab course that emphasizes students try themselves so more thought in mind that the opportunity to understand the matter directly (Sumargo & Yuanita, 2014) and (Dewi, Kannpiran, & Wibowo, 2018). As well as the use of ICT'S Android-based game in learning process gives positive effect on the students self-efficacy in the study of hydrocarbon chemistry material because it can be learned is used wherever and whenever (Fitriyana, Wiyarsi, & Sugiyarto, 2018).

5. Conclusion

Android apps media development in the learning material chemical reaction rates gives positive impact on the students metacognition ability and have the following characteristics: (1) media locally installed Android application Android and when installed, using media applications developed not requires an internet connection so that it can be used anytime and anywhere to learn the material rate of a chemical reaction; (2) an Android application developed get good responses from expert validator (material content expert and media expert), 8 chemistry teachers, 6 peer reviewers and 31 learners on a small scale trial of all empirical test for reserved

metacognition result is quite reliability; (3) media Android applications provide considerable influence against the thinking of metacognition ability.

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About the Author(s)
Anggun Dwi Astiningsih is a graduate student of Chemistry Departmen, Graduate School, Yogyakarta State University, Indonesia. Her interest of researcher are educational development such as application supplement technology as learning innovation including the implementation of media in the learning chemistry, and teaching-learning of various chemistry teaching method, metacognition ability in chemistry education.
Crys Fajar Partana is Dr lecturer and researcher in Chemistry Departement, Faculty of Mathematics and Natural Science, Yogyakarta State University, Indonesia. His interest of researcher are educational media development in chemistry teaching learning and focused expertise in the field of Chemical Physics, Computational Chemistry, Chemical Education Workshop, Chemistry Learning Media Development, Quantum Chemistry, Chemical Dynamics.

Conflict of Interests
The authors declare no conflict of interest.

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