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The Effectiveness of Android-Based Media in Chemistry Learning to Improve Chemistry Literacy and Learning Motivation

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Abstract

Research has been carried out on the development of android-based media in chemical learning to determine the feasibility ofandroid-based media reaction rate material in chemistry learning developed, and to know the influence of increasing chemical literacy skills and student learning motivation and knowing its effectiveness.This research is included in the type of Research and Development (R&D research) by referring to the 4D model, namely defining (define), planning (design), development (develop) and disseminate (disseminate). The validation of android application media products is done by two media experts and two material experts. The media quality assessment of the developed android application was carried out by 4 chemistry teachers and three peer reviewers. The research subjects used were class XI students of SMA Nurul Muslim Batealit Jepara. The limited trial of media developed was carried out to determine the readability of the media to students who were not samples, the trial of learning motivation questionnaires and the trial of test questions using chemical literacy indicators to students in Class XII MIPA SMA Nurul Muslim Batealit, Field tests using 2 classes XI MIPA SMA Nurul Muslim Batealit in learning chemistry material reaction rate. Data collection was carried out using media assessment questionnaires, learning motivation questionnaires, chemical literacy test questions. The results showed that the media that had been developed showed that there was a major influence on improving chemical literacy skills andmoderate influence on increasing student learning motivation.

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INTRODUCTION

During the 21st century educational transformation, changes in learning activities occurred a lot, including teachers and students. Along with the rapid development of science and technology, the professional development of teachers should not only be an aspect of student learning, but also an aspect of information management to facilitate learning activities. One of them is by utilizing android-based learning media. Nowadays, most of the learners can be said to be gadget addicts (addiction to handheld phones in this case smartphones) (Suhartien, 2018). Therefore, in supporting the 21st century, teachers must prepare themselves to face challenges in learning due to the scientific and technological revolution (Higgins, et al. 2012 ; Liliarti & Kuswanto, 2018.)

Science and technology developing very fast must be utilized in the learning process. The process of using technology in learning can be applied to learning media. Learning media are hardware and software created and developed for learning needs and to increase the effectiveness of learning (Kartini & Putra, 2020; Rahayu et al., 2022; Uy et al., 2017). Learning through mobile phones has experienced rapid development along with advances in science and technology (Abbas et al., 2020; Chusna & Utami, 2020). The use of android devices in learning is increasingly widespread, and their use is increasingly widespread for students (Nazar et al., 2020; Prastyo et al., 2021). The use of instructional media adds to the attractiveness and enjoyment of the learning process, which is expected to increase the motivation and interest of students in learning (Lestari et al., 2018). One of the lessons that can use technological media is chemistry. Chemistry is a science often associated with substances' essential properties. Therefore, teaching chemistry starts from simple concepts to more complex concepts. Chemistry learning includes aspects that can be seen with the senses in the form of concrete facts and aspects that cannot be seen with the senses that can only be understood by logic. However, in reality, learning chemistry has yet to achieve optimal results. Students still need help understanding chemistry material (Ayona & Hidayah, 2021; Nazar et al., 2020). Chemistry includes factual knowledge, concepts, procedures, and metacognitive. During a pandemic like now, learning cannot be done face-to-face. Learning is only done online via a smartphone (Lutfi et al., 2021). Classics in chemistry learning make students bored and uninteresting (Hatimah & Khery, 2021; Jofrishal & Seprianto, 2020). In addition, using only ordinary modules can make it challenging for students to understand chemistry material, including macroscopic, microscopic, and symbolic aspects (Fatma & Partana, 2019). In efforts to support online learning during a pandemic, learning media that are suitable and make it easier for students to understand chemistry material are needed. In online learning, teachers only use smartphones in learning by sending modules or material summaries via WA or Google Classroom (Nazar et al., 2020; Putri et al., 2021). The modules given to students still need to make students feel that easy to understand chemical material with multiple representative characteristics. Therefore, analyzing the need for learning media suitable for online learning during a pandemic is necessary, making it easier for students to understand chemistry material.

The solution for optimizing learning requires the help of appropriate learning media to support learning according to the material's and students' characteristics. Media influences learning effectiveness (Putri & Muhtadi, 2018). One of the media that can support online learning is mobile-based media. The large use of smartphones in Indonesia influences mobile-based learning media. Indonesia is the fourth largest smartphone user in the world. In smartphones used in Indonesia, the most widely used operating system is Android (Pusparini et al., 2017). The use of Android-based learning media is one of the trends in learning in the 21st century. Smartphones and tablets can have the power to enhance the learning experience and can improve cognitive, affective, metacognitive, and socio-cultural aspects. The use of Android-based learning media is not limited by time and place, so it is more flexible and makes it easier for students to learn at any time and at any time (Jazuli et al., 2018; Yektyastuti & Ikhsan, 2016a; Zuhdi, 2021). The use of Android-based learning media can adjust the needs of students, with the hope that the benefits of using Android-based media can be felt by students directly (Nazar et al., 2020). The use of mobile learning-based learning media or Android learning media allows students to access learning materials without being bound by time and place. Using mobile or Android-based learning media creates an attachment between teachers and students. The advantage of mobile devices is a challenge that must be utilized as a learning media. So this mobile device can be developed as a learning medium that can influence the learning process (Prastyo et al., 2021; Rahmawati & Partana, 2019; Yektyastuti & Ikhsan, 2016a). Previous research findings state that using mobile learning-based android learning media has many advantages that can replace computer-based learning media (Lathief Dwi Putra & Nurafni, 2021; Prastyo et al., 2021). Using mobile learning-based media that is easy to carry anywhere makes it easy for students to understand the subject matter (Ayona & Hidayah, 2021).

The results of the development of android media on IUPAC compound nomenclature material received a very good response from students (Kartini & Putra, 2020b). Using android learning media on solubility material and solubility results can improve student learning outcomes (Putra et al., 2017). The use of android learning media for twelfth science students shows an increased understanding of higher concepts (Hatimah & Khery, 2021). The use of game-based android media makes students feel entertained and provides enthusiasm for student learning so that students feel happy during learning and that student learning outcomes experience increase (Lutfi et al., 2021).

Based on the results of the questionnaire through a google form with a group of chemistry subject teachers in Jepara district, chemistry teachers rarely use android-based learning media because there are obstacles regarding dense teaching time and require good technological skills to get used to making the media, the media references used are still reference books, learning media occasionally use power points and teaching materials. This means that learners are less motivated in learning chemistry. Android-based media is one of the efforts that can support the motivation of students in learning chemistry. Therefore, in this study, android-based learning media in learning was developed as a support for chemical reaction rate material because this material is one of the mandatory materials in national exams and is related to daily life. Reaction rate matter also requires an understanding of the concept and chemical calculations that are considered difficult. Therefore, the development of learning media for the rate of chemical reactions is one of the supporting supplements for learning that can train thinking about chemical literacy skills and student learning motivation.(Liu et al., 2017)

METHOD

The efect size of the influence of android-based media learning on the ability of chemical literacy and learning motivation of students is determined by testing the results of the chemical literacy ability test and filling out the chemistry learning motivation questionnaire. Hasil from the chemical literacy test and the test of the results of filling in the learning motivation questionnaire were carried out normality tests, homogeneity tests, t-tests, and Independent Samples Effect Sizes tests.

Chemistry Literacy

After learning in experimental classes using android-based chemistry learning media, reaction rate materials and control classes without using android-based learning media obtained the results of chemical literacy values. The results of the chemical literacy ability test are then grouped into 3 value categories such as Table 1Figure Figure 1 :

Table 1. Chemical Literacy Value Categories

Class	Bottom Value Group	Medium Value Group	Top Value Group
Experiment	Value < 71	71 ≤ Value ≤ 85	Value > 85
Kontrol	Value < 62	62 ≤ Value ≤ 81	Value > 81

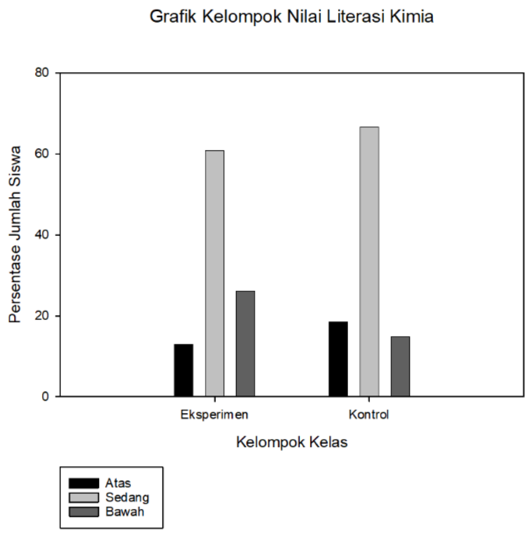

Figure 1. Chemical Literacy Value Group Graph

The results of the chemical litration ability test of the experimental class and the control class that have been carried out the Normality Test and the Homogeneity Test show normal distributed results, and the two classes are homogeneous, so the Independent Samples T Test is then carried out.

The results of the normality test in the experimental class and control class showed the Q-Q Plot Norm which is close to Figure 2 and Figure 3.

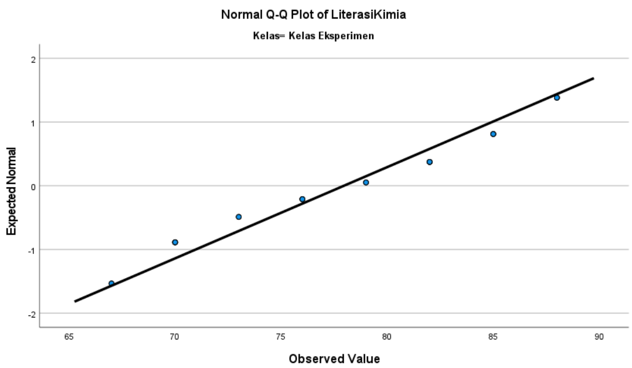

Figure 2. Normal Q-Q Plot Class Experiment (Chemical Literacy)

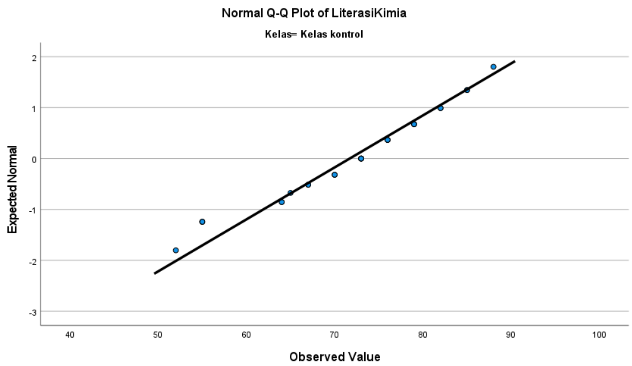

Figure 3. Normal Q-Q Plot Class Control (Chemical Literacy)

The homogeneity test is carried out to obtain the assumption that the research sample originated from the same or homogeneous variance. The test results can be seen in **Error! Not a valid bookmark self-reference.** :

Table 2. Levene’s Test results from chemical literacy ability test

		Levene's Test for Equality of Variances	
		F	Sig.
LiterasiKimia	Equal variances assumed	1,590	,213
	Equal variances not assumed		

The homogeneity of the chemical literacy ability of the sample is tested with Levene's Test which is used for testing if the experimental class has the same variant. The hypothesis testing criterion is accepted if the sig value > 0.05, meaning that the variance of the H_0 experimental class group is the same or homogeneous (Sukestiyarno, 2014). Based on the table Test of Homogenity of Variances obtained sig homogeneity = 0.213. The value is greater than 0.05 then accepted. Therefore, it can be known that the experimental H_0 class chemical literacy ability data comes from a homogeneous population.

The t-test was used to determine whether or not there was a significant improvement between the experimental class and the control class, with H_0: the average increase in chemical literacy of the experimental class learners was smaller or equal to the average increase in the chemical literacy of the control class learners; and Ha: the average increase in chemical literacy of experimental class learners is greater than the average increase in chemical literacy control class learners. The results of the t-test for the chemical literacy of students in the experimental class and control class can be seen in Table **Error! Not a valid bookmark self-reference.**.

Table 3. Independent Sample T Test Results Chemical Literacy Test

		t-test for Equality of Means						
							95% Confidence Interval of the Difference	
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
LiterasiKimia	Equal variances assumed	2,556	48	,014	6,25282	2,44594	1,33494	11,17070
	Equal variances not assumed	2,625	46,657	,012	6,25282	2,38173	1,46046	11,04517

Based on The t-test was used to determine whether or not there was a significant improvement between the experimental class and the control class, with H_0: the average increase in chemical literacy of the experimental class learners was smaller or equal to the average increase in the chemical literacy of the control class learners; and Ha: the average increase in chemical literacy of experimental class learners is greater than the average increase in chemical literacy control class learners. The results of the t-test for the chemical literacy of students in the experimental class and control class can be seen in Table **Error! Not a valid bookmark self-reference.**.

Table 3 Independent Samples T Test on t it was found that the sig value was less than a significant level of = 0,014 > 0,05 having given rejection of H_0 so that Ha was accepted. This shows that the average increase in science literacy of experimental class learners is greater than the average increase in science literacy of control class learners.

Learning Motivation

After learning in experimental classes using android-based chemistry learning media, reaction rate materials and control classes without using android-based learning media obtained the results of filling in student learning motivation questionnaires. The results of filling out the learning motivation questionnaire are then grouped into 3 value categories such as Table 4FigureFigure 4.

Table 4. Learning Motivation Value Categories

Class	Bottom Value Group	Bottom Value Group	Top Value Group
Experiment	Value < 78	78 ≤ Value ≤ 91	Value > 91
Control	Value < 73	73 ≤ Value ≤ 87	Value > 87

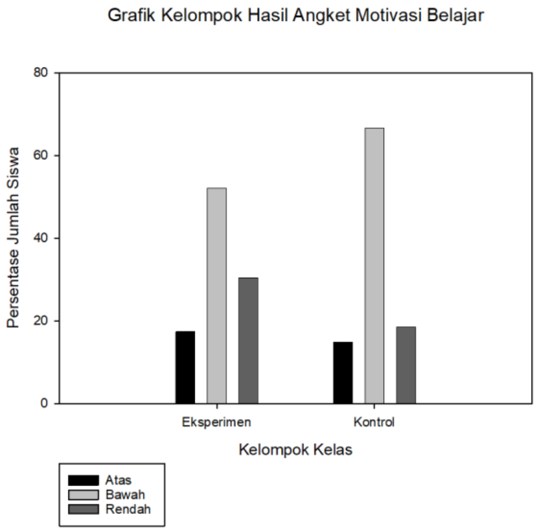

Figure 4. Student Learning Motivation Questionnaire Value Group Graph

The results of filling in the learning motivation questionnaire for students in the experimental class and control class were carried out Normality Test and homogeneity test then the Independent Samples T Test was carried out. Normality Test results in experimental classes and control classes show the Q-Q Plot Norms that are close to straight lines as in Figure 5 and Figure 6

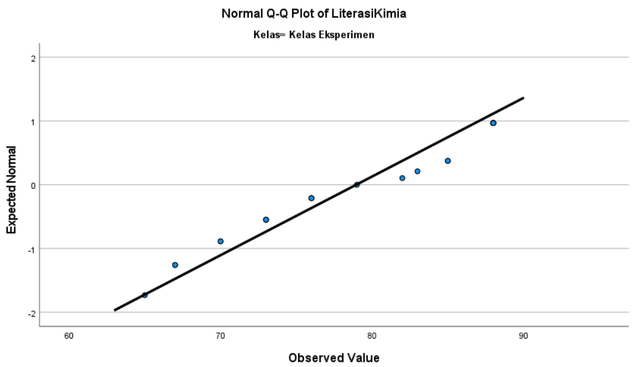

Figure 5. Normal Q-Q Experimental Class Plot (Results of Filling in the Learning Motivation Questionnaire)

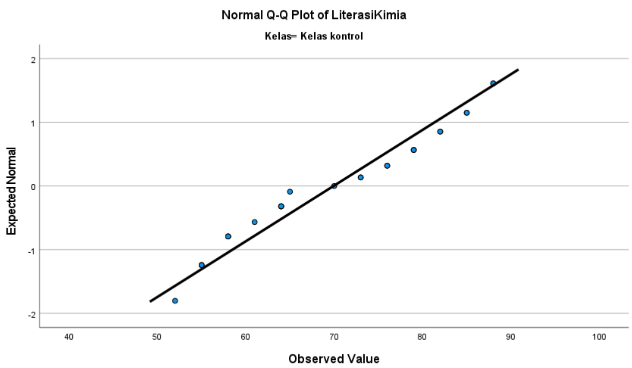

Figure 6. Normal Q-Q Control Class Plot (Results of Filling in the Learning Motivation Questionnaire)

The homogeneity test is carried out to obtain the assumption that the research sample originated from the same or homogeneous variance. The test results can be seen in **Error! Not a valid bookmark self-reference.**.

Table 5. Levene’s Test results from filling out motivational questionnaires

		Levene's Test for Equality of Variances	
		F	Sig.
MotivasiBelajar	Equal variances assumed	,077	,783
	Equal variances not assumed		

The homogeneity of learners' learning motivation from the sample was tested with Levene's Test which is used for testing if the experimental and control classes have the same variants. The hypothesis testing criterion is accepted if the sig value > 0.05, meaning that the variance of the H_0 experimental and control class groups is the same or homogeneous (Sukestiyarno, 2014). Based on the table Test of Homogenity of Variances obtained sig homogeneity = 0.783. The value is greater than 0.05 then accepted. Therefore, it can be known that the H_0 learning motivation data of experimental and control class learners come from a homogeneous population.

The t-test was used to find out whether or not there was a significant improvement between the experimental class and the control class, with H_0 : the average increase in learning motivation of the experimental class learners was smaller or equal to the average increase in the learning motivation of the control class learners; and Ha : the average increase in learning motivation of experimental class learners is greater than the average increase in learning motivation of control class learners. The results of the t-test for student learning motivation in the experimental class and control class can be seen in**Error! Not a valid bookmark self-reference.**.

Table 6. Independent Sample T- Test Results Learning Motivation Test

Independent Samples Test

		t-test for Equality of Means		
		Sig. (2-tailed)	Mean Difference	Std. Error Difference
LiterasiKimia	Equal variances assumed	,003	9,03060	2,85074
	Equal variances not assumed	,002	9,03060	2,77466

Based on The t-test was used to determine whether or not there was a significant improvement between the experimental class and the control class, with H_0: the average increase in chemical literacy of the experimental class learners was smaller or equal to the average increase in the chemical literacy of the control class learners; and Ha: the average increase in chemical literacy of experimental class learners is greater than the average increase in chemical literacy control class learners. The results of the t-test for the chemical literacy of students in the experimental class and control class can be seen in Table **Error! Not a valid bookmark self-reference.**.

Table 3 Independent Samples T-Test on t found that the sig value is less than a significant level = 0,0030,05 has given a rejection of H_0 so that Ha is accepted. This suggests that the average increase in science literacy of experimental class learners is greater than the average increase in science literacy of control class learners

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Effectiveness of Media Use

To find out the magnitude of the effect or influence of the use of Android-based media in chemistry learning on improving chemical literacy skills and learning motivation , the Independent

Samples Effect Sizes (Cohen's d) test can be used. The value of the lower limit of the effect size of Cohens d can be seen in
Table 7. The results of the Independent Samples Effect Sizes Test of chemical liquefaction ability and learning motivation are shown by Table Table 8TableTable 9

Table 7. The lower of Cohen's d value

Lower of Cohen's d	Effect size
0,3	Small
0,5	Moderate
0,8	Large

Table 8. Table of Independent Samples Effect Sizes Test Results for Chemical Literacy Ability

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
LiterasiKimia	Cohen's d	10,04657	,899	,310	1,479
	Hedges' correction	10,20703	,885	,305	1,456
	Glass's delta	11,43519	,790	,187	1,379

Table 9. Table of Independent Samples Effect Sizes Test Results

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
MotivasiBelajar	Cohen's d	6,74210	,628	,055	1,195
	Hedges' correction	6,84978	,619	,054	1,177
	Glass's delta	6,76719	,626	,039	1,202

The learning in this study was carried out in two different classes which can be called control classes and experimental classes. The difference between the control class and the experiment is influenced by the different treatments given. Experimental classes are given learning treatment using android-based chemistry learning media. Learning in experimental classes is more meaningful and less boring for students. Students can learn all the material through the media provided. This causes students to be more enthusiastic to read every material provided by the teacher. Interesting menus also increase students' enthusiasm for learning. In the media, examples of questions and their solutions are also provided which make students more interested in exploring the material. At the end of the media, there is also a quiz that students can do to measure the extent of students' understanding of the chemical rate material.

In the experimental class, learning using android-based chemistry media makes students able to develop their literacy and motivation skills. Students are able to develop their literacy skills because the packaging of the material is made attractively and clearly. Students can also study anywhere and anytime without having to bring books. Students only need to open the media then read. In addition to literacy skills, by using android-based media-assisted learning Students can also increase their learning motivation. This is because students can learn easily using android media, where today's students are more comfortable using cellphones than reading books. Learning using android-based chemistry media is effectively used to improve literacy and motivational abilities, during the learning process students are interested and actively follow the learning. This can be seen from the classroom atmosphere where the students are enthusiastic and enthusiastic in learning.

Learning carried out starting from the opening, core and closing stages in learning using android-based chemistry media has been proven to improve students' literacy and motivation skills. The results of the Independent Samples Effect Sizes Test obtained Cohen's value d chemical literacy ability (d=0.899) which showed that the use of android-based media had a major effect on improving chemical literacy ability and Cohen'd value of learning motivation (d=0.628) which showed that the use of android-based media had a moderate effect on increasing student learning motivation. From the results of the research above, it can be concluded that learning using android-based chemical media is effective for improving the literacy and motivation skills of class XI mipa students of Nurul Muslim Batealit High School material on reaction rates in the 2022/2023 school year.

CONCLUSION

The use of android-based media in chemistry learning has a significant impact on the chemical literacy ability of students Hasil analysis significance 0.014 < 0.05. These results show that the average increase in science literacy of class students who use android-based media in chemistry learning is greater than the average increase in science literacy of class students who do not use android-based media in chemistry learning

The use of android-based media in chemistry learning has a significant impact on student learning motivation. Hasil analysis of its significance 0.003 < 0.05. These results show that the average increase in learning motivation of class students who use android-based media in chemistry learning is greater than the average increase in learning motivation of class students who do not use android-based media in chemistry learning

Based on the results and discussions, it shows that the use of android-based media in chemistry learning is effective in increasing chemical literacy and student learning motivation. The results of the Independent Samples Effect Sizes Test obtained Cohen's d chemical literacy ability value (d=0.899) which showed that the use of android-based media had a major effect on improving chemical literacy ability and the Cohen'd value of learning motivation (d=0.628) which showed that the use of android-based media had a moderate effect on increasing participants' learning motivation.

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