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The Effectiveness of using Android Based Chemical Ludo Game Media Reduction and Oxidation Reaction Material on Students Learning Outcomes

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Abstract

This research follow up research development of Educational Design Research with Plomp model that has been done the validity and practicality test but hasn't been tested effectiveness using the android based chemical ludo game media for reduction and oxidation reactions material on student learning outcomes for class X SMA/MA. This aims for reveal the level effectiveness using the android based chemical ludo game media on reduction and oxidation reaction material to learning outcomes of class X SMA/MA.The design used was pretest-posttest control group design with random sample group. The sample of research were class X MIPA 4 with 34 students and X MIPA 3 with 34 students at SMAN Binaan Khusus. The research instrument is instrument test and questionnaires. The data using analyzed with N-Gain test and hypothesis test (t-test). N-Gain the experimental class was 0.79 with high category and the control class was 0.47 with medium category. The hypothesis testing which was carried out with the t-test with t_{count} (7.84527) > t_{table} (1.668) at the real level $\alpha = 0.05$. So the android based chemical ludo game media material for reduction and oxidation reactions effective in increasing learning outcomes for students significantly in the cognitive domain class X SMA/MA.

Keywords: effectiveness, android based chemical ludo game media, reduction and oxidation reactions, learning outcomes

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INTRODUCTION

Reduction and oxidation reactions are one of the topics in chemistry learning for class X even semester in the 2013 curriculum. The material for reduction and oxidation reactions contains a lot of factual knowledge and also conceptual knowledge (Husna et al., 2022). In order to spur and increase student activity in the learning process of reduction and oxidation reactions, learning media is needed. Learning media is media that can channel messages or information that contains a specific purpose or learning objectives (Desviana Siregar, 2017). Learning media has an important role in the ongoing teaching and learning process, so that a teacher can provide and convey learning material in a real way by using learning media more meaningfully (Sanjaya, 2014). Learning media is really needed to help students get concepts, skills and competencies (Hasan et al., n.d, 2021). Effective learning media can be assessed by considering several criteria such as cost, availability of supporting facilities, compatibility with class size, summary, ability to be changed, time and labor for preparation, as well as complexity and usability (Badriyah, 2015). In addition, the effectiveness of a learning media can also be determined using data on student learning outcomes. A learning media is said to

be effective if students who have completed the minimum completeness criteria are not less than 75% of the number of students (Heriyanto et al., 2013).

The use of information and communication technology in the learning process can also assist teachers in creating effective and efficient learning for students, especially in the 2013 curriculum (Fujiati et al., 2020). In the 2013 curriculum the use of information and communication technology really needs to be done, because one of the characteristics of the 2013 curriculum is that the curriculum is able to answer the challenges of changing times with globalization. So that students are expected to have various competencies that can counteract the bad effects of globalization and be able to survive properly (Anwas, 2013). So with the advancement of technology that is developing rapidly at this time of course it needs to be addressed and also applied to the world of education (Nawawi, 2020). This can be an innovation in using learning media that utilizes information and communication technology in these learning media (Wati, 2021).

The process of learning chemistry with reduction and oxidation reaction material can be supported by providing exercise to students (Azizah et al., 2022). The exercise aims to improve the consolidation of concepts related to the reduction and oxidation reaction material (Iman Sari & Harjono, 2016). Supported by current technological developments, exercise can be carried out using media that utilizes technological developments, such as using android based game media. Learning with the concept while playing has many benefits and advantages such as being able to create a fun learning atmosphere, making students active in participating in learning, and being able to improve students' abilities and familiarize students with using technology in learning (Mulia, 2016). This media game is used when giving exercises to students. As we know that the exercises or assignments given to students are very useful for students so that students can solidify the concepts they have learned before. If students are lazy in doing the exercises, there may be a possibility that students will not be able to apply the concepts given to their application in doing the exercises. Therefore, by give exercise with media through android based game media, students' enthusiasm for learning will increase more than before, while also encouraging students to be more active and think critically in solving problems (Wicaksono, 2021).

Based on the distribution of questionnaires that had been conducted to 6 chemistry teachers from 3 different schools, namely SMAN Binaan Khusus Dumai City, SMAN 2 Dumai City, and SMAN 5 Dumai City, the information was obtained that there was already use of technology in the provision of teaching materials using power point media and sourced from printed books. In addition, the provision of exercises for learning chemistry generally uses student worksheets. The use of technology has begun to be implemented in the media used to provide teaching materials, but innovations or alternatives in providing exercise have not used technology. In accordance with research conducted by Tekege (2017) that the use of technology in learning is important because it increases the effectiveness of the learning process so that it can improve student learning outcomes and the quality of individual students in terms of using technology that is more appropriate and also useful, then the use of technology can be used in providing exercise to students.

One of the game media that can support students' learning processes in the material of reduction and oxidation reactions is the chemical ludo game. Ludo games are usually done conventionally using a game board (Ningsih & Pritandhari, 2019). But by looking at the times and accompanied by information and communication technology, the ludo game can be developed based on android. The android based chemical ludo game can be done online or offline. The selection of media used in this lesson will certainly make it easier for students to understand the material provided by the teacher (Mardhiah et al., 2018). Research on the development of an android based chemical ludo game on reduction and oxidation reaction materials has been carried out in previous research by Aptriyani which has been tested for validity and practicality but has not yet been tested for the effectiveness of using the android

based chemical ludo game media material for reduction and oxidation reactions on student learning outcomes (Aptriyani, 2021).

Based on this background, research was conducted with the aim of revealing the level of effectiveness of using the android based chemical ludo game media on reduction and oxidation reaction material on the learning outcomes of class X SMA/MA students. It is hoped that later this media can become input material for chemistry teachers so that give exercise to students is more interesting and fun, one of which is by using the android based ludo chemistry educational game, besides that as a way to help students solidify the concept of class reduction and oxidation reaction material X SMA/MA. The hypothesis in this study is "The use of chemical ludo game media based on Android with reduction and oxidation reaction material is effective in increasing student learning outcomes significantly in the cognitive domain for class X SMA/MA ".

METHOD

The research is advanced research on the development of Educational Design Research with Plomp model which has been tested validity and practicality and then a product effectiveness test will be carried out on the android based chemical ludo game media, reduction and oxidation reaction material on the learning outcomes of class X SMA/MA. The research design is pretest-posttest control group design with a randomly selected sample group (Hardani et al., 2020). Design research is described in Table 1.

Table 1. Pretest Posttest Control Group Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

This research use two classes, namely the experiment class and also control class. In the experiment class the exercises carried out were assisted by using the android based chemical ludo game media. Meanwhile, the control class did not use the android based chemical ludo game media. This research was carried out at SMAN Binaan Khusus Dumai City in 2022/2023 academic year. This research location at SMAN Binaan Khusus Dumai City, the population in this research all students of class X MIPA at SMAN SMAN Binaan Khusus, which consisted of 4 classes.

The sampling technique group used in this study is the probability sampling group with the sampling technique that is random sampling. The conditions that must be met to carry out random sampling are population members who are members of a homogeneous population (Hardani et al., 2020).The research variables consist of independent variables namely learning that is assisted by an android based chemical ludo game in the experimental class and learning without the aid of an android based chemical ludo game for the control class, dependent variables namely student learning outcomes in the cognitive domain derived from the results of the pretest and posttest of the experimental class and the control class, and control variables that are students' abilities at the beginning are equal, learning materials, learning resource books, and the time allocation used are uniform, the questions given are the same, and the teachers who teach are the same. The data used in this study is primary data. The research procedure consists of the preparatory stage by finding problems to preparing learning tools, the implementation stage which includes the learning process, and the final stage which includes the data processing stage and make conclusions.

The research instruments used in this study came from various techniques, namely through learning achievement tests and giving questionnaires in the form of check lists with the aim of strengthening the data obtained. A data collection technique that combines various data collection techniques as is done is called a triangulation technique (Hardani et al., 2020). The learning achievement test was carried out by both sample classes. The test used is a test

with multiple choice questions that are in accordance with indicators of achieving competence, so to be able to determine whether a test is appropriate for use or use it must meet several conditions which include item validity, item reliability, item discriminating index, and item difficulty index. Data analysis was carried out in the form of the N-Gain test. The data obtained from the results of the learning outcomes test were analyzed by calculating the n-gain as follows:

$$\text{N} - \text{Gain} = \frac{\text{posttest score} - \text{pretest score}}{\text{skor maksmaximum score} - \text{pretest score}}$$

The interpretation of the normalized gain index which has been modified can be seen in Table 2 (Hake, 2014).

Table 2. Criteria of N-Gain

N-Gain Score	Interpretation
0.0 < g< 0.30	Low
0.30 < g < 0.70	Average
0.70 < g < 1.0	High

After the N-Gain test, it is continued with the preliminary test before testing the hypothesis, namely the normality test using kolmogorov smirnov with significance level of 0.05, if the significance value is greater than 0.05 then the data is normally distributed, and vice versa. The homogenity test with variance test, at a significance level of 5%. A variance is said to be homogeneous if $F_{count} < F_{table}$, then the two groups have a non-homogeneous variance if $F_{count} > F_{table}$. The hypothesis test is using t-test. The statistical hypothesis can be formulated as follows:

$$Ho: \mu 1 \leq \mu 2$$

$$H1: \mu 1 > \mu 2$$

Information :
μ1 = Average score of the experimental class
μ2 = Average score of the control class

RESULTS AND DISCUSSION

This study aims to reveal the level of effectiveness of using the android based chemical ludo game media on reduction and oxidation reaction material on the learning outcomes of class X SMA/MA students. The chemical ludo game is used as a medium for give exercise in strengthening students' concepts of the reduction and oxidation reaction material that has been studied. In this study, there were two sample classes, namely the experimental class and the control class which were the objects of this study.

Effective Media Criteria Questionnaire

The results of evaluating the effectiveness criteria of the android based chemical ludo game media material for reduction and oxidation reactions (Badriyah, 2015) were analyzed by calculating the average answer based on the score of each answer from the respondents presented in Table 3.

Table 3. Results of Effective Media Criteria Questionnaire

No	Criteria	Percentage of Approval
1	Cost	88%
2	Availability of supporting facilies	89%
3	Match with class size	85%
4	Summary	82%

No	Criteria	Percentage of Approval
5	Ability to be changed	80%
6	Time and labor preparation	82%
7	Complexity	88%
8	Usability	89%

The effective of media has certain criteria, namely as follows (Badriyah, 2015):

1) Cost

Criteria for media that are cost effective are assessed by taking into account the costs incurred by users. Android based chemical ludo game media, reduction and oxidation reaction material does not cost too much to use because based on research that has been done, the use of chemical ludo games is not too wasteful of batteries, so it does not require a lot of electrical power to charge the battery on a smartphone. The use of android based chemical ludo game media requires an internet network for the game download process. The internet network used is sourced from student data packages and there are also school facilities in the form of school wifi, so students don't need to worry if they don't have an internet package. So that students do not spend a lot of money to use the chemical ludo game media for this reduction and oxidation reaction material. The number of respondents that filled questionnaire was 34 students. The number of points obtained from each category is Strongly Disagree (STS) with 1 point, Disagree (TS) with 2 points, Less Agree (KS) with 3 points, Agree (S) with 4 points, and Strongly Agree (SS) with 5 points according to the answers from 34 students is 149, and the total ideal score is 170. So the level of agreement of respondents related to expenditure that is not too large in the use of chemical ludo game media material in reduction and oxidation reactions is = (149 : 170) x 100% = 88% of expected (100%). The continuum is described as follows in Figure 1:

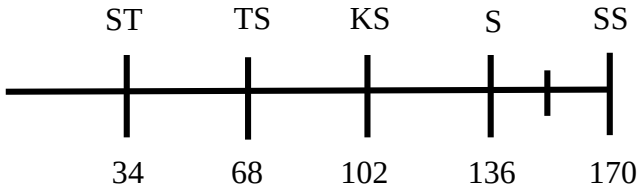

Figure 1. Interpretation of Points Total Cost Criteria

So based on the data obtained from 34 students, the number of points obtained (149) in the strongly agree area. This means that students strongly agree that in using the android based chemical ludo game media, reduction and oxidation reaction material does not require too much money.

2) Availability of supporting facilities

Criteria for effective media when viewed in terms of the availability of supporting facilities, namely the availability of supporting facilities in the form of adequate network or wifi and electricity. The existence of these supporting facilities can facilitate the use of android based chemical ludo game media. Supporting facilities in the form of wifi are available from the school, so students can use the wifi if they don't have an internet package. The next supporting facility is electricity. Electricity at the school is also sufficient so that students have no difficulty charging smartphones if the battery is low. With the existence of supporting facilities which will certainly support the ease of use of this ludo chemical game media, students will not find it difficult to access and use the chemical ludo game media for reduction and oxidation reaction materials. The number of respondents that filled questionnaire was 34 students. The number of points obtained from each category is Strongly Disagree (STS) with 1 point, Disagree (TS) with 2 points, Less Agree (KS) with 3 points,

Agree (S) with 4 points, and Strongly Agree (SS) with 5 points according to the answers from 34 students is 151, and the total ideal score is 170. So the level of agreement of respondents regarding the availability of supporting facilities such as adequate wifi and electricity to facilitate the use of chemical ludo game media material in reduction and oxidation reactions is = (151 : 170) x 100% = 89% of expected (100%). The continuum is described as follows in Figure 2:

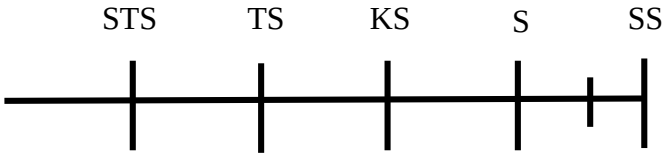

Figure 2. Interpretation of Points Total Criteria for Supporting Facilities

So based on the data obtained from 34 students, the number of points obtained (151) in the strongly agree area. This means that students strongly agree that with the existence of several supporting facilities that have been available such as school wifi and electricity, it can facilitate the use of android based chemical ludo game media, material for reduction and oxidation reactions.

3) Match with class size

The criterion of effective media in terms of compatibility with class size means that the android based chemical ludo game media, the reduction and oxidation reaction material used, can be used according to class size and number of students. The android based chemical ludo game media, material for reduction and oxidation reactions, is used in groups of 4 people per group, but there is 1 group which has 2 members because the number of students is not sufficient if the whole group has 4 members. Each group plays 1 media based chemical ludo game on Android. Based on the research conducted, all students can seriously answer and do exercises on the android based ludo chemistry game media and enjoy the game. The students were very enthusiastic about doing the exercises in the form of an android based chemical ludo game on reduction and oxidation reaction material. The number of respondents that filled questionnaire was 34 students. The number of points obtained from each category is Strongly Disagree (STS) with 1 point, Disagree (TS) with 2 points, Less Agree (KS) with 3 points, Agree (S) with 4 points, and Strongly Agree (SS) with 5 points according to the answers from 34 students is 144, and the total ideal score is 170. So the level of agreement of respondents regarding the android based chemical ludo game media material on reduction and oxidation reactions that match the class size is = (144: 170) x 100% = 85% of expected (100%). The continuum is described as follows in Figure 3:

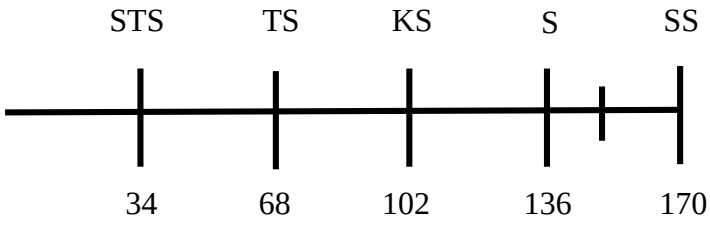

Figure 3. Interpretation of Total Points Class Size Compatibility Criteria

So based on the data obtained from 34 students, the number of points obtained (144) in the strongly agree area. This means that students strongly agree that the android based chemical ludo game media, reduction and oxidation reaction material, is suitable and

appropriate to the class size and number of students, as evidenced by the seriousness and enthusiasm of students in doing exercises on the android based chemical ludo game.

4) Summary

The criteria for effective media in terms of brevity have meaning, namely the android based chemical ludo game media, reduction and oxidation reaction material, contains questions covering the complete reduction and oxidation reaction material, so that it can assist students in consolidating concepts related to reduction and oxidation reaction material. been studied. Through the media of the android based chemical ludo game material for reduction and oxidation reactions, students can solidify the concepts from the exercises given. This is evidenced by an increase in student learning outcomes tests in the experimental class after being given the android based chemical ludo game media. The number of respondents who filled out the questionnaire was 34 students. The number of points obtained from each category is Strongly Disagree (STS) with 1 point, Disagree (TS) with 2 points, Less Agree (KS) with 3 points, Agree (S) with 4 points, and Strongly Agree (SS) with 5 points according to the answers from 34 students is 139, and the total ideal score is 170. So that the level of student agreement regarding the use of the ludo chemistry game media material on reduction and oxidation reactions can help students in strengthening concepts is = (139: 170) x 100% = 82% of expected (100%). The continuum is described as follows in Figure 4:

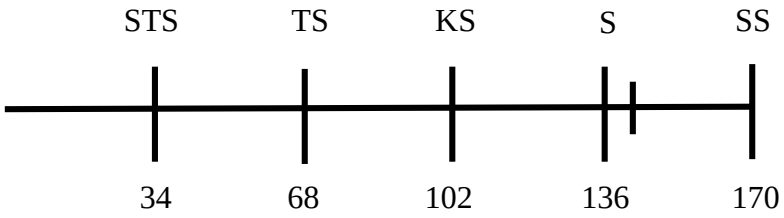

Figure 4. Interpretation of Points Total Summary Criteria

So based on the data obtained from 34 students, the number of points obtained (139) in the strongly agree area. This means that students strongly agree that the android based chemical ludo game media material for reduction and oxidation reactions can help students in strengthening the concept of material for reduction and oxidation reactions.

5) Ability to be changed

Criteria for effective media in terms of the ability to be changed, namely the media used can be adapted to the needs of students. The android based chemical ludo game media, material for reduction and oxidation reactions according to the needs of students, namely being present as a medium that can make students feel happy and challenged so that students become enthusiastic about doing the exercises. Previously, the exercise was carried out using print media only, but with the android based chemical ludo game media, this can be an alternative in carrying out fun exercises. The number of respondents who filled out the questionnaire was 34 students. The number of points obtained from each category is Strongly Disagree (STS) with 1 point, Disagree (TS) with 2 points, Less Agree (KS) with 3 points, Agree (S) with 4 points, and Strongly Agree (SS) with 5 points according to the answers from 34 students is 136, and the total ideal score is 170. So that the level of student agreement regarding the material ludo chemical game media on reduction and oxidation reactions is in accordance with the needs of students to be an alternative to doing exercises that are fun is = (136 : 170) x 100% = 80% of expected (100%). The continuum is described as follows in Figure 5:

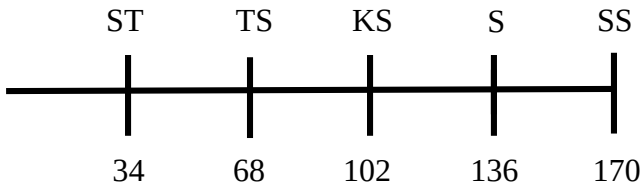

Figure 5. Interpretation of Total Score Criteria Ability Changed

So based on the data obtained from 34 students, the number of points obtained (136) in the agreed area. This means that students agree that the android based chemical ludo game media, material for reduction and oxidation reactions, is in accordance with the needs of students who need fun learning media in doing exercises, so that students can be more enthusiastic about doing the exercises.

6) Time and labor for preparation

The criteria for effective media are also related to the time and labor of preparation. The time needed to use the media can be adjusted according to the available time. The running time for the android based chemical ludo game on reduction and oxidation reaction material is 45 minutes or 1 lesson hour. Based on the research that has been done, during the use of chemical ludo game media, material for reduction and oxidation reactions, students do not lack time to use it. The number of respondents who filled out the questionnaire was 34 students. The number of points obtained from each category is Strongly Disagree (STS) with 1 point, Disagree (TS) with 2 points, Less Agree (KS) with 3 points, Agree (S) with 4 points, and Strongly Agree (SS) with 5 points according to the answers from 34 students is 139, and the total ideal score is 170. So the level of student agreement regarding the time needed to play this chemical ludo game media according to the time available during learning is = (139: 170) x 100% = 82% of expected (100%). The continuum is described as follows in Figure 6:

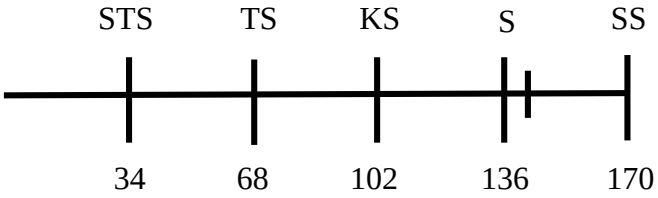

Figure 6. Interpretation of Points Total Criteria Time and Personnel Preparation

So based on the data obtained from 34 students, the number of points obtained (139) in the strongly agree area. This means that students strongly agree that the time to use the android based chemical ludo game media material for reduction and oxidation reactions is in accordance with the time available during the learning process.

7) Complexity and usability

The next criteria for effective media relate to complexity and usability. The media used is easy to use and apply and can help students in the habituation step of using technology, one of which is a smartphone, namely Android in the learning process, so that students are not only fluent in using technology to access social media, but the use of technology is also useful and useful in supporting learning.. The android based chemical ludo game media has a manual book that can assist students in operating this game media, but if students still do not understand how to play the chemical ludo game media, students can ask the teacher who teaches. The number of respondents who filled out the questionnaire was 34 students. The number of points obtained from each category is Strongly Disagree (STS) with 1 point, Disagree (TS) with 2 points, Less Agree (KS) with 3 points, Agree (S) with 4 points, and

Strongly Agree (SS) with 5 points according to the answers from 34 students is 150, and the total ideal score is 170. So that the level of student agreement regarding the android based chemical ludo game media, reduction and oxidation reaction material that is easy to operate is (150: 170) x 100% = 88% of expected (100%). The continuum is described as follows in Figure 7:

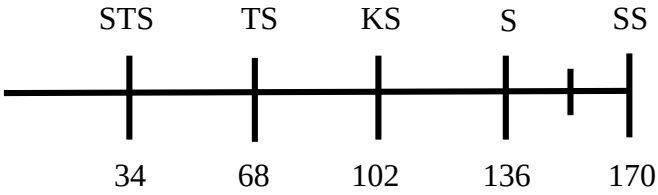

Figure 7. Interpretation of Total Points of Complexity Criteria

So based on the data obtained from 34 students, the number of points obtained (150) lies in the strongly agree area. This means that students strongly agree that there is ease in operating and using the android based chemical ludo game media, material for reduction and oxidation reactions.

In addition, the android based chemical ludo game media for reduction and oxidation reactions material, can help familiarize the use of technology such as android in the learning process is = (152: 170) x 100% = 89% of expected (100%). The continuum is described as follows in Figure 8:

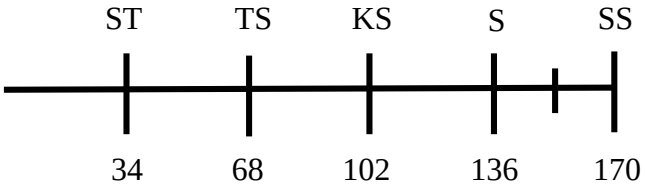

Figure 8. Interpretation of Usefulness Criteria Total Points

So based on the data obtained from 34 students, the total score obtained (152) lies in the strongly agree area. This means that students strongly agree that the android based chemical ludo game media, material for reduction and oxidation reactions, can be useful for helping the habituation of using technology such as android in the learning process.

Description of Research Data

Before the perocess of learning reduction and oxidation reaction material is carried out, each sample class namely the experimental class and the control class is given a pretest which aims to determine the initial students abilities regarding the material to be studied. The description of the research data is as follows in Table 4.

Table 4. Research Data

No	Statistics	Experiment Class		Control Class	
		Pretest	Posttest	Pretest	Posttest
1	Number of samples	34	34	34	34
2	Total value	1184	2920	1140	2216
3	Mean	35	86	34	65
4	Highest score	52	100	48	80
5	Lowest score	12	68	12	36
6	Standard deviation	12	10	11	12
7	Variants	140	110	112	150
8	Ranges	40	32	36	44
9	Median	40	84	36	72

The results of the initial ability of students in the experimental class and control class with the average pretest value of the experimental class 35 and the control class 34. The average pretest value shows that the two sample classes have initial abilities that are not much different. In accordance with the research Yanida & Iswendi (2018) that the initial ability of the students is the same as one of the variables that must be controlled by researchers in research.

The next activity after the pretest was carried out in the experimental class and control class was continued with learning on the material of reduction and oxidation reactions. In the learning process each sample class is given the same treatment. Learning materials, learning resource books, time allocation, teaching teachers, and practice questions in each of the sample classes are the same. Different treatment was given at the time of giving the exercises, in the experimental class using the android based chemical ludo game media on reduction and oxidation reaction material while in the control class the exercises were carried out conventionally such as using paper. The exercise using the android based chemical ludo game media, reduction and oxidation reaction materials, produces a total range of correct answers more than the exercise using only paper. This is because the students are enthusiastic about the ludo chemical game media as an alternative to doing the exercises, so that students are more enthusiastic about doing the exercises. This is also supported by research Ramadhani (2019) that the use of chemical ludo game media in learning is also interesting and fun so that students are not burdened and actively participate in doing exercises, this is what makes students enthusiastic in doing exercise. In addition, this chemical ludo game can also provide an interesting and competitive experience that motivates students to win the game. After being given different treatment when giving exercises to students, then the two sample classes were given a final test or posttest.

The final test (posttest) aims to determine the learning outcomes achieved by students after being given treatment. The average posttest score for the experimental class was 86 and for the control class was 65. From the average posttest score it can be seen that the posttest score for the experimental class was higher than the posttest score for the control class. The average value of the final test (posttest) in the experimental class and control class has a significant difference which can be seen in Table 5.

Table 5. The significance of Pretest and Posttest Scores

Class	Pretest	Posttest	Significant
Experiment	35	86	51,06
Control	34	65	31,65

Based on the average value of the pretest and posttest in the experimental class and the control class experienced significance. This is because in the experimental class when conducting concept strengthening, namely carrying out exercises using the android based chemical ludo game media on reduction and oxidation reaction material, it can be seen that all students actively participate in doing the exercises because they are fun in the step of strengthening concepts related to reduction and oxidation reaction material which have studied before. Supported by the findings by Fadillah (2019) there is a significant difference because in consolidating concepts in the experimental class students work on practice questions on games so that students participate and are motivated in learning. By using the game each student will compete to win the game so that students are fully involved in the learning process. In contrast to the control class, to solidify the concept students did not do exercises with games because generally students did not participate when faced with questions.

Games can also stimulate someone to learn something new and also provide a pleasant experience for students because of the interaction between players in the game, besides that it also provides skills in solving problems (MZ, 2013). Whereas in the control class the exercise

was given to solidify the concept in a conventional way using paper, from this treatment most students lacked participation and lacked enthusiasm in doing the exercises. Thus the effort to consolidate the concept in the control class is not optimal. So that the achievement of each Competency Achievement Indicator (IPK) from giving tests to the experimental class and the control class contains the result that the achievement of each IPK on the test in the experimental class is higher than the control class.

A learning media is said to be effective if students who complete the Minimum Completeness Criteria (KKM) are not less than 75% of the number of students (Heriyanto et al., 2013). The KKM set at school for chemistry subjects is 72. Based on research, posttest data for each student in the experimental class as many as 28 out of 34 students achieved KKM with a completeness percentage of 82% and an average score of 86 while in the control class only 9 of the 34 students who achieved the KKM with a completeness percentage of only 26% and an average score of 65, can be seen in Table 6.

Table 6. Percent Completeness of Sample Class

Class	KKM	Average value	Completeness percentage (%)
Experiment	75	86	82%
Control		65	26%

N-Gain Test

The results of the pretest and posttest were then analyzed to obtain the average N-Gain for the experimental class and the control class which can be seen in Table 7.

Table 7. The average of N-Gain Test

Class	N-Gain Average	Criteria
Experiment	0.79	High
Control	0.47	Medium

The average N-Gain result for the experimental class was 0.79 in the high category and for the control class was 0.47 in the medium category. This shows that there is an increase in students' cognitive learning outcomes which are better in the experimental class using the android based chemical ludo game media material for reduction and oxidation reactions compared to the control class which only uses paper.

Normality Test

The results of the normality test for the two sample classes can be seen in Table 8.

Table 8. Sample Class Normality Test Results

Class	α	D_{table} value	D_{count} value	Conclusion
Experiment	0.05	0.22743	0.11859	normally distributed data
Control		0.22743	0.195624	normally distributed data

Based on the normality test, it can be seen that the D_{count} value in the experimental class and the control class is smaller than the D_{table} value. So it can be concluded that the data obtained in the experimental class and control class are normally distributed data.

Homogenity Test

The results of the homogeneity test of the two sample classes can be seen in Table 9.

Table 9. Sample Class Homogenity Test Results

Class	α	F_{table} value	F_{count} value	Conclusion
Experiment Control	0.05	1.7878	1.2531	Homogeneous data

Based on the data processing obtained from the F test, it was found that F_{table} = 1.7878 and F_{count} = 1.2531. This shows that $F_{count} < F_{table}$ means that the difference between the pre-test and post-test scores in the two sample classes has a homogeneous variance.

Hypothesis Test

The results of data processing show that the two sample classes, namely the experimental class and the control class, are normally distributed and have a homogeneous variance. Furthermore, testing the hypothesis with the t test because the sample class is normally distributed and has a homogeneous variance. The results of hypothesis testing can be seen in Table 10.

Table 10. Sample Class Hypothesis Test Results

Class	X Mean	Significance	t_{table}	t_{count}
Experiment	51.06	0.05	7.84527	1.668
Control	31.65			

Based on data processing, the t_{count} was 7.84527 and the t_{table} at a significant level of 0.05 was 1.668. The test criteria are accept H_0 if $t_{count}t < t_{table}$ and reject H_0 if $t_{count} > t_{table}$. The calculation results show that the price of $t_{count} > t_{table}$, so that H_0 is rejected at a significant level of 0.05 and H_1 is accepted. This shows that the learning outcomes of the experimental class are higher than the control class. So it can be concluded that the use of android based chemical ludo game media material for reduction and oxidation reactions is effective in increasing student learning outcomes significantly in the cognitive domain in class X SMA/MA.

During the research process, there were obstacles encountered in the implementation of learning, namely when dividing study groups, many students did not agree with the division of group members that had been formed by the teacher, but this could be overcome by giving directions so that in learning students should not be allowed to choose friends and members. Group members should be able to work well together. Besides that, in playing this chemical ludo game media students can compete to solve problems on questions in the chemical ludo game so that students become more enthusiastic and challenged to do the exercises. However, students lack collaboration because in the study group the android based chemical ludo game is played individually in the study group.

Supporting research is utilized to become a reference in research activities in adding insight and knowledge related to research activities. Supporting research is intended so that the research conducted by researchers can be illustrated, where this research is in the same scope as previous research. Based on previous research conducted by Putri (2019) by using android-based learning media in the learning process it was found that there was an influence of learning using media to improve student achievement and provide a good influence in improving cognitive learning outcomes student. This is because android based learning can meet various student learning styles. Based on previous research conducted by Putra et al (2009: 9) it was seen that students' interest in learning media was in the ease of access and easily understood by students, so that the use of android application-based learning media received a positive response from students. In addition, it also increases student learning motivation and makes learning more active and interesting so as to foster students' willingness to learn which has an impact on increasing student learning outcomes. In addition, based on research Ramadhani (2019) the use of the ludo chemistry educational game as a learning medium can also improve student learning outcomes and understanding. Based on Ramadhanis' research results obtained, the average student learning outcomes in the experimental class were higher than those in the control class, this indicated that there was a positive impact on the use of media in the learning process. Among them is providing an interesting and competitive experience that motivates students to win games, so that the use

of the ludo chemistry educational game as a learning medium on chemical bonding material is effective in improving student learning outcomes.

CONCLUSION

Based on the results of research, data processing and data analysis conducted on the effectiveness of the use of android based chemical ludo game media material for reduction and oxidation reactions on student learning outcomes, it was concluded that the use of chemical ludo game media based on android reduction and oxidation reaction material is effective in improving student learning outcomes significantly in the cognitive domain in class X SMA/MA.

RECOMMENDATION

Recommendation with this research it is hoped that chemistry teachers can utilize android-based chemical ludo game material for reduction and oxidation reactions as an alternative medium used to provide exercise in the learning process of reduction and oxidation reaction materials, and it is recommended for future researchers to be able to condition students to collaborate with each other in using android-based chemical ludo game media material for reduction and oxidation reactions. So that besides students being able to compete and also students feeling happy while playing, students can also collaborate in using the Android-based chemical ludo game media material for reduction and oxidation reactions.

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