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The Practicality and Effectiveness of the Chemical Snakes and Ladders Game on Acid-Base Material on the Learning Outcomes of Class XI SMA/MA Students

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ABSTRACT

This research was motivated by the availability of the chemical ladder snake game as a medium for learning acid-base material developed by Amalia Putri Lubis & Iswendi. It is valid but not tested for practicality and effectiveness. This study aims to determine the suitability and effectiveness of the chemical snakes and ladders game. This type of research is a continuation of development research with a Pretest-Posttest Control Group Design and is a 4-D model development. The research population is class XI MIPA students of SMAN 1 Ranah Batahan. Samples take using by Simple Random Sampling technique. The research instruments were useful questionnaires and learning achievement tests. The data analysis technique is the practicality percentage technique and the N-Gain test and t-test. The results of the data analysis of practicality are, at a convenient level, for effectiveness the results of data analysis show pretty effective. This is evidenced by the N-Gain percentage of the experimental class of 66% at a somewhat adequate level and the control class of 47% at a less practical level, and supported by hypothesis testing with the t-test, namely $t_{count} (2.6686) > t_{table} (2.0106)$ at the real level $\alpha = 0.05$ with $dk = 48$ and chance $t0.95$.

1. Introduction

Effective learning can be retrieved when the learning process feels fun for students. Learning something fun makes students feel unburdened. Based on that assumption, teachers must design teaching strategies that make students like the learning process. One of the methods that can do is to use game-based learning media. According to Sadiman (2012), Game-based learning media will make students more active while learning. One example of game media that can use is the chemical snakes and ladders game.

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Based on the 2013 curriculum (Kemendikbud, 2018), acid-base material is a subject matter for chemistry class XI SMA/MA. This primary material has factual, conceptual, and procedural knowledge. Accurate knowledge of acid-base materials, such as acids, can change the colour of blue litmus paper to red, while bases can turn red litmus paper to blue. According to the theory of Arrhenius, Bronsted-Lowry, and Lewis, conceptual knowledge of acid-base materials is the definition of acids-base. Procedural knowledge of acid-base materials, for example, how to use a pH meter and test the properties of an acid or base solution. From the characteristics of the material, in the learning process, students are required to read a lot and discuss. They must actively carry out exercises to increase students' understanding and strengthen concepts of the material studied. This follows the opinion of Falahudin (2014) that efforts to improve student mastery regarding the material concepts, principles, or procedures that have been learned require practice.

Based on the results of a questionnaire obtained from students in class XI MIPA and a chemistry teacher at SMA Negeri 1 Ranah Batahan, from students in class XI MIPA and a chemistry teacher at SMA Negeri 1 Lembah Melintang and from class XI MIPA and a chemistry teacher at SMA Negeri 1 Koto Balingka, It was found that learning had never used learning media based on chemical snakes and ladders games on acid-base material as an alternative to training with a percentage of 100%.

According to Munadi (2013), the game as a learning medium is one of the multimedia that involves many senses in the game, causing students' remembering and learning activities to be more effective. The game of chemical snakes and ladders as a learning medium will make the learning atmosphere more enjoyable, so students' activities in education improve. Media games have an element of competition that makes students want to win in the games they play. It follows the game's characteristics, namely the enthusiasm to achieve achievements. Previous studies have shown that game-based learning media positively impacts student learning outcomes. Using the chemical ladder snake game in the TGT cooperative learning model positively affects student motivation and learning outcomes (Anggraeni, et al. 2018).

An exercise in the form of a chemical snake and ladder game that has been tested for its validity but has not yet been tested for its practicality and effectiveness. Suitability is tested to determine whether a media in the form of a chemical snakes and ladders game is practical. At the same time, the point was tested to determine whether a medium in the form of a chemical snakes and ladders game was effectively used. Based on the explanation above, the authors are interested in continuing the research from Amalia Putri Lubis and Iswendi (2021) to test the practicality and effectiveness of the chemical snakes and ladders media game seen from student learning outcomes. Snakes and Ladders game is a board game that two or more people usually play. Snakes and Ladders game is a game that is familiar to students and is one the games that is easy to do. The game of snakes and ladders tends to be in demand by all children because the rules of this game are pretty simple.

2. Methodology

The type of research used was quasi-experimental research with a pretest-posttest control group design. The form of the research design is presented in Table 1 (Sugiyono, 2012).

Table 1. Pretest-Posttest Control Group Design Research

Class	Pretest	Treatment	Posttest
Experiment	O ₁	X	O ₂
Control	O ₃	-	O ₄

Clarity:

O₁ : Initial test for the experimental class

O₃ : Initial test for the control class

X : Learning to use Snakes and Ladders game media on acid-base material

O₂ : Final examination for the practical class

O₄ : Final test for control class

This research was conducted in April-May 2022 at SMA N 1 Ranah Batahan. The population of this study was all students of class XI MIPA at SMA N 1 Ranah Batahan, which consisted of two classes, namely class XI MIPA 1 and class XI MIPA 2. The research sampling technique used Simple Random Sampling. The samples used by the researchers were two classes, namely class XI MIPA 1, which became the control class, and class XI MIPA 2, which became the experimental class.

Research variable:

- The independent variable of this research is learning assisted by Snakes and Ladders game media in the experimental class and ordinary learning in the control class.
- The dependent variable in this study is the learning outcomes of students obtained from the pretest and posttest results conducted in the experimental and control classes.
- The control variables in this study were educators who taught, the subject matter, the time provided, and questions on the pretest and posttest questions used.

Data is a collection of values that describe the characteristics of each individual in a specific population, and data can be in the form of letters, numbers, pictures, or sounds. The purpose of the data is to get as much information as possible from the population. The data used in this research is primary data. Primary data is taken directly from the research object (Usmeldi, 2014). Preliminary data from this study were obtained from students' learning outcomes in class XI MIPA SMA N 1 Ranah Batahan through pretests and posttests.

3. Results and Discussion

Based on the research conducted at SMA N 1 Ranah Batahan, data on student learning outcomes were obtained in the cognitive domain. Learning outcomes are assessed by giving an initial test (pretest) and a final test (posttest) in the form of 20 multiple-choice questions with five answer choices taken from the 40 questions that have been tried out. The initial test (pretest) is given to determine students' abilities before starting learning. In summary, the average pretest of students in the two sample classes is presented in Table 2.

Table 2. Average Sample Class

Class	N	Pretest average
Experiment	25	33,4
Control	25	34,8

Table 2 shows the average pretest score for the experimental class was 33.4, and the control class average was 34.8. Students' initial ability in the practical course is lower than in the control class. The final test (posttest) is given after the meeting ends in the learning process, which aims to determine student learning outcomes after treatment. In summary, the posttest results of students in the experimental and control class are presented in Table 3.

Table 3. Average Posttest Sample

Class	N	Posttest average
Experiment	25	78,6
Control	25	68,4

Table 3 shows the average value of the posttest experimental class is 78.6, and the average posttest value of the control class is 68.4. There is an increase in student learning outcomes in the practical course after treatment. The N-Gain test is used to determine the increase in students' understanding and mastery of concepts which can be seen from the results of cognitive learning before and after learning. The results of the percentage of N-Gain in the experimental and control classes are presented in Table 4.

Table 4. N-gain Test of Learning Outcomes

Class	Percentage %	Interpretation
Experiment	66 %	Effective enough
Control	47%	Less effective

Based on Table 4, the experimental class has an N-gain percentage of 66%. The learning outcomes in the practical course are at an adequate level. While the learning outcomes in the control class with an N-gain rate of 47%. The learning outcomes in the control class are less effective. The normality test is used to determine whether the data is normally distributed or not. The normality test carried out in this study used the Liliefors test. The results of the normality test from the research results are presented in Table 5.

Table 5. Test the Normality of Learning Outcomes

Class	N	α	L_0	L_t	Distribution
Eksperiment	25	0,05	0,1731	0,18	Normal
Control	25	0,05	0,1795	0,18	Normal

Table 5 shows that the two sample classes have $L_0 < L_t$ values at the significant level $\alpha = 0.05$. The learning outcomes of the two sample classes are typically distributed. The homogeneity test is used to see whether the data in the two samples have a homogeneous variance. The homogeneity test was carried out using the F test. The data processing results for the homogeneity test are presented in Table 6.

Table 6. Results of the Homogeneity Test of Learning Outcomes

Class	N	α	S^2	F_h	F_t	Information
Experiment	25	0,05	254	1,00994	4,04	Homogenous
Control	25	0,05	251,5			

Table 6 shows that both sample classes have $F_{\text{count}} < F_{\text{table}}$ on an actual level $\alpha = 0.05$. The learning outcomes of the two sample classes have a homogeneous variance. The last test is a hypothesis test used to determine whether the research hypothesis can be accepted. Based on the normality test and homogeneity test of the data on the difference in pretest and posttest scores, it can be seen that the learning achievement data of the two sample classes are normally distributed and have a homogeneous variance. Therefore, the hypothesis is tested by t-test, as presented in Table 7.

Table 7. Test the Learning Outcomes Hypothesis

Class	n	X means	S	t_h	t_t
Experiment	25	45,4	15,89	2,6686	2,0106
Control	25	33,4			

Table 7 shows that the value of $t_{\text{count}} > t_{\text{table}}$ face H_0 rejected. This indicates differences in learning outcomes in the experimental and control classes, where the practical course using the chemical ladder snake game media is higher than the control class. The chemical snakes and ladders game was tested for practicality and effectiveness. The picture of the chemical snakes and ladders board game used is presented in Figure 1.

a. In practice

1) Aspects of ease of use

From the ease of use of the chemical ladder snake game from the responses of teachers and students, the average scores were 100% and 86.88%, respectively, which were efficient. Shows that the match of chemical snakes and ladders on acid-base materials has been practical in terms of ease of use. This media has been systematically compiled and equipped with clear instructions for use and language that are easy to understand. This statement follows Setyosari's opinion (2018) that practical media is easy to use. The chemistry snakes and ladders game has an

exciting design complemented by pictures (in the form of images of snakes and ladders). With the help of photos, it makes it easier for students to learn. Afandi (2015) revealed that students would find it easier to understand because of the support from the pictures contained in the Snakes and Ladders game.



Figure 1. Board of chemical acid-base material snakes and ladders

b. In practice

2) Aspects of ease of use

From the ease of use of the chemical ladder snake game from the responses of teachers and students, the average scores were 100% and 86.88%, respectively, which were efficient. Shows that the match of chemical snakes and ladders on acid-base materials has been practical in terms of ease of use. This media has been systematically compiled and equipped with clear instructions for use and language that are easy to understand. This statement follows Setyosari's opinion (2018) that practical media is easy to use. The chemistry snakes and ladders game has an exciting design complemented by pictures (in the form of images of snakes and ladders). With the help of photos, it makes it easier for students to learn. Afandi (2015) revealed that students would find it easier to understand because of the support from the pictures contained in the Snakes and Ladders game.

3) Aspects of the efficiency of learning time

From the aspect of time efficiency in learning, the chemical ladder snake game on acid-base material was obtained from the responses of teachers and students, each worth 100% and 90.13%, which are at an efficient level. Shows that the chemical ladder snakes game can make students exercise according to their abilities and learning speed. This follows Kustandi and Sutjipto's (2016) opinion that using instructional media requires a short amount of time to convey learning content and messages in large quantities, and the possibility of students' absorption will be greater.

4) Benefits aspect

The benefits of the chemical ladder snake game on acid-base material obtained from the responses of teachers and students each scored 100% and 87.08% at an efficient level. Shows that the match of chemical snakes and ladders on acid-base materials developed is helpful in learning chemistry. Learning media using the chemical ladder snake game makes students active in education.

The practicality of the chemical ladder snake game on acid-base material can be seen from the student's activities during the game. Can be seen from the attitude of students who were initially passive to become active in participating in the learning process. The student's actions when using the chemical snakes and ladders game are presented in Figure 2. Using the chemical snakes and ladders game as an alternative exercise makes students enthusiastic about participating in the learning process. This happens because the chemical snakes and ladders game has an attractive design and is arranged systematically.



Figure 2. Exercise using the Material Chemical Snake and Ladder Game Acid Base

Student activity during the use of the chemical ladder snake game in participating in the learning process gives students a greater absorption power in receiving learning material quickly. This is because the chemical snakes and ladders game media used only takes a short time to convey content and learning messages in large quantities (Yuliani and Saragih, 2015).

c. Effectiveness

The effectiveness of using the chemical ladder snake game media on acid-base material is based on students' mastery of the material as measured by the percentage of learning completeness and the rate of N-gain. Based on the study's results, the experimental class had an N-gain percentage of 66%, which was reasonably practical. In comparison, the control class had an N-gain rate of 47%, which was less effective. Based on the percentage of learning completeness obtained by students, by calculating the number of students who reached the Minimum Completeness Criteria (KKM) limit set by the school for class XI, namely 75. The acquisition of posttest scores for each student in the experimental class was 22 out of 25 students reached KKM, so the percentage completeness is 88%, with an average value of 78.6. In the control class, 7 out of 25 students achieved KKM, so the percentage of completeness was 28%, with an average score of 68.4. in line with what was revealed by Rante (2013), one of the conditions that must be met to determine the effectiveness of a media, namely a minimum of 75% of student learning outcomes are in a complete category or meet the Minimum Completeness Criteria (KKM). Shows increased students' cognitive

learning outcomes, which are better in the experimental class using the chemical snakes and ladders game media.

The results of processing the normality and homogeneity test data show that the two sample classes are normally distributed and have a homogeneous variance. Hypothesis testing is done by t-test. Based on the processing of the hypothesis testing data, it can be seen that at the fundamental level $\alpha = 0.05$, the value of t_{count} (2.6686) $>$ t_{table} (2.0106). The calculation results show that the price of t is outside the acceptance area of H_0 , so H_0 is rejected at a significant level of 0.05, and H_1 is accepted. Shows that the learning outcomes in the experimental class are higher than the control class. So it can be concluded that using chemical Snake and Ladder snake game media on acid-base material can effectively improve student learning outcomes of class XI SMAN 1 Ranah Batahan, and the hypothesis is accepted.

Another thing that supports the effectiveness of the chemical Snakes and Ladders game as a learning medium can be seen from several criteria, such as the costs needed to make the chemical Snakes and Ladders game media affordable, the chemical snakes and ladders game used includes all the content in an acid-base material (abridged media), the time needed in using the chemical ladder snake game can be adjusted. Then the chemical ladder snake game media is a medium that is easy to use. Badriah's (2015) opinion is that several criteria are used to assess a media's effectiveness, such as the cost of making the media, brevity, time and labour for preparation, and ease of use.

Several obstacles occurred during the research, namely before the game started. The researcher conveyed the procedures for the rules of the game, and after it was explained, no one asked again. When the game started, there were still several coordinators who asked about the rules of the game. This was proven after 45 minutes. Only three groups had made it to the finish. The next obstacle was when selecting coordinators for each group. There were several groups whose members were unwilling to become coordinators because all group members wanted to be players.

4. Conclusion

The chemical snakes and ladders game as a learning medium for acid and base material developed is at an efficient level. Using the chemical ladder snake game as a learning medium for acid-base material effectively improves student learning outcomes for class XI SMA/MA. This is evidenced by the percentage of N-Gain in the experimental class of 66%, which is at a reasonably practical level, while in the control class, 47% is at a less reasonable level and is supported by hypothesis testing data at a significant level of 0.05 that t_{count} (2.6686) $>$ t_{table} (2.0106) so that H_0 is rejected and H_1 is accepted.

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