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Article

Effect of Plickers-Based Discovery Learning on Learning Outcomes in Salt Hydrolysis among Class XI MIPA Students at SMA Kartika XX-1 Makassar

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Article Info

ABSTRACT

Students are always faced with a saturated situation due to uninteresting and monotonous learning models and media. This causes students to pay less attention to the teacher's explanation and causes low student learning outcomes. One way to improve student learning outcomes is to use the Discovery Learning Model with the help of technology-based assessment tools, namely Plickers. The purpose of this research was to determine the effect of Plickers media in the Discovery Learning Model on the learning outcomes of Class XI MIPA students at SMA Kartika XX-1 Makassar. The research method used was quasi-experimental using a post-test only control group design. The research population was all classes XI MIPA SMA Kartika XX-1 Makassar with a total of six classes. The research sample was class XI MIPA 5 as the experimental class and class XI MIPA 4 as the control class. The data collection technique was carried out by giving a multiple-choice test with 20 validated items to obtain learning outcome data. Inferential statistical analysis used the Mann-Whitney test and obtained $Z_{count} = 10.94$ and the Z_{table} value at the 0.05 level of significance is 1.65. So that Z_{count} (10.94) > Z_{tabel} (1.65), which means that the Plickers media in the Discovery Learning Model has an effect on participant learning outcomes. Class XI MIPA students at SMA Kartika XX-1 Makassar on the main material of salt hydrolysis.

INTRODUCTION

The Indonesian government through the Ministry of Education and Culture continues to make updates and innovations in the field of education, one of which is in the curriculum. Currently, the curriculum in Indonesia is the 2013 curriculum. Kartika XX-1 Makassar high school which is the location of this research has also implemented it. The 2013 curriculum is a curriculum that is focused on students to be ready to face future challenges, and also to anticipate possible developments (Kurniawan & Susanti, 2021). Thus, in the development of education, it must be integrated with the existing curriculum in improving the quality of

students. The quality of learning is supported by continuous learning components. The components of learning include learning objectives, learning materials, learning methods, learning media, learning evaluations, learning models, learning strategies, students and teachers (Subakti et al., 2022).

From the results of interviews with chemistry teachers at SMA Kartika XX-1 Makassar, information was obtained that the application of the Discovery Learning model had been implemented, but the learning outcomes obtained were not optimal. In the learning process that occurs, only a small proportion of students are active in terms of the stimulus given by the teacher due to the lack of enthusiasm of students as well as in data collection or proof activities. This can be seen from the learning evaluation results of some students on salt hydrolysis material which is still below the predetermined Learning Objective Achievement Criteria (KKTP) of 75.

From the interview results, it was obtained that most students considered hydrolysis to be a difficult material to understand. Salt hydrolysis is considered difficult by most students because hydrolysis material is material that requires students' understanding at the macroscopic, submicroscopic, and symbolic representative levels, while some students find it difficult to understand the three characteristics of the material (Andina et al., 2017). Difficulty in understanding this chemical material causes less than optimal learning outcomes for students, including the achievement of cognitive, affective and psychomotor abilities. This has an impact on student learning outcomes which are classified as low.

The low learning outcomes of students caused by the lack of student activity can be overcome by implementing a learning activity with an effective, innovative, creative and enjoyable learning model to plan, implement and evaluate towards the expected goals. The learning model that is oriented to train innovative 21st century skills is group discussion, simulation, case study, collaborative learning, cooperative learning, project-based learning, problem-based learning, or other learning that can effectively facilitate the fulfillment of learning outcomes. One of the innovative learning models in the 2013 curriculum that provides guidelines in the learning process is the Discovery Learning Model.

The implementation of the Discovery Learning Model aims to enable students to understand the material on changes in the form of objects as well as possible and learning feels more meaningful, so that student learning outcomes will also increase. The Discovery Learning Model is a learning model in the form of finding problems and students also seek solutions to the problems that have been found so that educators only provide direction if students experience difficulties (Eskris, 2021). The Discovery Learning Model is a learning model that encourages students to be active, so that it has a positive impact on communication and learning, which can ultimately influence cognitive aspects (Pranoto, 2023).

In the learning process, students are always faced with a saturated situation because the teaching models and media are less interesting and monotonous. This causes students not to pay attention to the teacher's explanation and causes low student learning outcomes. One way to improve student learning outcomes is by using the Discovery Learning Model assisted by learning media. The use of media in learning is one form of creativity that can be done to improve student learning outcomes in the learning process. Some media that can be used in learning, especially in chemistry learning on salt hydrolysis material include Kahoot, Socrative, and Plickers. Research results Solmaz & Cetin (2017), revealed that Plickers was most preferred by students from the three media. So that the learning media that can be used to improve student learning outcomes is using Plickers media. Plickers is a technology-based assessment tool that allows teachers to conduct interactive assessments without requiring electronic devices from students. This media was chosen because it is widely used at various levels of education to increase student engagement, provide immediate feedback, and overcome limited access to technology in the learning environment (Chou, 2022; Nunes et al., 2023; Pearson, 2020; Situmorang & Mediatati, 2023; Zubaidi et al., 2022).

Plicker is a technology-based interactive assessment tool that uses paper card s with QR codes to collect and analyse student learning data using mobile devices. In the learning process, teachers can use Plicker to create quizzes, collect student answers, and view analysed results in real-time. The way it works, students answer questions by lifting the unique card that has been provided, students do not need to use electronic devices and internet connections so that students can still follow the lesson, and still feel fun and make students not bored with the use of media (Kim et al., 2018).

Referring to the background description above, the author is interested in conducting research related to the Influence of Plickers Media in the Discovery Learning Model on the Learning Outcomes of Class XI MIPA Students of SMA Kartika XX-1 Makassar on the Main Material of Salt Hydrolysis. This research aims to determine the effect of Plickers media in the Discovery Learning Model on the learning outcomes of Class XI MIPA students at SMA Kartika XX-1 Makassar. This research is new because it combines the use of Plickers an assessment tool that does not rely on student-owned devices with the structured phases of the Discovery Learning model, creating a hybrid approach that is rarely explored in previous studies, particularly in the context of high school chemistry education. Unlike other studies that utilize smartphone-based applications like Kahoot or Quizizz, this research highlights the unique advantages of Plickers in low-tech classroom environments while addressing the specific cognitive demands of learning salt hydrolysis.

Several previous studies have proven that Plickers media can improve the effectiveness of learning and evaluation at various levels and subjects Situmorang & Mediatati (2023) in her research showed that the use of Plickers media in Civics subjects at SMK Negeri 2 Salatiga was able to significantly reduce the level of cheating behaviour. This study used a descriptive qualitative approach with a focus on changes in learner behaviour as an indicator of the success of learning evaluation. Meanwhile, Safitri et al. (2024) conducted a class action research (PTK) and found that the application of Plickers media in learning mathematics at the elementary school level can significantly increase student learning activeness. Furthermore, Nugroho & Dewantoro (2023) also used the Kurt Lewin model PTK approach and found that the implementation of Plickers in Islamic Religious Education (PAI) subjects contributed to improving students' cognitive abilities at the C1 and C2 levels at SDN Candirejo, Sleman. The implication of this research is that it provides new insights for teachers and educational practitioners about the importance of media selection in accordance with classroom conditions to improve learning effectiveness. The use of Plickers in Discovery Learning can be used as an alternative learning strategy that encourages active student involvement, as well as an innovative solution to overcome the limitations of technological facilities in the chemistry learning process. In addition, the results of this study can be used as a basis for developing ICT-based learning models that are adaptive to the educational environment in Indonesia.

METHODS

This type of research is a quasi-experimental research, which was conducted in the even semester of the 2023/2024 academic year, at SMA Kartika XX-1 Makassar Jl. Sungai Tangka No.13 Sawerigading South Sulawesi Province. The population in this study were all students of class XI MIPA SMA Kartika XX-1 Makassar in the academic year 2023/2024. The sampling technique used in this study was simple random sampling. Of the six XI MIPA classes at SMA Kartika XX-1 Makassar, two classes were randomly selected to be used as experimental and control classes. The selection was carried out by giving a number to each class, then a random draw was made to determine the class that would be used as the experimental class (which used Plickers in the Discovery Learning model) and the control class (which did not use Plickers in the Discovery Learning model). XI MIPA IV was chosen as the control class and XI MIPA V as the experimental class. This study compares the learning outcomes of students who use Plicker media for the experimental class with students who do not use Plicker media for the

control class but both classes are taught using the Discovery Learning Model on Salt Hydrolysis material. The research design used was posttest only control group design.

The data collection techniques used were observation of implementation and tests. The test given to students is a multiple choice test that has been validated by expert validation. The instrument used in this research is a learning outcome test in the form of multiple choice questions with indicators compiled based on basic competencies and learning objectives. This instrument consists of 20 questions that cover aspects of conceptual, procedural, and analytical knowledge related to the topic of salt hydrolysis. The questions taken cover all indicators on the material that will be used as a posttest to determine the improvement of student learning outcomes in experimental and control classes. Instrument validation was carried out through two stages, namely Content Validity Test where the instrument was validated by two experts, namely chemistry education lecturers and high school chemistry teachers, to assess the suitability of the questions to the indicators, level of difficulty, and relevance to the material. Revisions were made based on input from the experts. The revised questions were tested on 30 students from schools with similar characteristics. The test results were then analysed using item validity test (point biserial correlation), reliability test (Cronbach's Alpha), as well as analysis of the difficulty level and differentiating power of the questions. Only questions that met the criteria were used in the research.

The Discovery Learning model in this study consists of five stages, each of which is synergised with the use of Plickers media, as follows:
1. Stimulation: The teacher starts the learning by asking triggering questions and contextual phenomena related to salt hydrolysis material.
2. Problem Statement: Students are directed to formulate problems based on the stimulus that has been given.
3. Data Collection: Students explore and observe the data or information provided by the teacher.
4. Data Processing: Students process information and make provisional conclusions from their findings.
5. Verification and Generalisation: At this stage, students test the correctness of the concept through class discussion. Plickers is used for a closing quiz in the form of conclusive questions to measure final understanding and validate student learning outcomes.

RESULTS AND DISCUSSION
1. Research result
a. Descriptive Statistical Analysis

Descriptive statistical analysis is used to provide an overview of the characteristics of learning achievement of class XI MIPA students at SMA Kartika XX-1 Makassar on salt hydrolysis material. Student learning outcomes based on the results of descriptive statistical analysis can be seen in Table 1.

Table 1. Results of Descriptive Statistical Analysis of Learning Outcomes in Experimental Class and Control Class

No.	Statistics	Statistical Values	
		Experimental Class	Control Class
1.	Number of Students	35	33
2.	The highest score	100	95
3.	Lowest Value	65	55
4.	Average value	81.04	73.7
5.	Median (Me)	74.25	75.5
6.	Mode (Mo)	76.5	73.17
7.	Standard Deviation	9.24	10.79

The post-test scores in the experimental and control classes showed that the experimental class was higher with an average score of 81.04, compared to the control class with an average score of 73.7. The post-test scores in the experimental and control classes showed that the experimental class was higher than the control class with an average score difference of 7.27.

The values obtained by students in the experimental class and control class, if the students' learning outcomes are grouped into the category of learning outcome completion based on the learning completion standards for chemistry class XI MIPA SMA Kartika XX-1 Makassar, then the frequency and percentage data on the students' learning outcome completion are obtained as in Figure 1.
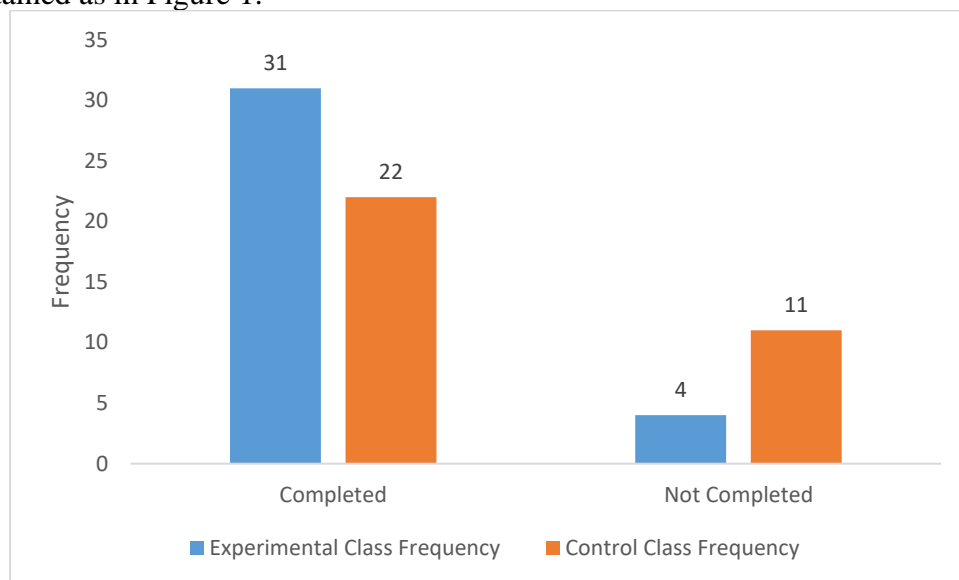

Figure 1. Criteria for Student Learning Outcome Completion

Figure 1 shows a comparison of the completion rate of learning outcomes between the two classes, namely the Experimental Class and the Control Class. The completeness obtained by the experimental class is higher than the control class. This shows that the use of Plickers media in the Discovery Learning Model for the experimental class provides higher learning outcomes compared to the control class using the Discovery Learning Model without Plickers media. In the category of students with a score ≥ 75 (who have completed the task), the Experimental Class recorded 31 students or 88.57% who successfully completed, while the Control Class only recorded 22 students or 66.67%. On the other hand, in the category of students with scores < 75 (who had not completed the task), the Experimental Class had 4 students or 11.43% who had not completed, while the Control Class had 11 students or 33.33% who had not completed. Overall, the Experimental Class showed a higher completion rate compared to the Control Class, with fewer students not completing the learning outcomes in the Experimental Class.

Another thing that supports learning outcomes is the observation of the implementation of learning using Plickers media in the Discovery Learning Model in the experimental class and the control class without using Plickers media. Based on the results of observations of the implementation of learning in the experimental class and the control class, the percentage of observations of the implementation of learning was obtained, namely both producing very good observations.

Inferential statistical analysis is used to test the research hypothesis, namely whether there is a *Plicker* media influence in Model *Discovery Learning* on student learning outcomes. However, before the hypothesis test was conducted, a prerequisite test was conducted, namely the normality test and the homogeneity test on the experimental class and the control class. Based on the prerequisite test, it was found that both the control class and the experimental

class data were not normally distributed. In addition, based on the homogeneity test, it was found that the experimental class and the control class were homogeneous.

b. Hypothesis Testing

This hypothesis testing uses *non-parametric* statistical test, namely *Mann-Whitney test* (z test). The scale of the data is ordinal, i.e. from ranked results.

$$\text{H}_0 : Z_{calculated} \leq Z_{table}$$
$$\text{H}_1 : Z_{calculated} > Z_{table}$$

The results of the calculation of the ranking of student learning outcomes using the Mann-Whitney test can be seen in Table 3.

Table 3. Hypothesis Test of Student Learning Outcomes

Class	Amount	Zcalculated	Ztable = 0.05	Conclusion
Experiment	35	10.94	1.65	H_0 is rejected and H_1 is accepted
Control	33			

From the data, it can be seen that z count (10.94) > z table (1.65). This shows that H_0 is rejected and H_1 is accepted and it is concluded that there is an influence of Plickers media in the Discovery Learning Model on the learning outcomes of class XI MIPA students at SMA Kartika XX-1 Makassar on the material of salt hydrolysis.

2. Discussion

This study aims to determine whether or not there is an influence of *Plicker* media in the Discovery Learning model on student' learning outcomes of class XI MIPA SMA Kartika XX-1 Makassar on the topic of salt hydrolysis. Plickers is one of the online platforms or media that helps teachers to provide quick testing of students' knowledge through multiple-choice questions that are packaged like a game. This study compares the learning outcomes of students who use *Plicker* media for experimental classes with students who do not use Plickers media for the control class but both classes were taught using the Discovery Learning Model on the Salt Hydrolysis material. This Plickers media is used at the verification stage, where each student is given a different QR card. Students are given questions that have been prepared on a computer connected to the Plickers application on a mobile device, then they will be displayed on the screen. Students answer questions by lifting the card with choices A, B, C, and D, according to the answers that students have determined, the teacher plays a role in scanning the results of students' answers using a mobile device, the answers from students right or wrong will appear on the monitor screen. This stage aims to train students' thinking skills and students are very active in solving every problem faced, this certainly has a good impact on student learning outcomes.

Based on inferential statistical analysis, the truth of a hypothesis is proven through hypothesis testing. However, a prerequisite test is first carried out, namely the normality test and the homogeneity test. Based on the analysis of the prerequisite test, it is stated that the data from the experimental group and the control group come from a population that is not normally distributed and both groups come from homogeneous variances. Therefore, hypothesis testing is carried out using statistical *non parametric* test (Mann-Whitney test). The results of the hypothesis test show the z-count value (10.94) > z-table (1.65), This shows that H0 is rejected and H1 is accepted and it can be concluded that the Plickers media in the Discovery Learning Model has an effect on the learning outcomes of class XI MIPA students at SMA Kartika XX-1 Makassar on the material of salt hydrolysis. The use of Plickers media in chemistry learning through the Discovery Learning Model makes students in the experimental class achieve higher learning outcomes than the learning outcomes of students in the control class. This is because students are more stimulated to follow the learning process, making students more active in learning in class. During the process, Plickers arouses students' interest, makes them more enthusiastic and very satisfied, so that student learning is more focused (Situmorang & Mediatati, 2023). Plickers media is more effective than using models alone so that it can improve student learning outcomes Chou (2022); Nunes (2023); And Babacan & Guler (2022).

In line with Arifin & Irawan (2021) who stated that the use of this learning model provides opportunities for students to find concepts related to the material independently. As a result, students can hone and optimise their logical thinking skills to solve problems they face during the learning process.

Plickers can increase student engagement and participation. Students are more active and engaged in the learning process, both in large and small classes, as Plickers allows all students to participate equally without device barriers (Auliya et al., 2023; Chou, 2022; Elmahdi et al., 2018; Utaminingsih & Setiawaty, 2023). The classroom atmosphere also becomes more interactive and fun, so students are more motivated to learn (Auliya et al., 2023; Chou, 2022; Elmahdi et al., 2018). To improve students' thinking skills, what must be done is to arouse students' interest (Al Mustafid et al., 2024). If students are motivated to develop their abilities, then students are more challenged to acquire new knowledge which in turn can improve their learning outcomes (Pristianti & Prahani, 2023).

Most students found Plickers easy to use, made learning more interesting, and helped them stay focused (Auliya et al., 2023; Hassan & Hashim, 2021; Wiyaka & Prastikawati, 2021). Students feel more motivated and challenged to actively participate in learning (Hassan & Hashim, 2021). In addition, students get immediate feedback on their answers, making the learning process more effective and reflective (Elmahdi et al., 2018; Wiyaka & Prastikawati, 2021).

This study has several limitations that need to be considered in interpreting the results, including:

1. Limited Scope of Research Subjects. This study was only conducted in one school with a limited number of samples, so generalisation of the results to a wider population needs to be done carefully.
2. Limited Research Time. The learning treatment with Plickers media was only conducted in a few meetings, so the long-term impact on learning outcomes or student retention cannot be known thoroughly.
3. Uncontrolled Intervening Variables. External factors such as individual motivation, students' psychological condition, and home learning environment support were not directly measured, but may affect students' learning outcomes.

To reduce potential bias, researchers tried to maintain teaching consistency between classes, equalise teaching materials and learning time, and use validated evaluation instruments.

CONCLUSION

Based on the results of data analysis and discussion obtained the average learning outcomes of the experimental class were higher than the control class, with an average value of the experimental class of 81.04 and an average value of the control class of 73.7, and Zcount > Ztable (10.94 > 1.65) so it can be concluded that H0 is rejected and/or H1 is accepted which means there is an influence of Plickers media in the Discovery Learning Model on the learning outcomes of class XI MIPA students at SMA Kartika XX-1 Makassar on the material of salt hydrolysis.

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