The Effect of Macromedia Flash-based Animation Media on the Discovery Learning Model on the Learning Outcomes of Class XI Science Students of SMAN 5 Makassar

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ABSTRACT

This quasi-experimental study investigated the impact of using Macromedia Flash-based animation media integrated with the Discovery Learning model on the learning outcomes of Class XI Science students at SMA Negeri 5 Makassar regarding buffer solutions. Employing a posttest-only control group design, the research sampled from a population of eight XI Science classes using random sampling. Class XI Science 1 served as the experimental group, while XI Science 2 was the control group. The experimental group achieved a significantly higher average learning outcome score (80.86) compared to the control group (63.69). Inferential statistical analysis (Mann-Whitney U test, $\alpha = 0.05$) revealed that while the data was homogeneous, it was not normally distributed. The result ($Z\_count = 5.56 > Z\_table = 1.64$) indicates a statistically significant positive effect of the Macromedia Flash-based animation media within the Discovery Learning model on student learning outcomes for the buffer solution topic.

Keywords: animation media, macromedia flash, discovery learning, and learning outcomes.

INTRODUCTION

Chemistry subjects at the high school level contain many concepts that are complex and difficult for students to understand and are considered difficult material. The results of the observation of one of the students at SMA Negeri 5 Makassar on the subject of chemistry considered that the subject of chemistry was not fun, difficult, a lot of memorization and a lot of calculations. Chemistry subjects are considered difficult because they involve chemical reactions and calculations as well as abstract concepts and are considered by students to be relatively new material (Selatan et al., 2016).The buffer solution material includes complex concepts and uses a lot of mathematical calculations in solving problems so that it is difficult for students to understand them. Research conducted by (Sanjiwani et al., 2018) stated that 93% of grade XI MIA students in high school have difficulty understanding buffer solution material. This can have an impact on student learning outcomes.

Student learning outcomes are influenced by three main components, namely teachers, content or learning materials, and students. The low learning outcomes of students in chemistry subjects are generally influenced by the content or materials of chemistry learning where students experience difficulties in solving problems related to chemical reactions and chemical calculations, due to a low understanding of chemical concepts (Anisa & Yuliyanto, 2017). Therefore, a creative and innovative learning is needed in shaping students' concepts and understanding, either in the form of applying models or with the use of appropriate media. The discovery learning model is one of the learning models that centralizes the learning process to students or the student center approach. This learning model emphasizes that students are able

to sort and find information and understand learning concepts based on their abilities. The discovery learning model emphasizes the discovery of concepts or principles that were previously unknown. So that teachers only act as facilitators by presenting lessons not in the final form, but it is expected that students can organize themselves. However, in the application of the model, it does not always go as expected where there are still several obstacles, one of which is that for students who are not good at it, it will be difficult to connect concepts that make learning outcomes low.

The media can be an intermediary to help teachers in the unclarity of the material conveyed in learning activities, so that the media can represent what teachers are less able to convey orally. The use of a learning model combined with learning media is one of the efforts to help students achieve learning goals, especially in chemistry learning which contains many complex and difficult to understand concepts. Media can also attract students' attention in the learning process so that students are more focused on the learning process that will support the achievement of learning goals. The media needed is simple and easy to understand, whether it is contained in text, images, audio, video, or animation. One example of learning media is animation-based macromedia flash.

Macromedia flash is a software used to display multimedia, a combination of graphics, animation, sound, and user interaction. This application program can also be used for 5 to create interactive, interesting and dynamic object or text animations so that it can encourage students to learn. With the existence of the animation media, students can interact directly with the chemical propagation process, especially in the buffer solution material. Learning that uses animation media can increase students' learning activities, especially in terms of observing, listening, and participating in the learning process so that it cause students. (Salempa & Danial, 2018)

Therefore, an effort is needed, namely by applying a learning model supported by the use of the right media in order to create a better learning process. So that the use of macromedia flash combined with the discovery learning learning model can improve students' learning outcomes on buffer solution materials. The use of animation-based macromedia flash is supported by the behavior of students who are used to interacting with animation shows both on TV and on smartphones. Based on the description of the problem above, an effort is needed to improve the learning outcomes of students on buffer solution materials. So the author took the initiative to conduct a research with the title of the influence of Macromedia Flash-based animation media in the Discovery Learning Model on the learning outcomes of students in class XI Science of SMA Negeri 5 Makassar on buffer solution materials.

METHODS

This research utilized a quasi-experimental design to examine the effect of Macromedia Flash-based animation media within a Discovery Learning model on the learning outcomes of Class XI Science students at SMAN 5 Makassar regarding buffer solutions. The posttest-only control group design was implemented to ascertain whether the inclusion of the Flash-based animation significantly affected student performance.

This study involves two variable types: independent variables and the dependent variable. The independent variables comprise two levels: (1) the discovery learning model *with* Macromedia Flash animation media, and (2) the discovery learning model *without* Macromedia Flash-based animation media. The dependent variable is the learning outcomes of Class XI Science students at SMA Negeri 5 Makassar on buffer solution material. The population encompasses all Class XI Science students at SMAN 5 Makassar for the 2019/2020 academic year, totaling eight classes. Sampling employed simple random sampling, selecting group samples randomly from the population. From the eight classes, two

were chosen: Class XI Science 1 served as the experimental group, and Class XI Science 2 as the control group, with a combined total of 69 students.

The research instruments comprised: (1) a chemistry learning outcomes test measuring cognitive aspects through multiple-choice questions, (2) student activity observation sheets, and (3) learning implementation observation sheets. The initial 25-item multiple-choice test underwent expert validation for content validity. Subsequent item analysis involved pilot testing with Grade XII Science students familiar with buffer solutions. This yielded a refined 20-item test with the following psychometric properties: difficulty indices ranging from easy to moderate categories, generally sufficient distinguishing power, and low-range validity coefficients.

Data collection involved administering a posttest to both the experimental and control groups. The test results from these groups were subsequently compared to determine the influence of Macromedia Flash animation media integrated with the discovery learning model on student learning outcomes for buffer solution material. Learning outcome scores were derived solely from this posttest, conducted after the treatment. The instrument was an objective multiple-choice test comprising 20 items, each offering five answer alternatives. Correct responses were scored 1 point, while incorrect responses received 0 points.

Hypothesis testing is used to test hypotheses that have been formulated. Hypothesis testing is carried out by one-party testing.

H0 : $\mu1 \leq \mu2$

H1 : $\mu1 > \mu2$

This study defines μ_1 as the mean posttest score of the experimental group and μ_2 as the mean posttest score of the control group. The null hypothesis (H$_0$) states that integrating Macromedia Flash animation media into the Discovery Learning model has no significant effect on buffer solution learning outcomes for Class XI Science students at SMAN 5 Makassar ($\mu_1 = \mu_2$). Conversely, the alternative hypothesis (H$_1$) posits a significant effect of this integration on learning outcomes ($\mu_1 \neq \mu_2$).

RESULTS AND DISCUSSION

This quasi-experimental study was conducted at SMA Negeri 5 Makassar, involving Class XI Science students. Class XI Science 1 (experimental group, n=36) was taught using Macromedia Flash-based animation integrated with the Discovery Learning model, while Class XI Science 2 (control group, n=33) received Discovery Learning instruction without the animation. Data characteristics were analyzed descriptively from posttest scores of all 69 participants, providing statistical overviews of learning outcomes for both groups.

Table 4.1 Descriptive Statistical Values of Learning Outcomes of Experimental Group and Control Group Students

Descriptive Statistics	Statistical Value	
	Experiment (XI Science 1)	Control (XI Science 2)
Sample Size	36	33
Lowest Rate	60	50
Highest Scores	100	90
Average Score	80,86	63,39
Media	83	62,8
Mode	81,6	53,92
Standard Deviation	8,82	9,91

The average score of the experimental group was higher than that of the control group. The difference in standard deviation between the two groups is not much different, which shows that the two groups come from homogeneous groups because they have relatively similar data diversity. Student learning outcomes can be grouped based on the criteria for the completeness of student learning outcomes of SMA Negeri 5 Makassar.

Table 4.2 Categories of Completeness of Learning Outcomes of Experimental Group and Control Group Students

Category	Value	Experimental Group		Control Group	
		Frequency	Percentage	Frequency	Percentage
Complete	≥75	32	88,88	9	27,27
Incomplete	<75	4	11,12	24	72,73
Sum		36	100%	21	100%

Class mastery was met by the experimental group but not the control group based on KKM standards. These results demonstrate that integrating Macromedia Flash animation into Discovery Learning elevates student achievement beyond what is attainable through Discovery Learning alone.

Student learning outcomes were categorized according to indicator achievement, yielding the following average percentage rates for both experimental and control groups.

Table 4.3 Completeness of each Indicator in the Experimental Group and Control Group

No.	Indicator	Percentage of Classes Eksperimen	Percentage of Classes Control
1.	Explaining the meaning of buffer solution	100%	100%
2.	Identify the properties of buffer solutions based on experimental results	71,4%	24,2%
3.	Describe the components that make up the buffer solution	27,7%	18,2%
4.	Explaining the working principle of buffer solutions	91,6%	18,2%
5.	Calculating the pH of a weak acid buffer solution and its conjugated bases	5,5%	3%
6.	Calculating the pH of a weak base buffer solution and its conjugated acid	88,9%	63,6%
7.	Explaining the role of buffer solutions in the body of living beings	88,9%	63,6%
8.	Making a buffer solution with a specific pH	97,2%	48,5%
	Number of Completed Indicators	5	1
	Number of Incomplete Indicators	3	7

This research examined the hypothesis that Macromedia Flash animation integrated with Discovery Learning impacts buffer solution learning outcomes for Class XI Science students at SMA Negeri 5 Makassar. Prerequisite analyses confirmed homogeneity of variances but non-normal data distributions, violating parametric assumptions. Consequently, a one-tailed Mann-Whitney U test replaced the t-test for hypothesis evaluation.

Analysis via the Mann-Whitney test produced a Z_calculated statistic of 5.562. Comparing this to the critical Z_table value of 1.64 ($\alpha = 0.05$) shows Z_calculated > Z_table. Therefore, H0 is rejected, and H1 is accepted. This leads to the conclusion that Macromedia Flash animation media implemented through the Discovery Learning model significantly enhances student learning outcomes on buffer solution material.

This study was conducted to determine whether there is an influence of macromedia flash-based animation media in the *discovery learning* model on student learning outcomes on buffer solution materials. The animation media used in this study was designed by the researcher using macromedia flash which contains phenomena that can attract the attention of students as well as an overview of an event in the buffer solution material. Through this media, it is hoped that it can help teachers in delivering students to achieve learning goals.

Results indicate that integrating Macromedia Flash-based animation into the Discovery Learning model significantly improves student learning outcomes, supported by both descriptive and inferential analyses. The inferential analysis substantiated descriptive findings, revealing that the animation media substantially enhanced student achievement. This is evidenced by the experimental group's higher mean score, superior indicator mastery rates, and greater group completeness percentage compared to the control groupThis is shown by the acquisition of a greater Z value than the Z value $_{of\ the\ table}$, which means that H0 is rejected and H1 is accepted.

The learning process using the discovery learning model with the help of learning media has a very important contribution. Media can improve the quality of learning by attracting the interest and attention of students so that there is interactive learning between educators and students and changing the role of teachers in a more positive and productive direction (Karo-Karo & Rohani, 2018). So that with the help of the use of macromedia flash animation media, it can improve the learning outcomes of students in the experimental group. The use of this learning media is used at the stimulus level and data collection in the discovery learning model. In the stimulus stage, students are faced with something that causes confusion and curiosity. Through macromedia flash animation media, students will be more interested and focused on following the learning process. At the data collection stage, macromedia flash animation media is also used with the aim of making it easier for students to find concepts, because this macromedia flash-based animation media contains animation that will provide an abstract description of the occurrence of an event and explain an event systematically in each time of change (Fitriani et al., 2014). The use of animation media can also attract more attention from students, lessons that are visualized in the form of animated images are more interesting and more motivating because they can provide a more concrete learning experience for students. The above description is in line with the results of observation of student activities in each group during the learning process, where the experimental group had an average percentage of learning activities from three meetings of 89.88% while the control group was only 83.22%. These results show that macromedia flash-based animation media in the discovery learning model can increase interest and can attract students' attention so that they can play an active role in following the learning process.

Macromedia Flash-based animation can boost student interest and simplify concept mastery, serving as an effective learning tool. Its combination with the discovery learning model is particularly appropriate: the animation fosters engagement and clarity, while discovery learning promotes active involvement and self-directed concept formation, leading to better understanding retention. In contrast, the control group's learning outcomes – relying solely on discovery learning without animation – were less optimal. The experimental group's advantage stems from the Flash media's ability to visually represent events, creating more vivid and memorable impressions than reading or listening (Damayanti et al., 2018). This result corroborates research indicating that Macromedia Flash integrated with discovery learning improves student achievement.

CONCLUSION

Findings confirm the rejection of H_0 and acceptance of H_1, establishing that Macromedia Flash-based animation within the Discovery Learning model positively influences buffer solution achievement for Class XI Science students at SMA Negeri 5 Makassar.

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