THE INFLUENCE OF PROBLEM-BASED-LEARNING MODELS AND MACROMEDIA FLASH TO INCREASE CHEMISTRY LEARNING ACTIVITIES AND RESULTS

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Abstract

The purpose of this work is to find out the effect of using PBL and Macromedia Flash models on the operation and results of the chemistry teaching material. The population of this study was students of Class X IPA SMA Negeri 2 Tebing Tinggi, a total of 7 classes and 2 classes were purposely taken as experimental class and control class. As an instrument, a test instrument in the form of a test of learning outcomes of chemical bonding material and a non-test instrument in the form of activity observation sheets are used. The data obtained are normally distributed and homogeneous. The effect of the use of media, Macromedia Flash and Powerpoint, on the learning results and activities of both classes was determined by a one-tailed t-test, and a two-tailed t-test was used to determine student differences. n profit at a significant 5% level. From the results of data processing, learning scores were t_{count} = .393 and activity t_{count} = .619, while t_{table} = 1.667, while the t-power test gave t_{count} = 3. 782 and t_{table} = 1.995. Tcount>table observation shows the acceptance of the alternative hypothesis, therefore it can be concluded that the use of PBL and Macromedia Flash models has an impact on the chemical learning activities and results of students, where the average, activity and n-confirmation of learning results in the experimental class are better than in the control class. This study also concluded that the use of PBL models and Macromedia flash in chemical bonding material is a very good addition to student learning outcomes and online course activities.

Keywords: Macromedia Flash, Powerpoint, PBL, Activities and Learning Outcomes.

Introduction

Learning is a process of interaction between teachers and students and the elements in it. The teacher is the most dominant factor determining the quality of education. Good teaching quality will certainly yield good learning outcomes (Siregar and Lisnawaty, 2020). A scientific approach is used in the chemistry learning of the 2013 curriculum, therefore it is necessary to increase advanced thinking ability when solving a problem related to everyday life. Therefore, students must be able to actively participate in identifying and solving the problem to make learning more meaningful.

When the problem at hand is relevant to students and the "real world". One way is to use the PBL model in learning. In particular, the use of PBL can be used to solve "real world" problems, or problems that

are influenced by issues in society or things that are happening in society (Nariman & Chrispeels, 2016).

Along with the wide spread of Covid-19 in the past, which was not an issue but a reality, until now there are still schools that maintain a study-from-home program. (Jandric. 2020) states that we have to adapt to many things in connection with the presence of Covid-19, which not only causes loss of learning during quarantine or isolation but can also affect education in the long term. (Fegert et al., 2020), said that all over the world, people not only mourn the loss of many things but also worry because they know that significant changes in learning will be detrimental to the future (Sawhney et al. 2023).

The results of the researchers' observations and interviews with the chemistry teacher at SMAN 2 Tebing Tinggi, during this research it was found that the school was still carrying out the online learning process. At SMAN 2 Tebing Tinggi. This raises learning problems, especially in a chemical bonding material, there are still many students who obtain learning outcomes below the standard Minimum Completeness Criteria (KKM), which is 75 (Srivastava et al. 2022).

Rasmitadila et al. survey results, 2020; Trust & Whalen, 2020, found that distance teaching such as online learning was only an emergency. Additionally, they say they struggled to find quality tools, select content that aligns with standards and curriculum, and use digital tools effectively to communicate with students at a distance, and adapting teaching materials to the conditions and needs of students (Carillo & Flores, 2020) said that COVID-19 has resulted in drastic changes in learning so that online learning or distance education is implemented. Furthermore, Xiaoshan Li, et al (2021) wrote, that changes in students' concepts of science learning are closely related to student activities (Irfan et al. 2022).

Literatur Review

Online learning at SMAN 2 Tebing Tinggi using assignments sent via Whatshap Group accompanied by the use of PowerPoint media is less attractive to students, causing students to become bored with learning. (Bell, 2010; Thomas, 2000) has found that there is a shift in the curriculum from the traditional learning model to the PBL learning model, which can improve performance and produce better products (Pramanik et al. 2021)

PBL differs greatly from traditional teaching in that the teacher's role changes from information provider to facilitator, which is a transitional period for many teachers (Ertmer and Simons, 2006; Spronken-Smith and Harland, 2009). In PBL classes, teachers promote discussion, guide, challenge students' thinking, and guide group work (Ngeow and Kong, 2001).

To improve student learning outcomes on chemical bonding material, apart from using the PBL model, you can also use Macromedia flash. Using the PBL model and Macromedia Flash is expected to improve (Mohseni et al. 2021).

activity and chemical bond learning outcomes. This PBL model will invite students to be active in solving a problem, with the appearance of a continuous and moving Macromedia Flash. Meanwhile, PowerPoint media was used in this study to replace online blackboards, with a normal display without attractive animation as a comparison to Macromedia Flash in this study. According to (Khaerunnisa et al, 2018), PowerPoint media is media that can ease a teacher's task in explaining learning material because with this media long explanatory theories can be shortened with points so that students don't feel bored listening to the teacher's explanation. The use of the PBL model combined with animated media will be able to increase student activity Ravitz (2010) said that PBL is a constructivist-based instructional approach designed to support learning that involves more student activity (Narayan et al. 20217).

The use of Macromedia Flash can present interesting and innovative learning materials. Meanwhile, this Macromedia Flash software can be accessed freely on the internet quickly

and produces interactive animations, making it easy to use for student learning. In connection with this, it is said that the characteristics of a symptom can be analyzed by changing the value of a parameter, and there will be a change in the visual form. Through the form of visual changes, students can understand the characteristics of the concept. Furthermore (Yori et al, 2017), said that Macromedia Flash can present audio-visual messages consisting of images, text, simple moving animations, and other effects clearly to students with various animated images so that students are more interested in learning, and better understand the material. conveyed by educators, and can bring a new freshness to the learning experience of students.

The use of PBL models and animated media is also very useful when many face-to-face classes have to suddenly switch to online courses during the COVID-19 pandemic, as many students, parents and teachers are concerned about the online learning. The results of research by Dong et al., (2020), found in China that parents reject online learning because they feel it is

ineffective, that their young children are not independent enough as learners to benefit from learning.

The PBL model in this study follows the steps proposed by Arends (2012). Several studies have shown the successful application of PBL learning to chemistry subjects in the classroom, including Vegatama (2018) that using the PBL model affects student learning outcomes and increases student learning motivation, while Sumarmi (2017) finds low student activity in the learning process will affect student learning outcomes. student learning. Kalle Juuti et al, (2021) also said that PBL can be used as a means to increase student activity. Student activity can be measured using a situational experience sampling questionnaire delivered via cell phone.

Problem-based learning has the following four main characteristics: (1) focus on complex real-world problems for which there is no single correct solution, (2) students work in groups, (3) students acquire new knowledge through independent learning, and (4) the teacher acts as a facilitator (Boud and Feletti, 1997; HmeloSilver, 200 ; 2015). In addition, problem-based learning is sometimes described as having a strong philosophical and epistemological foundation (Savery, 2015), based on integrated learning firmly rooted in John Dewey's educational theory, constructivist philosophy (McCaughan, 2015), and psychological theory. (Hmelo-Argento, 2015).

In other sources it is said, this PBL model also functions for teachers to help guide students through failure, repeat they're problem-solving, and consolidate their efforts into a more meaningful mental model (Kapur, 2018). Meanwhile, the research results of Yuli Ifana Sari et al (2021) found that there was an effect of problem-based learning on student learning outcomes. Research findings by Funa & Prudente (2021) show that PBL, as an approach to teaching science, has a large and positive influence (ES = 0.871) on high school student achievement. This PBL model also has implications for professional development

teacher (Herman, 2012; Peterson & Scharber, 2018).

This study aims to see whether or not there is an influence of the PBL model using flash animation media on chemistry learning outcomes, on student learning activities and whether there is a difference in improving student chemistry learning outcomes taught using flash animation media and powerpoint media (Paricherla et al . 2022) (Narayan et al . 2017).

Methods and Data Analysis

This study is a quasi-experimental design that represents the types of research with a control group and an experimental group that aims to find out if growth has an effect or differences due to the effect on activities and student learning outcomes. Using flash animation media and powerpoint in learning with PBL model (Tyagi et al. 2023).

All students in Grade X of SMAN 2 Tebing Tinggi, which consisted of 7 classes participated in this study and purposively used as samples of 2 classes, each consisting of 36 students (Faiz et al . 2022).

Macromedia Flash is used in the research, and PowerPoint is used in the PBL teaching in the experimental class and the control classs as a substitute for online blackboards.

This quasi-experimental research design uses a pretest-posttest control group design as shown in Table 1.

Table 1: Research Design

Class	Pretest	Treatment	Posttest
Eksperimental	T_1	X	T_2
Control	T_1	Y	T_2

Hypothesis test :

Testing Hypotheses 1 and 2 uses the one-sided t-test formula (right-hand side), namely the test of the difference in the mean of the two sample classes with the t-test as follows (Naraya et al. 2023).

$$t_{count} = \frac{\overline{X1}-\overline{X2}}{\sqrt{(\frac{S1^2}{n1}+\frac{S2^2}{n2})}}$$

Where hypothesis 1, reads:

H_{o1} : There is no effect of the PBL model using macromedia flash on students' chemical bonding learning outcomes

H_{a1} : There is an effect of the PBL model using macromedia flash on students' chemical bonding learning outcomes

While hypothesis 2 reads:

Ho2 : There is no effect of the use of PBL and *macromedia flash* models on student activity

Ha2 : There is an effect of using PBL and *macromedia flash* models on student activities (Babu ert al. 2022).

While the third hypothesis about the difference in increasing learning outcomes, before conducting the t test, it is first tested with Percent (%) Increasing student learning outcomes, following the formula (Meltzer, 2002), (Naraya et al. 2023), (Naraya et al. 2022).

$$g = \frac{nilai\ posttest\ -nilai\ pretest}{nilai\ maksimum-nilai\ pretest}$$

with the gain criteria as follows:

Table 2. Criteria for Normalized Gain (N-Gain)

N-Gain Earnings	Criteria
N-Gain ≥ 0.70	Tall
0.30 ≤ N-Gain ≥ 0.70	Currently
N-Gain < 0.30	Low

Analysis of Student Activity Data

To find out how much active students are, the activity percentage formula is used:

$P = \frac{n}{N}$ x 100,

where :

P = Percentage of student activity (%)

n = total score obtained

N = maximum number of scores

And the activeness criteria are like table 3:

Table 3: Criteria for Student Activeness

Percentage of student activity (%)	Category
76 – 100	Very active
51 – 75	Active

26 – 50	Pretty active
0 – 25	Not active

Results and Discussion

1. Results of research and discussion of hypothesis one

The results of the analysis of student learning outcomes at the *pretest* and *posttest* are obtained as in Table 4.

Table 4. Summary of Student Learning Outcomes

Data	Statistic	Class	
		Experiment	Control
		PBL Model and Macromedia flash	PBL Model and media Powerpoint
Pre-test	Total students	36	36
	Average	48.47	41.52
	Standard Deviation	10.26	9.08
	Variance	105.456	82.599
	Smallest Value	25	20
	Greatest Value	65	60
	Total Value	1745	1495
Post-test	Total students	36	36
	Average	81.11	74.30
	Standard Deviation	7.37	5.75
	Variance	54.44	33.07
	Smallest Value	60	60
	Greatest Value	95	85
	Total Value	2920	2675

While the results of the learning outcome hypothesis tests are summarized in Table 5 below:

Table 5: Results of Learning Outcome Data Hypothesis Testing

Class	Data source	X	S^2	t_{count}	t_{table}	Information
Class Experiment	Posttest	81.11	54.44	4.393	1.667	Ha Accepted
Class Control	Posttest	74.30	33.07			

The calculation results show that tcount (4.393) is greater than ttable (1.667). This means that Ho is rejected and Ha is accepted, which means that the use of Macromedia Flash in PBL model learning affects the learning outcomes of students in chemistry. Research by Nasir & Hadijah, (2019) concluded that the use of flash animation media with the PBL model has a positive effect on student achievement.

The results of this study are consistent with a previous study (Khayroiyah et al., 2020) that found that students taught using Macromedia Flash had higher mean scores than students using PowerPoint media. Macromedia Flash which was 75. 83 while those using PowerPoint media obtained 66.67. Swelle et al, 2019, said that the use of flash animation videos had a significant impact on learning. In addition, Macromedia Flash also makes student learning more real. Siregar &

Kurniawati's research (2022) shows that Macromedia flash makes abstract material more visible and interesting, students can find out and ask questions from the images displayed in the media.

2. Results of research and discussion of hypothesis two

The results of the activity value analysis for 3 meetings can be seen in table 6 below

Table 6: Activity Analysis Data for Each Meeting

Claasss		Meeting I	Meeting II	Meeting III
Experiment Class	Average	79,16083	80,08694	81,1675
	Total value	2849,79	2883,13	2922,03
Average score sum		2885		
Average		80,14		
Variance		71,89		
Standard deviation		8,48		
Control Class	Average	71,75417	71,75417	71,9083
	Total value	2583,15	2583,15	2588,7
Average score sum		2595		
Average		72,08		
Variance		47,16		
Standard deviation		6,87		

Based on the results of the analysis of students' learning activities a whole, the results are as shown in Table 7.

Table 7: Summary of student activity results

	Data type	Results
Experiment Class	Total students	36
	The highest score	94
	Lowest value	61
	Total value	2885
	Average	80.14
Control Class	Total students	36
	The highest score	83
	Lowest value	56
	Total value	2595
	Average	72.08

From the student activity data in the experimental class and control class, hypothesis testing was then carried out, and the calculation of the activity data hypothesis test is summarized in table 8 below.

Table 8: Hypothesis Test Results for Student Learning Activity Data

Class	X	S^2	t_{count}	t_{table}	Information
Experiment Class	80.14	71.894	4.619	1.667	Ha Accepted
Control Class	72.08	47.16			

The calculation results show that t_{count} (4.619) is greater than t_{table} (1.667). The data processing results revealed that the use of the problem-based learning model and Macromedia Flash had an impact on students' learning activities. Furthermore, it is said that student learning activities taught using Macromedia Flash with the PBL model are

better than learning activities using PowerPoint media.

The researcher also observed student activities during the learning process through activity observation sheets which were filled out by the researchers themselves and assisted by a teacher to observe student activities during 3 meetings. This aims to see the activeness of students towards the treatment carried out during learning. In the experimental class, many students were active in asking questions, wanting to express opinions, listening well when friends were expressing opinions, entering Zoom on time, students were not sleepy while learning was taking place, and was on time in collecting assignments given. While giving quizzes via Macromedia Flash, many students were competing to give answers to the quiz questions displayed on the media, and many students answered correctly. Whereas in the control class some students were late for zooming in, only a few students were enthusiastic about learning such as asking questions, expressing opinions, and submitting assignments and some students were also noisy on zoom.

The difference in learning activities of students in control and test lessons was due to being given different media so that the activities in the experimental class was better than the control class, even though the activities of the two classes were not so perfect but in the class, students were already actively involved in learning and experienced an increase in every meeting and wanted to cooperate in teams. Rasi & Poikela, (2016), found that in problem-based learning using animation learning method knowledge can increase student activity. Meanwhile, Castro-Alonso et al., 2018, said that audiovisuals can reduce students' cognitive load because it gives concrete meaning to the process. Jin & Bridges (2014) found that the use of animation is good as a communication tool in PBL learning to teach process skills such as discussing, taking notes, and viewing or searching for articles as learning resources.

For the activity, (Palmer and Hall, 2011) found that in PBL learning, students discover teamwork and the use of "real world" applications that activate team members. The results of the study by Stehle and Peters-Burton (2019) that "putting students into groups, provides feedback, and bring a good ending to learning. Meanwhile, Emily E.Virtue et.al (2019) said that with PBL students can articulate the values of their work and apply them to everyday life.

The results of this study are also in line with research conducted by Mustamine et al (2019) which states that The PBL model uses the Macromedia flash value student activities increases at each meeting where the first meeting of student learning activities reaches 81.6%, the second meeting reaches 85.4%. and the third meeting reached 85.75%. In addition, in the experimental class, students were more enthusiastic about learning as seen from students who asked questions during the learning process and wanted to express opinions from the questions given by the researcher. Research Arwira et al. (2019) found that the learning process in the classroom would be interesting, not boring, and innovative if using the problem-based learning model combined with Macromedia flash. Meanwhile, the relationship between PBL and activities was also examined by Bagus Shandy Narmaditya (2018) who concluded that the application of Problem-Based Learning also encourages students to engage in various activities such as asking questions, discussing problems, and making solutions related to problems.

3. Results of research and discussion of hypothesis three

The results of the N-Gain analysis of the study results were given in Table 9.

Table 9: Summary of N-Gain results

Class	Avarege Gain	Variance	Standard Deviation	% N-Gain	N-Gain Criterion	Information
Experiment Class	0,64	0.0119	0.1105	64%	0,30 ≤ N-Gain	Currently

Control Class	0.56	0.0083	0.0922	56%	≥ 0,70	Currently

From table 9, it can be seen that the average n-gain of the two classes where the experimental class obtained an average n gain of 0.64 or 64% which can be categorized as moderate, which means that the average student learning outcomes in the experimental class have moderate abilities. . While the average n gain in the control class obtained an average n gain of 0.56 or 56% which can be categorized as moderate, meaning that the control class also has moderate abilities.

Table 10: Hypothesis Test Results for Increasing Student Learning Outcomes

Class	X	S^2	T_{count}	t_{tabele}	Information
Experiment Class	0.64	0.0119	3.4782	1.995	Ha Accepted
Control Class	0.56	0.0083			

The results of the hypothesis test show that the use of Macromedia flash is better than PowerPoint media with an increase in N-Gain percentage of 64%. This is consistent with a previous study (Fakhri et al. 2018) that found using Macromedia flash can improve student learning outcomes with an N-gain obtained of 0.57 in the medium category. Acceptance of Ha (alternative hypothesis) concludes that there are differences in improving student learning outcomes taught using Macromedia flash and PowerPoint media in the PBL model learning which can be seen from the average N-Gain score of students in the experimental class better than the control class so that PBL model with Macromedia flash is more effective in improving student learning outcomes (N Gain) compared to using PowerPoint media.

In connection with the use of animation (Clark & Lyons, 2010; Mayer, 2009) also said that the use of animated videos that meet instructional standards will contribute to student learning. Several views support that using the right theory will have a significant impact on learning. While the results of the research (Ibrahim et al., 2012; Brame, 2016; Clark & Mayer, 2016) found an increase in understanding of learning material through multimedia which also improves the learning process. This is also consistent with a study (Pratiwi and Wuryandani, 2020) that animated media can affect student learning outcomes with an average student n-benefit score of 0.542 in the moderate category.

Findings and Implications

Overall the results of this study indicate that the use
PBL models and flash animation media in Chemistry learning provide higher learning outcomes and activities compared to. use
PBL model using PowerPoint media. The Powerpoint media used only contains points instead of whiteboards in the online period. Based on the conclusions the findings of this study, it will provide implications related to learning chemistry, especially chemical bonding material.
The implications in question are related to:

(1) Designing chemistry lessons, especially chemical bonds, has been shown to be more effective using a PBL model with moving flash animations
with attractive colors than using the PBL model with PowerPoint media which only contains learning material points, as is the case with using blackboard in traditional learning.
The research results suggest that the PBL model using flash animation media should be developed and applied more in

chemistry learning, especially in high school chemical bonding.

Applying the PBL model using flash animation media, the learning process is not only a "transfer of knowledge" but a process learning can be more knowledge-building through learning activities such as reading and observing phenomena and problems, discussing them with fellow students and parties related to problems, accessing information from various learning sources, researching, conducting experiments, concluding, and communicating. Students are allowed to actively participate in various activities and experiences to discover for themselves various concepts and procedures in the study of chemistry. Thus the learning process can meet the needs of students according to the characteristics and objectives of the Chemistry lesson.

(2) The teacher's role in learning Chemistry.

Another implication of the findings of this study is the change in the teacher's role in the chemistry learning process. This research shows that the use of the PBL learning model with Flash animation in Chemistry learning, as a whole is more effective than the PBL learning model using Powerpoint media. For teachers, learning that was originally teacher-centered and only used PowerPoint media as a substitute for blackboards needed a change of role, leading to student-centered learning activities (student-centered) in the chemistry learning process. Teachers who do learning are expected to be willing to share roles with other learning resources and their environment, so the teacher knows that the teacher is not the only source of learning for students. Likewise, PowerPoint media is usually used by the teacher, then the teacher will use flash animation media which can increase student activity and learning outcomes.

Conclusion

The results of research and discussion, findings, and implications conclude that:

The PBL model is influenced by Macromedia Flash and PowerPoint on student learning outcomes, and there is an effect of the PBL model using Macromedia Flash and PowerPoint on student learning activities. There are differences in student learning outcomes between classes with flash animation media and classes with PowerPoint. The experimental class gain with animation media is better than the class gain using powerpoint. So it can be said that the PBL model using Macromedia Flash in learning is more effective than using PowerPoint media.

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