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How does the Problem-Based Learning with Chatbot AI Enhance Learning Outcomes?

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Abstract. This study aims to determine the effect of problem-based learning models with chatbot AI on learning outcomes in Class IV at SDN 1 Genteng, Banyuwangi, East Java. This type of research uses a quantitative approach with a quasi-experimental research method and a non-equivalent control group design. Non-probability sampling was used. The population and sample consisted of 33 students in class IV-A as the experimental class and 39 in class IV-B as the control class in SDN 1 Genteng, Banyuwangi, East Java. The data-collection instrument used a written test using multiple choices and descriptions. Data analysis techniques using SPSS Statistics 21. The study showed that problem-based learning models with chatbot AI affected learning outcomes. Other results using problem-based learning models with chatbot AI differ from those obtained using conventional models. The improved learning outcomes based on the N-Gain score of problem-based learning models with chatbot AI is 56.1545, and that of conventional models is 21.0266. Using problem-based learning models with chatbot AI is likely effective in elementary school learning.
Keywords: Chatbot, Artificial Intelligent, Elementary School

INTRODUCTION

Education is an important aspect of shaping competent, creative and relevant generations. In an effort to improve the quality of education, the Indonesian government has initiated an Kurikulum Merdeka. Kurikulum Merdeka is a learner-centered learning approach, focusing on developing 21st century skills, problem solving, and critical thinking. These efforts are made to form a generation that can be relevant to the times. The development of technology has changed human habits, people have abandoned practical habits and replaced them with instant methods. These changes also change the existing jobs, so humans need new skills that are relevant to the world of work and daily life.

The Kurikulum Merdeka is an approach that gives educators the freedom to create quality learning, taking into account the learning needs of students. The concept of a Kurikulum Merdeka aims to liberate education with free thinking and free innovation (Vhalery et al., 2022). To liberate learning, the Kurikulum Merdeka tries to change a conventional teaching method centered on educators to learner-centered learning. In the Kurikulum Merdeka, learners are placed as active agents in learning.

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One of the lessons that can place learners as active agents is learning with the Problem-Based Learning (PBL) model.

Problem-based learning is one of the learning models developed for active learning activities, with a learner-centered approach (Haris, 2022), and trains students' ability to solve problems (Handayani & Muhammadi, 2020). Problem-based learning is a learning model using problems in life to investigate (Kurama et al., 2021). Based on several definitions, problem-based learning can make students active in learning activities.

Problem-based learning promises to improve thinking patterns and skills in solving problems. Researchers who use problem-based learning have proven that problem-based learning can improve learning outcomes (Novianti et al., 2020; Shofwani & Rochmah, 2021; Yunitasari & Hardini, 2021) and learning motivation. Problem-based learning has been recommended as a learning model that can prepare the next generation to be relevant to the times. Problem-based learning offers awareness that learning must be carried out throughout life. In other words, it also emphasizes increasing the learning outcomes obtained. However, it also offers opportunities for students to apply knowledge and skills in the real world. Problem-based learning assimilates knowledge through interaction with tools and other people (Belland, 2019).

Syntax of Problem-Based Learning, according to (Saputra, 2020), 1) Provide students with an understanding of the problem. 2) Organize and organize student knowledge to solve problems. 3) Guiding investigations for each student and group regarding problems. 4) Develop and present the results of their work. 5) Analyze and evaluate the problem-solving process. The syntax states the process stages that have been carried out for a long time. There are four criteria for identifying Problem-Based Learning design problems by brainstorming ideas to explore learning potential. There are four criteria for exploring the potential of the Problem-based learning model (Dabbagh, 2019) namely 1) an effective means of bringing together students with significant subject matter content and the opportunity to gain experience in a rational, reflective way. Reasoning process; 2) the problem lends itself to investigation at a level of complexity that is interesting without being frustrating; 3) unstructured authentic problems that can be managed within the learning time that will be devoted to the unit; 4) the opportunity to achieve the curriculum objectives that are usually required.

Learning outcomes through Problem Learning (Moallem, 2019) are activity processes that are felt by learning interest where students' skills are involved with knowledge and knowledge skills. Strategies in implementing problem-based learning support self-direction and involvement with activities that require students to make meaning from learning experiences. Problem-Based Learning syntax provides direction and coherence for research on learning outcomes and identifies interactions between educators and students in Problem-Based Learning.

In the context of an Kurikulum Merdeka, the application of technology in learning is one of the factors for achieving learning goals. The application of technology is closely related to changing times. The increasingly rapid development of technology cannot be separated from everyday life, technological developments are also utilized in the educational aspect. The application of technology in learning is a form of positive

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change because it is relevant to current developments. The implementation of learning activities in the future will use more artificial intelligence (Tjahyanti et al., 2022). Artificial intelligence has been widely adopted and used in the field of education (Chen et al., 2020). The use of artificial intelligence in education is an experiment to prepare future generations.

Artificial Intelligence (AI) is a technology created to replace and mimic human intelligence. In education, AI technology makes it possible to create an improved learning experience for students, starting from the most basic educational units (Timms, 2016). According to (Sharma et al., 2019) technological advances by creating artificial intelligence functions can make predictions that allow solving problems and making decisions so that it has the potential to be used also in the field of education. Most AI in education is used to reduce the role of educators in teaching (Moturu & Nethi, 2023). In learning, of course, the role of educators still cannot be replaced by AI, but educators need to provide various kinds of learner needs in practice. One basic need for learners is to ask educators what they want to know. The intensity of communication between educators and students can produce a good education (Yunita & Irsal, 2021).

Chatbot AI is a computer program with artificial intelligence to interact with audio or text (Haristiani, 2019). Chatbot AI can provide information to learners directly (Cunningham-nelson et al., 2019). The task completion rate for learners using chatbot AI is five times higher than other programming tools (Benotti et al., 2018). Several studies have used hatbots AI for educational purposes, including answering learners' questions (Sinha et al., 2020) and completing tasks (Ranoliya et al., 2017). Another advantage of using a chatbot is that it can provide information without demanding time, making it efficient (Ondáš et al., 2019). Therefore, it is suitable for use in learning. One of the chatbots with an artificial intelligence interface developed by OpenAI is ChatGPT. As one of the most advanced artificial intelligence, ChatGPT has attracted much public attention worldwide (Tlili et al., 2023).

Based on observations made at SDN 1 Genteng, there are several treatments that educators should wait to do. Educators focus on themselves as a source of learning, using lecture and question-and-answer methods. Educators need to provide more space for students to find other sources so that learning time tends to be spent answering questions between students and educators or vice versa. As for other observations, technological resources are underutilized in learning, such as the internet and computer devices at the School. The lack of technology utilization in learning is irrelevant to the digital age. Therefore, it is necessary to use technology-assisted learning models to prepare a generation that is relevant to the times.

Based on the observation results, the researcher aims to find out 1) Whether or not there is an effect of Problem-based learning model assisted by chatbot AI on learning outcomes, 2) whether there is or is not a difference between the learning outcomes of the Chatbot AI-assisted Problem-based learning model and the conventional model, 3) How much is the increase in the influence of the Problem-based learning model assisted by Chatbot AI and conventional classes on learning outcomes. The chatbot used in this research is ChatGPT-3.5. According to (Biswas, 2023), ChatGPT is a tool that can help in open education by providing support, direction, and feedback

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to learners, thus increasing motivation and engagement. Researchers hope that using the Problem-based learning model assisted by Chatbot AI can be useful for further learning.

METHODS

The research approach taken is a quantitative research quasi experimental research method. Quasi-experimental research is used to determine the effect of treatment on a group. The quasi-experimental research design uses a Non-Equivalent Control Group Design. The research process was carried out on May 11-12, 2023. The research was conducted at SDN 1 Genteng Banyuwangi, East Java. Sampling using non-probability sampling. The population in the study is grade IV students of SDN 1 Genteng. The study used two different samples: the experimental and control classes. The experimental class is IV-A, while the control class is IV-B. The number of students in class IV-A was 33 students, while class IV-B was 39 students.

Data collection techniques using tests, namely pre-test and post-test. Research data in the form of learning outcomes of IPAS phase b class 4 chapter 3 topic of forces around us. The instrument is a written test with ten multiple-choice and four description questions. At the same time, the observation instrument is used to find out the actual field conditions described in the introduction. The data analysis technique was used to find the answer to the problem formulation and test the hypothesis. The analysis technique used paired sample t-test, independent sample t-test, and N-Gain. The prerequisite tests carried out are normality test and homogeneity test. Data analysis using IBM SPSS Statistics 21 for Windows. The criteria for making decisions on how much the level of effectiveness of the treatment is in Table 1.

Table 1. N-Gain Effectiveness Interpretation Categories

Percentage (%)	Interpretation
< 40	Innefective
40 – 55	Less Effective
56 – 75	Effective Enough
> 76	Effective

Source: Hake (Juniati et al., 2020)

RESULTS AND DISCUSSIONS

Learning is conducted with syntax according to the Problem-based learning model. Chatbot AI will be added to the syntax of inquiry in learning. Learners can search for information and references using ChatGPT-3.5 to develop their work. ChatGPT-3.5 acts as an assistant that helps the group determine the best solution to the problem.

The study's data collection flow, first conducts a pretest to determine the initial ability in the control and experimental classes. Then conduct treatment in the experimental class using the Problem-based learning model assisted by a Chatbot AI and in the control class using a conventional model (lecture and question and answer). After that, conduct a posttest to find out the results of the treatment in the experimental class and control class. Then the results of the posttest will be compared to the level of

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effectiveness using N-Gain.

Table 2. Statistical Description

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-Test Experiment	33	40	92	67.03	11.251
Post-Test Experiment	33	69	100	84.91	8.387
Pre-Test Control	39	42	85	65.28	10.498
Post-Test Control	39	56	87	73.03	7.922
Valid N (listwise)	33				

Source: Processed by researchers (2023)

Based on the data output in Table 2. Statistical Description, the results of the experimental class pretest scores totaled 33 students, obtained a maximum score of 92 and a minimum score of 40, an average score of 67.03, with a standard deviation of 11.251. The results of the experimental class posttest scores totaled 33 students, obtained a maximum score of 100 and a minimum score of 69, an average score of 84.91 with a standard deviation of 8.387. The control class pretest scores totaled 39 students, obtained a maximum score of 85 and a minimum score of 42, an average score of 65.28 with a standard deviation of 10.498. The results of the posttest scores of the control class of 39 students obtained the highest score of 87 and the lowest score of 56, with an average score of 73.03 with a standard deviation of 7.922. This shows that the average pretest scores of the experimental and control classes are not too different, only a difference of 1.75. At the same time, the posttest value is quite different, with a difference of 11.88.

Furthermore, the pretest and posttest data obtained will be tested through paired sample t-tests. Before doing the test, it is necessary to do a prerequisite test, namely data normality. The data normality test uses the Shapiro-Wilk test because the sample data studied is more than 30; according to (Sintia et al., 2022) the Shapiro-Wilk test has the highest level of consistency than the Kolmogorov-Smirnov test and the Anderson Darling test. The following are the results of the data normality test using the Shapiro-Wilk test with SPSS version 21.

Table 3. Normality Test

	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Learning Outocomes	Pretest Experiment	.103	33	.200*	.967	33	.414
	Posttest Experiment	.149	33	.060	.943	33	.086
	Pretest Control	.136	39	.069	.964	39	.240
	Posttest Control	.092	39	.200*	.975	39	.539

Source: Processed by researchers (2023)

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Based on the data output in Table 3. Normality Test Results: The experimental class pretest scores obtained a significance of 0.414, meaning the data was normally distributed. The results of the experimental class posttest value obtained a significance of 0.086, meaning that the data was normally distributed. The result of the pretest value of the control class obtained a significance of 0.240, meaning that the data was normally distributed. The result of the posttest value of the control class obtained a significance of 0.539, meaning that the data was normally distributed. The results show that all data obtained in the Shapiro-Wilk test are greater than the significance level of 0.05, so it can be seen that the research data is normally distributed. After that, a paired sample t-test was conducted to determine the effect of the experimental and control class learning models on learning outcomes. The following are the results of the paired sample t-test using SPSS version 21.

Table 4. Paired Samples Test Results

		Paired Differences			t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	Pretest Experiment - Posttest Experiment	-17.879	7.853	1.367	-13.078	32	.000
Pair 2	Pretest control - Posttest control	-7.744	5.389	.863	-8.974	38	.000

Source: Processed by researchers (2023)

Based on the data output in Table 4. The Paired Sample t-test results, on the results of pair 1 of the experimental class, showed a sig value. (2-tailed) of 0.000 is smaller than the significance level of 0.05, so it can be seen that there is a difference in the average learning outcomes. While the control class is also the same showing the sig value. (2-tailed) of 0.000 is smaller than the significance level of 0.05, so it can be known that there is a difference in the average learning outcomes. Furthermore, an independent sample t-test will be conducted to determine the difference in learning outcomes between the experimental and control classes. Before doing the test, it is necessary to do a prerequisite test, namely data homogeneity. The following are the homogeneity test results with SPSS version 21.

Table 5. Homogeneity Test Results

	Levene Statistic	df1	df2	Sig.
Pretest	.127	1	70	.723
Posttest	.013	1	70	.910

Based on the data output in Table 5. Homogeneity Test Results: The results of the experimental class pretest and control pretest values obtained a significance value of 0.732 with a significance level of 0.05; it can be concluded that the data is homogeneous. Furthermore, the results obtained in the homogeneity test between the experimental class posttest and the control posttest obtained a significance value of 0.910 with a significance level of 0.05; it can be concluded that the data is homogeneous. The results

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show that all data obtained are homogeneous so it can be continued with the paired sample t-test. The following are the results of the independent sample t-test using SPSS version 21.

Table 6. Independent Sample t Test Result

		t-test for Equality of Means				
		t	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
Posttest	Equal variances assumed	6.174	70	.000	11.883	1.925
	Equal variances not assumed	6.144	66.595	.000	11.883	1.934

Source: Processed by researchers (2023)

Based on the data output in Table 6. Independent Sample t-test results: the results obtained a significance value of 0.000 with a significance level of 0.05; it can be concluded that there is a difference in learning outcomes between the experimental and control classes learning outcomes. Furthermore, it is done by finding the N-Gain value to determine the effective value of the treatment on learning outcomes. The following are the results of the N-Gain test using SPSS version 21.

Table 7. N-Gain Test Result

	Class			**Statistic**	**Std. Error**
N-Gain Percent	Experimental	Mean		56.1545	4.11349
		95% Confidence Interval for Mean	Lower Bound	47.7756	
			Upper Bound	64.5334	
		5% Trimmed Mean		56.3520	
		Median		52.6316	
		Variance		558.387	
		Std. Deviation		23.63022	
		Interquartile Range		25.69	
		Skewness		.247	.409
		Kurtosis		.228	.798
	Control	Mean		21.0266	2.05219

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Class			Statistic	Std. Error
	95% Confidence Interval for Mean	Lower Bound	16.8722	
		Upper Bound	25.1811	
	5% Trimmed Mean		21.0404	
	Median		22.2222	
	Variance		164.247	
	Std. Deviation		12.81589	
	Interquartile Range		17.50	
	Skewness		-.062	.378
	Kurtosis		.184	.741

Source: Processed by researchers (2023)

Based on the data output in Table 7. The N-Gain test results determine how much improvement in learning outcomes. The experimental class results obtained a value of 56.1545 with a standard deviation of 4.11349. The control class obtained a value of 21.0266 with a standard deviation of 2.05219. If referring to table 1. N-Gain Effectiveness Interpretation Category, the value of 56.1545 from the experimental class using the problem-based learning model assisted by chatbot AI is quite effective. The control class with a conventional learning model with a value of 21.0266 is ineffective.

The initial stage of the research obtained data by conducting field observations at the School and obtaining information through grade IV educators. Observations obtained, educators do learning with conventional models. According to educators, conventional methods have been used for a long time, and during that time also, conventional models have been proven to improve student learning outcomes. So far, educators have yet to think about changing how they teach, even though some of the tools and technology available at the School are adequate. Based on observation, SDN Genteng 1 is a school with adequate facilities for technology-based learning. The availability of projectors and computer laboratories need to be utilized for teaching and learning activities. In line with research conducted by (Astini, 2020) the results of research utilizing information technology have a very effective impact on learning in elementary schools.

The learning process begins with syntax 1, Providing understanding to students about the problem with apperception activities related to the material to be taught by asking triggering questions related to the material to be taught, such as "Why can't humans float in the air?" and "Can objects on Earth float in the air?". Experimental and control classes are given the same material, namely the forces around us; only the learning models are different. The experimental class used the problem-based learning model by adding chatbot AI technology in the learning process. The control class used a conventional learning model with lecture and question-and-answer methods. Learners get information from educators about the learning objectives of the learning process assessment indicators. Then, educators motivate students to increase their enthusiasm for learning by clapping 1-5.

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In the experimental class learning process, the educator explains material about style using a presentation projector before the children are given problems. The learning flow carried out by Syntax 1 is preparing the problem and understanding the problem, namely, why do objects always fall? Syntax 2 organizes and organizes students' knowledge to solve problems. Participants are trained to form groups of four members and given a worksheet of two activities. Education participants listen to the educator's explanation about the activities that will be carried out, namely making a mind map about the concept of gravitational force. Before working on the worksheet, students do icebreaking to take a short break after listening to the explanation from the educator before working on the worksheet. The learning process continues with Syntax 3, Guiding each student's investigation and group toward the problem. Students look for solutions to the problems and collect information to create a mind map with the help of ChatGPT-3.5. Students and their groups complete the activity stages on the worksheet. The group discusses what will be shown for the presentation. Next, in Syntax 4, explaining and translating the work, students explain the results of their work to other groups in front of the class. The group preparing the presentation is allowed to ask questions. Continued in syntax 5 Analyzing and solving the problem-solving process. Participants educate together with educators and conclude the results of the activities they have carried out. After that, each group was asked to collect worksheets. Students are given reinforcement of material concepts about energy changes and continue conducting learning evaluations.

At the end of the learning activity, students get an assessment as evidence of appreciation for students. Learners shared their learning experience as part of the reflection activity for the questions "How do learners respond to the learning media used?" and "Can the Problem-based learning model make learners develop critical thinking skills?". Learners felt that using technology helped them find learning resources and were motivated to learn by using technology. Next, learners can summarize learning activities and motivate learners to keep learning. Learners, together with educators, end the learning with a closing greeting.

Unlike the control class, this class was given a conventional learning model. According to (Wasiso & Winarsih, 2020) the conventional learning model is a model that centers on educators directly to students in a gradual and structured manner. In line with that, according to (Siahaan et al., 2022) , conventional learning models are learning in which educators become more dominant than students. The conventional model referred to in the study used lecture and question-and-answer methods. Educators as teachers in front of the class and students as listeners. Learning using the lecture method cannot improve junior high school students' science ability (Sudarto, 2022). Learning with lecture and question-and-answer methods makes the performance of educators ineffective in managing time. In the learning process, students are required to listen to gain knowledge. After the lecture, the educator provides a question-and-answer session for students who still need clarification and want to know more about the material. As a result, learners do not absorb the knowledge gained, and not all learners can learn independently, so they depend on educators.

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After treatment in the experimental and control classes, a posttest was given to determine the effect on learning outcomes. The test contains ten multiple-choice questions and four descriptive questions. The experimental class's questions were the same as those of the control class. After being given the questions, it turned out that the learning outcomes in the experimental class were higher than the control class. The average value comparison obtained in the experimental class was 84.91, while in the experimental group, it was 73.03. The difference in scores is due to the experimental class getting more learning resources through the help of chatbot AI technology. The experimental class is more motivated and active in learning by looking for problems so that they can work on worksheets without the help of educators so that learning becomes efficient. The problem-based learning model makes learners more willing to challenge their ability to solve the problems on the worksheet. Problem-based learning model assisted by chatbot AI is quite effective in learning. Based on the spss output with an N-Gain value of 56.1545. Chatbot AI can increase students' motivation to seek deeper knowledge than conventional models. Based on the spss output, the conventional learning model gets an N-Gain value of 21.0266. When referred to, the category of interpretation of the effectiveness of N-Gain is ineffective.

The learning process using the Problem-based learning model in science subjects at SDN 1 Genteng involves problems. Obstacles are experienced in the learning process when students still need to determine their groups. Educators need to prepare group members before starting learning because, in previous lessons, they were not used to group learning. As a result, there was an exchange of ideas in completing the group worksheet. Group members who feel more dominant will take over decision-making, while passive members have less opportunity to make decisions. In the problem-based learning process, students still need to be used to worksheets. Students' habits of taking notes and listening mean that students need to be guided to fill in the worksheet. Educators can provide guidance and examples before the class and continue with Syntax 3 in Problem-based learning. Guidance is provided to avoid communication errors. Using technology such as projectors in learning motivates students, even though they think they will watch films in class. Educators at SDN 1 Genteng rarely use projectors when they are often used to watch films or for teacher meetings. According to research conducted, the use of projectors in learning shows an increase in the activity of students and educators in understanding and motivation to participate in learning (Zakri, 2022).

Using mobile phone technology in the learning process is also foreign to students. Educators need to convince students to allow cell phones in learning because previously, it was a prohibition for class IV students, and class VI students to use cellphones in learning. The availability of cellphones also makes students motivated to learn. Another use of technology is when students try ChatGPT-3.5. 2 students learned about ChatGPT-3.5 through the Tiktok application out of 33 students. However, the two students had only seen it and had never used it directly. Because students have never used it, educators need to demonstrate it first. There are interesting positive events in the learning process using the problem-based learning

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model assisted by chatbot AI. Students feel more flexible in learning and feel they can solve problems. When students have worked on the worksheets given, students continue to explore information about the material provided. Students are enthusiastic about asking questions to ChatGPT-3.5 related to the material, and with their findings, students are motivated to present their findings to other groups. The results obtained from working on students' worksheets are that students can answer problems with different answers. However, the essence of the students' answers refers to the same outline.

Problem-based learning assisted by chatbot AI is useful for elementary school learning. Interaction between students involving technology can provide a different experience from conventional learning models. Students experience learning according to the speed of learning or, in other words, personalization of learning. Using ChatGPT-3.5, students are accustomed to using technology in classroom learning activities. The use of technology in learning is an effort to develop education that is relevant to the times. ChatGPT-3.5 provides immediate feedback to students without waiting for their turn, like asking the teacher. Students can ask questions directly without waiting; whenever students ask questions, they will be answered by ChatGPT-3.5 as long as the question or prompt is clear. Using ChatGPT-3.5 although students can ask questions and get the answers they want, it is not certain that the answers they get when using ChatGPT-3.5 are correct. Therefore, it also needs confirmation from a teacher in its use. According to (Tlili et al., 2023) in their research on using ChatGPT technology in education, 10 question scenarios were experimented with and revealed various problems, including ChatGPT cheating and honesty, misleading privacy, and manipulation. So there needs to be validation from an educator in learning activities in the classroom. Based on the results of different students' work, although it generally refers to the same answer, this is the reason for using ChatGPT-3.5. ChatGPT-3.5 will provide different answers to sentences or words so that there are differences in students' words or sentences when answering the worksheet. As long as educators have good pedagogical skills, using ChatGPT is not a danger. Good educators will make learning in the classroom a place for self-development for students rather than making school a place to listen to lectures. Education also needs to be relevant to the current era so that students' understanding can be useful in everyday life.

CONCLUSIONS

Based on the results of the research data and discussion, it was concluded that there was an influence of the use of the Problem-based learning model assisted by chatbot AI and the learning outcomes of the conventional lecture and question-and-answer model had a significant effect on the learning outcomes of the phase b science class 4 chapter 3 topic of styles around us at SDN Genteng 1. This is proven by the SPSS output results with a significance level 0.05. The experimental class obtained a sig value of 0.000, while the control class obtained a sig value of 0.000, meaning there was a significant influence between the pretest and posttest results. Next, an independent sample t-test was conducted for differences in posttest results. Based on the data

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output, it can be concluded that there is a significant difference between the AI chatbot-based learning model and the learning results of the conventional model in the learning outcomes of science and science learning phase b class 4 chapter 3 topics of styles around us at SDN Genteng 1. This is proven by the SPSS output results with a significance level 0.05. The posttest results for the experimental and control classes obtained a sig value of 0.000, meaning a significant difference exists. Next, regarding the effectiveness of the treatment, it can be concluded that the use of a chatbot AI-based learning model has a greater influence than the learning outcomes of the conventional model using the lecture and question and answer method on the learning outcomes of the science and science learning phase b class 4 chapter 3 topic of styles around us at SDN Genteng 1. This can be proven by the N-Gain value in each class. The Experimental Class got an N-Gain score of 56.1545, so if you refer to Table 1. The N-Gain Effectiveness Interpretation Category is quite effective, while the control class scored 21.0266, which is in the ineffective category.

Researchers recommend that the next educational process should pay attention to relevance to the times so that students can play a greater role in learning and be useful for everyday life. The results of implementing the problem-based learning model assisted by chatbot AI prove that learning needs to pay attention to this. So, researchers recommend adopting a chatbot AI-based learning model for elementary school learning.

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