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Contextual-Based Bulletin as Media for Learning Renewable Energy

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Abstract

Physics is a science that teaches about physical phenomena. To make it easier for students to learn physics in the Merdeka curriculum, appropriate media for learning. "Profil Pelajar Pancasila" in the Merdeka curriculum is Indonesia's response to the 21st-century education paradigm to increase students' critical thinking. This research aimed to determine the effect of contextual learning media in bulletins and PowerPoint on contextual critical thinking ability in terms of curiosity. The research instruments were formative assessment, curiosity questionnaire, contextual teaching module, bulletin, and PowerPoint. The research used an experimental method, which was held in classes of 10 senior high schools; one control class used PowerPoint, and another class used a bulletin as an experiment class. Before the study was done, those instruments were tested in different schools. Data that were taken for this research were critical thinking using assessment and curiosity using questionnaires, but the researcher also documented the study through videos. The data was analyzed using IBM SPSS Statistics and Microsoft Excel, including questions on validity and reliability, normality, homogeneity, two-tailed t-tests, two-way analysis of variance, effect size, and Scheffe. Based on research, using contextual bulletin has a better effect on critical thinking than using learning media, which teachers, namely PowerPoint, always use. The student's results can be improved through innovative media, and this study proves that it effectively increases students' critical thinking by using bulletins as media. This study can become a reference for Merdeka curriculum learning, and the teacher can use it in the school to enrich and enhance the media references that will be used.

Keywords: *contextual; bulletin; physics media; renewable energy*

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INTRODUCTION

Education aims to increase intellectual intelligence, develop ability, and form a good attitude toward everyone. The right curriculum is needed to achieve these goals so teachers and academic devices can utilize them. The current Merdeka curriculum in Indonesia focuses on students' literacy skills [1] when facing the challenges of 21st-century learning [2]. To achieve the goals of Indonesian Education, the Merdeka curriculum is made a "Profil Pelajar Pancasila" that contains the formation of students' character, one of which is the ability to think critically.

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Critical thinking ability helps explore problems [3] that can be found in everyday life [4]. Nahdiyah et al. revealed that learning carried out in the surrounding environment would help students observe and find solutions by exploring concepts[5], cultivating the character of curiosity [6], and then constructing knowledge broadly without instructions from the teacher [7]. Contextual models can strengthen literacy, foster curiosity, and improve students' critical thinking abilities [8,9]. Contextual learning is student-centered teaching. Thus, the teacher is a facilitator [10]. That method uses the environment as the primary learning resource to provide meaningful learning [11] and make learning more flexible and interactive [4].

Pictures can be used as illustrations to facilitate contextual learning. Bulletins are an alternative media that can be used to improve literacy and critical thinking ability [12]. Bulletins are usually presented in print media by providing actual information and arranged contextually [13]. This media can be used in physics learning, in which the nature of physics requires students to study physics through a process that is described in the form of a product. Physical phenomena can be found in everyday life, one of which is in the energy field. Energy in Indonesia has many problems, one of which is caused by the excessive use of fossil energy, which causes a climate crisis. The threat of a climate crisis due to the use of fossil energy can be felt on the northern coast of Central Java, which has resulted in tidal flooding [14]. Students can be aware of saving and reducing fossil fuel use by switching to renewable energy sources.

In addition, many studies have proven the excellent effect of using bulletin to increase critical thinking because research by Wulandari et al. showed that students' critical thinking was shallow [15]. Putri et al. proved that the contextual method could improve critical thinking for physics learning [16]. Research by Diana [17] and Ardiansyah et al. [18] has shown that contextual models affect critical thinking ability in an amount of 0.77 from gain normalization, and research by Prastuti et al. [19] has an effect of 0.5 with a medium category for critical thinking. The study from Yani et al. proved that learning with nature physics could increase critical thinking [20]. His investigation showed that physics textbooks' critical thinking ability is still low, between 29.6% and 51.6%, so the media election significantly suggests increasing that ability. Students' critical thinking is mostly still shallow [21-24]. Saepuloh et al. research showed that students' critical thinking before experimentation is in the poor category [25].

A study by Tari and Rosana shows that contextual learning could develop critical thinking in students[26]. Muzzalifa and Oktaviani [27] and Mikraj et al. [28] have researched using bulletins and indicated that students have good learning outcomes. That result was proven through the development of media by Utami et al. [29] that bulletin could increase learning outcomes. Yasin et al. Yasin et al.'s studies showed that contextual learning could be used to transition from textbook-based learning and that this method is effective in the language center [30]. The results of the study by Amir et al. flaunted that contextual learning is better than learning using direct learning methods [31]. However, Ardiansyah et al. [18] and Yani et al. [20] did not use a bulletin, although they used physics matter. Putri et al. [16] and Tari and Rosana [26] have the same problem. While researchers used bulletin for media, they did not use contextual learning as the method [27,28]. In this experimentation, a bulletin as media and contextual learning as the method, which did not operate by them.

A few research types did not use physics matter, and only one research study used renewable energy. Accordingly, this study used renewable energy for class research, which is easily found in students around and more accessible to connect with contextual learning, which uses actual

information. Their research used the 2013 curriculum, whereas Indonesia right now has a new curriculum and has yet to have much discussion in the study. Thus, this research implemented the Merdeka curriculum based on differentiated learning and "Profil Pelajar Pancasila" to increase the student's ability. In addition, this study is essential and can be a reference for the Merdeka curriculum learning, especially for physics teachers who are determining more appropriate media and methods.

Furthermore, this investigation strengthens research [16] that using contextual learning in renewable energy in class can increase student's results. In addition, Prastuti et al. recommend doing the same research with developed media and other materials [19]. Another analysis by Wulandari et al. showed that undergraduate students' critical thinking skills are still deficient, so this study can answer the problem of increasing their critical thinking skills [15]. On the other hand, this investigation used Canva to make the bulletin media better than Yasin et al. research, which used Microsoft Word and can handle their problem [29].

This study aimed to assess the influence of 1) the effect of using contextual-based bulletins and without bulletins on critical thinking ability, 2) the effect of students' curiosity between high and low categories on critical thinking ability, and 3) the interaction of the effects of using contextual-based bulletins and without bulletins with a curiosity level of critical thinking ability. In class, without a bulletin, use PowerPoint as media for learning. Based on the research objectives, the research hypotheses were as follows: 1) there is an effect of using contextual-based bulletins and PowerPoint on critical thinking ability, 2) there is an effect of students' curiosity between the high and low categories on critical thinking ability, and 3) there is an interaction effect of the use of contextual-based bulletins and without bulletins with the level of curiosity on critical thinking ability.

METHOD

An experimental method was used to determine the effect of the independent variable on the dependent variable under controlled conditions. The controlling variable or moderator variable was the curiosity of the students. The independent variable used was contextual-based bulletins and PowerPoint, while the dependent variable was students' critical thinking ability.

The research population was students of class tenth, Senior High School in Wonosari, Klaten Regency, using the cluster random sampling technique. The experimental group used a bulletin, and the control group used a PowerPoint. The research instruments used were contextual-based bulletins, PowerPoints, student curiosity questionnaires, formative assessments of critical thinking ability, and contextual teaching modules (MA). Renewable Energy was used as the material for this study. Analysis of the research data was performed using IBM SPSS Statistics Version 29.0.1.0. and Microsoft Excel.

Before being used for the research, all instruments were consulted with experts (supervisors) for qualitative validity with a rating scale. The supervisors gave the notes for contextual teaching modules (MA) based on format, components, and language. Afterward, the media did not get the revision from the expert. Trials on questionnaires and assessments were conducted at Senior High School 1 Karangdowo with 36 students. Research data were collected through questionnaires, assessment results, and documentation.

$$\boldsymbol{r_{xy}} = \frac{\boldsymbol{n\sum x_i y_i - (\sum x_i)(\sum y_i)}}{\sqrt{\left\{\boldsymbol{n\sum {x_i}^2 - (\sum x_i)^2}\right\}\left\{\boldsymbol{n\sum {y_i}^2 - (\sum y_i)^2}\right\}}} \quad (1)$$

[32]

where r_{xy} is the correlation coefficient between x and y variable, x_i is the i data value from variable x, y_i is the i data value from variable y, and n is the lots of data.

The questionnaire validity technique uses construct validity as quantitative validity. Based on the analysis, 25 of 32 item questionnaires that are valid for continued reliability analysis were obtained. The conclusion is obtained from 25-item questionnaires with a high-reliability category, which will be used in this experiment. Reliability test of the instrument using Cronbach's alpha formula (2). Moreover, a formative assessment used item analysis techniques for quantitative validity. According to Sudijono [33] item analysis, each item aims to produce better items by improving and perfecting them. Item analysis uses Sudijono's [33] formula in his book, including questions differentiating power, difficulty level, and distractor effectiveness. After validity, 4 questions were obtained, 18 questions were revised, and 3 were rejected. The researcher revised 11 questions, and the total number of questions for the experiment was 15, with the reliability category being reliable.

$$r_i = \frac{k}{(k-1)}\left\{1 - \frac{\sum S_i^2}{S_t^2}\right\} \quad (2)$$

[33]

where r_i is Cronbach's alpha reliability, k is the total number of items, $\sum S_i^2$ is the variance of each item, and S_t^2 is the total variance. The score reliability of both instruments is shown in Table 1.

Table 1. Instrument Reliability

Instrument	Reliability	Conclusion
Questionnaire	0.840	highly reliable
Assessment	0.659	reliable

The Cronbach's alpha coefficient criterion was considered reliable if ≥ 0.60 and highly reliable if the reliability value was ≥ 0.80 [34,35]. Furthermore, the researcher continued to the next step, the experimentation on senior high school students of Wonosari, which was to analyze students' initial use by final semester assessment (PAS) in the experimental and control classes. Students' initial abilities were tested using the final semester assessment scores, representing critical thinking ability indicators.

The tests performed included normality by the Lilliefors method homogeneity by the Levene method, and the two-tailed t-tests. The results of the initial ability tests are presented in Table 2. An analysis of the initial ability test of students showed promising results, indicating that the sample could be used for research. If the result shown did not qualify for the research, the researcher had to find a new class to analyze again.

Table 2. Test Students' Initial Ability

Test		Result	Conclusion
Normality	I	0.200	Normal
	II	0.200	Normal
Homogeneity		0.957	Homogeneous
Two-tailed t-test		0.197	There is no difference

In addition, the researchers experimented in the class using validated instruments. The data are obtained, i.e., assessment and questionnaire, then analyzed using a variance research design with steps normality, homogeneity, and two-way analysis. The two-way analysis of variance was used because it wants to know the difference in the treatment of the two variables (columns and rows) on the dependent variable [36].

Table 3. Two-Way Analysis of Variance Research Design

Curiosity (B)	Contextual Learning (A)	
	Using Bulletin (A_1)	Without Bulletin (A_2)
High Category (B_1)	A_1B_1	A_1B_2
Low Category (B_2)	A_2B_1	A_2B_2

In this research, the location of the independent variables is as a column, and the moderator variable is as a row. The dependent variable, the influenced variable, fills in the columns and rows according to Table 3. Thus, the effect in hypotheses 1 and 2 will be used following analysis with effect size to know the effect magnitude [37]. Hypothesis number 3 suggests using Scheffe for further tests; the purpose of the Scheffe test or post hoc is to determine which variable has the most significant influence on the dependent variable [38].

RESULTS AND DISCUSSION

Media learning used in research is bulletin and PowerPoint. The phenomenon used in media about air balloons in Cappadocia was viral in one of the Indonesia series. That phenomenon is arranged in a bulletin with various topics, including the history of Cappadocia, air balloons as a tourist attraction, how air balloons fly in the sky, parts of air balloons, and principles about how air balloons fly.

The bulletin contains general information, so to help students understand renewable energy matter, they have to use the bulletin guidebook. That book includes contextual questions to make construction about energy theory. The renewable energy theory can be found in the sub-material in Table 7. Those media were used in the experiment class, and the control class, the researcher used PowerPoint with the same method, which contains phenomena and questions to discover students' critical thinking.

Students will identify energy forms from air balloons and analyze them for energy change. Furthermore, they will categorize those energies into renewable or fossil energy. The students analyze energy change and discuss why air balloons fly in the sky, including work and energy. In the last session, students will conclude the work and energy equation from the phenomenon and questions in the bulletin.

Data of Students' Curiosity

The measure of student curiosity is determined by completing a questionnaire; this variable is a moderate variable that strengthens or weakens the relationship between the independent and dependent variables [32]. The questionnaire was completed after the learning process. Questionnaire items were prepared based on curiosity indicators, according to Rowson et al. [39]. The curiosity data of the experimental and control group students are shown in Table 4.

Table 4. Data of Students' Curiosity

Groups	Total Students	Mark			
		Mean	Standard Deviation	Highest	Lowest
Experiment	32	84.2	7.9	98.75	68.75
Control	32	71.2	6.8	85.00	57.50

Based on the results of the analysis using Microsoft Excel, the mean curiosity score in the experimental group was greater than that in the control group. The standard deviation value of the experimental group was broader than that of the control group, indicating that student's curiosity in the experimental group was more diverse. The curiosity categories of the students in the experimental and control groups are presented in Table 5.

Table 5. Curiosity Category

Groups	Category	Total Students	Frequency
Experiment	High	18	56.25%
	Low	14	43.75%
Control	High	18	56.25%
	Low	14	43.75%

The category of students' curiosity, the high curiosity category, was more dominant than the low category in the experimental and control groups based on the mean value.

Data of Formative Assessment for Critical Thinking Ability

Students' critical thinking abilities are based on formative assessment data of the critical thinking ability of renewable energy materials. Learners obtain formative assessments after completing the learning process using the teaching module. Renewable energy was used in this study because that matter could connect with contextual methods. That matter is easier to find in the environment, so students can learn physics by looking at the renewable energy phenomena.

Table 1. Formative Assessment Data of Critical Thinking Ability

Groups	Total Students	Mark			
		Mean	Standard Deviation	Highest	Lowest
Experiment	32	79.8	9.4	100.0	60.0
Control	32	72.9	11.4	93.3	53.3

The results of the formative assessment of the students in the experimental group are presented in Table 6. The indicators of critical thinking ability [40] are presented in Table 7 as a reference for indicators of critical thinking ability.

Table 7. Formative Assessment Critical Thinking Ability Indicators

Sub-material	Indicator	Items
Energy forms	Interpretation	1, 2, 3
	Analysis	4
Energy sources	Analysis	5
	Inference	6
Energy change	Analysis	7
Renewable energy	Evaluation	8
Application of renewable energy	Inference	9
Work and energy	Analysis	10, 11, 13
	Evaluation	12
	Inference	14
Application of work and energy	Inference	15

Data from the formative assessment of the experimental and control groups varied. Even though the control group had a lower mean than the experimental group, the standard deviation in the control group was more expansive. Hince students' critical thinking abilities in the control group were more diverse. The distribution of the formative assessment data for the experimental group is presented graphically in Figure 1. Based on Figure 1, the data distribution is normal because the mode ≈ means ≈ median with a mode and median of 80.

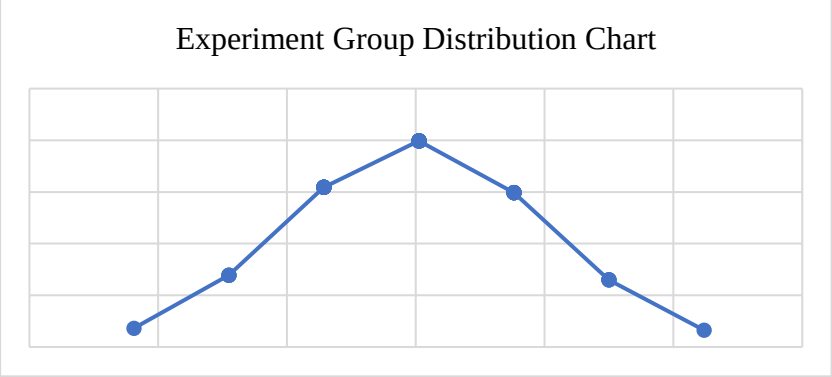

Figure 1. Distribution Data of Experimental Group Formative Assessment

Figure 2 shows the graphical distribution of the formative assessment data on the control group's thinking ability. Most of the data and the median value in the control group are 73.3, while the average is 72.9, so the data distribution is normal or symmetrical.

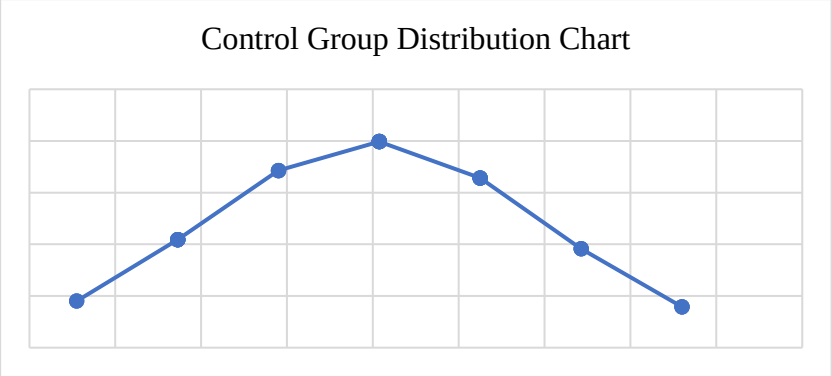

Figure 2. Distribution Data of Control Group Formative Assessment

The requirements test was used to analyze the data obtained before testing the hypothesis. In addition, a requirements test is used to determine the appropriate hypothesis testing technique according to the results of the requirements analysis. The requirements were analyzed using IBM SPSS Statistics Version 29.0.1.0 software.

Table 8 shows the normality test results, using the Lilliefors technique to determine the data's normality. The significance (α) of 5% = 0.05 shows that both samples have a significant value greater than 0.05 and are normally distributed.

Table 2. Normality Test Results

Group	Sign. α = 5% (0.05)	Conclusion
Experiment	0.073	Normal distribution
Control	0.062	Normal distribution

The homogeneity test aims to ascertain whether the two variances are homogeneous. The homogeneity test used Levene's method, with a significance (α) of 5% = 0.05. The significance value of the homogeneity test results (α) is 0.280, which is higher than the homogeneity significance value (α), so it can be said that the research data comes from homogeneous variance.

Hypothesis Test Results

The research data shows that it is normally distributed, and the homogeneous results come from homogeneous variants. Sugiyono states that hypothesis analysis and parametric statistics must be applied because the normality test is normally distributed, and the homogeneity test comes from a homogeneous variance [32]. The data obtained from the research in ratio data makes the data analysis use two-way ANOVA of unequal cells.

Two-way analysis of variance (ANOVA) was performed using IBM SPSS Statistics Version 29.0.1.0 and Microsoft Excel software. The formula used in the analysis of variance is taken from [41]'s book. The effect of the independent variables on the dependent variable can be determined by analysing the variance test [41]. The results of the analysis of the mean and the average number of cells are presented in Tables 9 and 10.

Table 3. Mean and Mean Cell Count

Learning media	Curiosity		Total	Mean
	High (B_1)	Low (B_2)		
Experiment (A_1)	81.4	77.6	159.0	79.5
Control (A_2)	79.2	64.7	143.9	72.0
Total	160.6	142.3	302.9	-
Mean	80.3	71.2	-	-

Table 9 shows that the mean of the experimental group was better than that of the control group. Regarding curiosity, the average score of students in the experimental group was also higher than that of students in the control group. The analysis of the variance test showed that groups using contextual-based bulletins had a better mean score than groups with learning processes using PowerPoint. Therefore, learning contextual-based bulletins improved critical thinking ability more effectively. This finding follows research by Sari et al. [13] and Erviani et al. [42], which have found that using contextually presented bulletins can improve critical thinking ability. Improving critical thinking ability is also related to using literacy bulletins, which can increase interest in reading. Contextual learning makes students' efforts independent and increases students' engagement [10].

Learning that connects material with the surrounding environment as a learning resource will create more meaningful and interactive learning [11,31,4], and students will be more active [43,44]. Contextual learning is about making decisions [45]; even students will construct their knowledge without instructions from the teacher [7]. Contextual learning can help students understand the matter [46] and improve classroom learning [47]. In physics learning, it is likely effective if students are active during the learning process so that research using a contextual-based bulletin restores the essence of physics learning, which studies natural phenomena as processes and products.

The control group uses learning media in the form of PowerPoint with a contextual learning model that has a lower mean value because the use of PowerPoint is not optimal. Learning occurs in one direction, and students are positioned as passive recipients of information [48]. Learning in one direction causes students to be less active and suboptimal in gaining knowledge [49]. These problems make students unable to construct the knowledge gained through authentic experiences and affect their critical thinking ability.

In Table 9, the mean scores of the experimental and control groups of students in the high curiosity category were more significant than those of the experimental and control groups in the low category. Compared with low-category curiosity, high-category curiosity has more potent critical thinking ability. This fact is supported by Pratiwi et al. [50] and Rinesti et al. [51], who state that curiosity influences the ability to think critically. The findings of Nafisa et al. [52] and Pohan & Syahwin [53] prove that literature, the higher the curiosity, the higher the students' critical thinking ability.

Research from Ni'mah [54] and Nurdiana et al.. [55] concluded that curiosity is related to critical thinking ability, meaning that indicators of curiosity intersect with indicators of critical thinking ability [39,40]. One factor that causes low curiosity is that learning physics is still centered on teachers [56]. In line with the study of Badi'ah et al., physics learning shows an increased curiosity and critical thinking ability [6].

Table 9 shows the interaction effect between media use and curiosity on students' critical thinking ability. For each group, the highest critical thinking ability was found in the experimental

group with the highest curiosity category, followed by the control group in the same curiosity category. The group with the lowest critical thinking ability was the control group, which had low curiosity. This fact shows how students with a high curiosity category can use bulletins to improve their critical thinking ability. Novelyya revealed that using learning models and media affects students' curiosity [57]. However, students with a high level of curiosity positively correlated with learning success [58].

The contextual-based bulletin used for this research could improve students' critical thinking because they contained contextually presented interesting and contextual information. The material was selected by considering the context that students were interested in; thus, the viral air balloons in Cappadocia were chosen. The media can help realize education policies in Indonesia, namely increasing literacy and numeracy competencies [60]. Literacy competence is an effort to collect information that is then transformed into numeracy as a step toward dealing with a problem [61]. Those abilities are needed by high critical thinking to face the challenges of 21st century learning [2] and to achieve the goals of the Merdeka curriculum in a "Profil Pelajar Pancasila" [21].

In the "Profil Pelajar Pancasila", critical thinking ability is one of the elements [4] that aims to find solutions based on literacy and numeracy. Critical thinking ability is the capacity to solve difficulties [62], and it is this capacity combined with curiosity to solve challenges in daily life [55]. Thus, students will be triggered to find information. The need to dig up information is one of the scientific attitudes, namely curiosity, [63] meaning that each individual's curiosity affects their ability to think critically.

This study used differential learning as in the Merdeka curriculum during the research. In bulletin class, it was shown that students with high critical thinking had visual learning styles. Hence, other students needed to show maximum results for their critical thinking. Moreover, in PowerPoint class, the students with visual and auditory learning styles had better critical thinking than kinesthetic. For that, the Merdeka curriculum used differential learning; the teacher must use various media learning.

Furthermore, it is a valuable suggestion to analyze the subsequent research that did not have this kind of research. The researchers should still learn more about differential learning in the Merdeka curriculum. Thus, further research can explore differential learning more powerfully and make another learning media for each style group. In another case, in this study, only one meeting in each class was held so that the subsequent study could increase the number of meetings for the highest results.

Consequently, this study impacted physics learning, especially for students who want to enhance their critical thinking; they must learn with contextual methods that connect the material with the surrounding environment as a learning resource [11]. The teacher must also use bulletin or varied learning media so that the learning in class is interactive [4], more meaningful [31], and active [46], [47]; thus, students' critical thinking will increase. Another way to increase students' critical thinking is for teachers to boost students' curiosity with viral phenomena that students are interested in and find around them.

CONCLUSION

Based on the analysis and discussion, it can be concluded that the findings of experimental research are as follows: there is an effect of using contextual-based bulletins and without bulletins on critical thinking ability; there is an effect of students' curiosity between high and low categories

on critical thinking ability; and there is an interaction effect of the use of contextual-based bulletins and without bulletins with a level of curiosity on critical thinking ability. Using contextual-based bulletins in physics learning can help restore the nature of physics, namely, learning that emphasizes processes and products. The contextual method can be used in physics material, a phenomenon among students. Context-based bulletins can increase students' critical thinking more than PowerPoint, which teachers always use. However, teachers need to build students' curiosity to improve their critical thinking. When the study was done in a school, researchers had drawbacks because this study was just done in one meeting so that the result can be maximum; a learning with a bulletin can used for two meetings. Moreover, this study used differential learning but needs to be analyzed from the perspective of students' learning styles, which are suitable when using a contextual-based bulletin. The researcher hopes teachers can develop similar media to help and facilitate students' learning and use contextual methods to shape students' characters based on "Profil Pelajar Pancasila" in the Merdeka curriculum.

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AUTHOR CONTRIBUTIONS

Gayuh Adi Susetyo: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data Curation, Writing-Original draft, Writing-Editing, Visualization; Sarwanto: Methodology, Validation, Writing-Review, Supervision; and Sukarmin: Conceptualization, Validation, Writing-Review, Project administration.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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