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Exploring the Effect of Cultural Responsive Teaching and Brain-Based Learning to Improve Critical Thinking Skills in Different Learning Styles

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Abstract: Thinking critically is one of the essential skills to master when entering the Era of Industry 4.0 and Society 5.0. This ability can be optimally developed through contextual learning. The observations found that students' critical thinking skills were low, and the implementation of learning tended to be textual. This study investigates the effect of integrating culturally responsive teaching and brain-based learning approaches on critical thinking skills in different learning styles in elementary schools. This study used a quasi-experimental method with a pretest-posttest non-equivalent control group design. The target population is grade 5 elementary school students selected through purposive sampling. The results found that integrating a culturally responsive teaching approach with brain-based learning significantly improved the critical thinking skills of elementary school students for all different learning style groups.

Keywords: Critical Thinking, Culturally Responsive Teaching, Brain-Based Learning, Learning Style, Elementary School.

INTRODUCTION

The 21st century significantly changes educational institutions in how students learn and teachers teach. The 21st century requires new and different ways of teaching (Gardner, 2008). Students need 21st-century skills with new learning paradigms (Kivunja, 2014). One of the challenges of the 21st century is the need to master special skills to adapt to the development of the industrial era 4.0 and the current era of society 5.0.

The two eras had different priorities; If the industrial era 4.0 focuses on the use of technology to facilitate people's lives, the Society Era 5.0 focuses on the use of technology. However, it relies on humans as the main actors. Students today need interactive pedagogical experiences to solve complex problems, adapt to changing circumstances, and leverage technology to create opportunities, network with other students, and organise in new ways (Bernhardt, 2015).

More specifically, in several studies, it is stated that to be able to compete in the industrial era 4.0 and the era of society 5.0, students need 4C skills, namely critical thinking and problem-solving, communication, collaboration, creativity and innovation (Jayadi et al., 2020; Mayasari et al., 2016). This is in line with the purpose of primary education, which is to build holistic and inclusive learning by providing the basics of knowledge, skills, and attitudes to each individual in the early stages of education (Widodo, 2020).

Meanwhile, socially, development disparities are increasing disparity between regions, causing urbanisation and migration between regions and countries. This causes the condition of classes in elementary schools to be increasingly plural, both from ethnic, religious and cultural backgrounds. The condition of a diverse population in the community, contributing to

a diverse student population in schools, will create challenges for teachers to develop learning processes responsive to cultural differences (Lew &; Nelson, 2016).

The student population is diverse in race, ethnicity, language, and socio-economic level, demanding that teachers meet those needs. Several studies stated that concern for students, sensitivity to student differences, fairness, and power in making decisions and getting things done is necessary for supporting learning success for a teacher in the classroom. This happens because of the tendency of individuals to act in specific ways in certain situations based on their beliefs (Edwards &; Edick, 2013). Other studies report that culturally responsive teaching positively impacts urban students (Chevalier & McKenzie, 2012).

Educators must pay attention to and adapt learning patterns to student differences in the classroom and how those differences can affect learning processes and outcomes. That way, culturally responsive learning will encourage educators to see student diversity in the classroom as a strength, not a weakness (Kieran &; Anderson, 2019).

This aligns with one view that the implementation of learning should be able to provide an inclusive learning climate and create learning differentiation for all students. The Indonesian government's newly released 'Merdeka curriculum' also emphasises learning with the principle of partiality to students (differentiation). In differentiation learning, teachers facilitate various strategies, such as teaching materials, assignments, and assessments, to suit student interests and needs (Lukitawanti et al., 2023). Tomlinson also expresses the same view; according to him, differentiated learning facilitates, serves, and recognises student diversity based on student readiness, interests, and different student choices in learning (Tomlinson et al., 2014).

As one of the essential skills in the industrial era 4.0 and the era of society 5.0, critical thinking skills are essential to be trained and developed in elementary school students; Changwong (2018), in his study explained that logical thinking skills to be taught to elementary school students have a close relationship with critical thinking skills. Logical thinking provides the necessary framework for structuring arguments consistently and reasonably. Critical thinking helps evaluate arguments by considering the broader context, examining the underlying premises, and identifying potential weaknesses or biases. In practice, critical thinking is often used to solve problems, make rational decisions, and gain a deeper understanding of the learning context (Apiati &; Hermanto, 2020).

Critical thinking is an essential intellectual skill for elementary school students and can be developed through practice, analysis, and continuous reflection (Nuraida, 2019). Gasong (2018) mentions that critical thinking can be stimulated through contextual and inclusive learning. Contextual learning includes teaching relevant to real life and situations familiar to learners. By understanding learning concepts that function in everyday situations, learners can develop better critical thinking skills (Bustami et al., 2018). Four indicators interpret a person's critical thinking process, including 1) essential clarification; 2) further clarification; 3) strategy and tactics; and 4) inference (Apiati &; Hermanto, 2020).

Based on the creation of critical thinking, one form of learning that is believed to be able to present contextual and inclusive learning situations is the Culturally Responsive Teaching (CRT) approach. The CRT approach is a form of learning that recognises and values the cultural diversity of learners (Muñiz, 2019). As facilitators in the classroom, teachers must consider the cultural backgrounds of learners to create more relevant, inclusive, and engaging learning experiences. The CRT approach is based on the understanding that each learner brings a unique cultural experience into the classroom. It aims to create a learning environment that reinforces students' cultural identity and increases their involvement in learning.

Through the application of the CRT approach, it is seen that the learning process will involve consideration of the classroom environment. This underlies the creation of five principles that must be considered in the implementation of the CRT approach, namely: 1) recognising the existence of various cultures from different ethnic groups, both as something

that can affect attitudes, learning approaches, and learning content according to the curriculum; 2) build meaningful connections between learners' experiences at home and school; 3) use a variety of learning strategies that are connected to learners' learning styles; 4) teaching learners to know and love their own and others' cultural heritage; and 5) combining information, resources, and multicultural skills (Acquah &; Szelei, 2020).

Referring to the principles of the CRT approach, teachers will have a complex and diverse teaching system. According to Marlina's research (2020), diversity of learning in the classroom can be realised through inclusive learning. Inclusive learning is the projection of learning situations considering students' characteristics and learning needs. According to research, one form of inclusive learning is to pay attention to student learning styles. Research also explains that the implementation of learning based on observation of learning styles is very important because it can train various cognitive abilities of students.

In creating learning situations that accommodate different learning styles, the learning process should be student-centred and carried out in group discussions. One learning model that can provide a solution to this is brain-based learning. Brain-based learning effectively influences improving students' critical thinking skills (Rohmaha &; Mashurib, 2021). This learning model is also very suitable for primary education, helping to create an open learning environment that accommodates student differences, improves critical thinking skills, provides a pleasant learning atmosphere, and improves science process skills (Fatonah et al., 2021). Another study mentions that brain-based learning environments positively improve student retention and learning attitudes (Tüfekçi &; Demirel, 2009).

Based on preliminary research conducted through analysis of learning outcomes and observation of learning implementation in grade 5 level SD 'ABC' Metro, several findings were produced: 1) students lack critical thinking competence. Learners tend to receive information passively, not questioning, analysing, or evaluating the information received. Learners take information for granted without further thought, so the analytical process is invisible. 2) It can also be seen that the implementation of learning has not paid attention to aspects of student learning styles.

From these initial findings, it is essential to conduct research that integrates culturally responsive teaching approaches with brain-based learning models to determine the effect of these treatments on students' critical thinking skills in elementary school. To test whether the treatment contributes to creating an inclusive and differentiated learning climate, effectiveness tests were conducted on different groups of student learning styles.

METHODS

To investigate the effect of culturally responsive teaching and brain-based learning approaches on critical thinking skills in group student conditions in the classroom, a quasi-experimental research method pretest-posttest non-equivalent control group design model was used, with simple regression analysis techniques. This study compared the performance experimental group and the control group. Experimental groups will be treated using an integrated BBL model with a CRT approach, and study groups will be formed based on adjustments to student learning styles. The control group was enforced using the BBL model without integrating the CRT approach but still adapting to the group's learning style. At the beginning of learning, the control group will be given a pre-test, and after the learning is complete, both research classes will be given a post-test. The following is the research design interpreted through Table 1.

Table 1. Non-Equivalent Group Pretest-Posttest Design

Group	Pretest	Treatment	*Posttest*
A	Y_1	X	Y_2
B	Y_1	C	Y_2

Information:
A = Experimental group
B = Control group
Y1 = Pre-test
Y2 = Post-test
X = BBL-CRT learning and group learning styles
C = BBL learning and group learning styles

Several instruments are used in pre-research, including observation sheets of ethnicity, culture, and learning styles. Pretest and posttest description question instruments are used to move critical thinking skills. These instruments are tested for validity using expert validators. Reliability test using Alpha Cronbach. The instrument has been declared valid and reliable for use in this study.

The research was conducted at SD 'ABC' Metro to the grade 5 level. The selection of elementary schools and grade levels is carried out by purposive sampling based on learning facilities, curriculum, and teacher competencies, as well as the location of schools in urban areas with a higher level of plurality than schools in rural areas. The selection of research subjects was carried out based on the results of observations of ethnic and cultural diversity, learning styles, and analysis of science learning outcomes. The study subjects were selected from as many as 50 students, using cluster random sampling techniques to determine experimental and control classes. From the day of reckoning, 25 students were selected for each research class. An equivalence test of control classes and experiments was conducted to determine the equality of values in the control group and exexperiment. This test uses the results of the class V midterm assessment in science subjects as preliminary data for grade equivalence. Several equivalence test techniques are used: 1) Kolmogorov-Smirnov normality test with a significance level of $\alpha = 0.05$; and 2) Bartlett homogeneity test with a significance level $\alpha = 0.05$.

Post-test effectiveness was also tested in different learning style groups. This test helps determine differences in the effect of research treatment on critical thinking skills. This test uses the Independent Sample t-test calculation. The criterion for the level of critical thinking ability is processed based on calculating the minimum completeness criteria (KKM) for science lessons is 75. The following is the determination of the range of interval values (Sugiyono, 2006).

Range = $\frac{maximum\ score - score\ KKM}{Many\ criteria} = \frac{100-75}{3} = 8{,}33\ (8)$

Due to the range length of 8, the values can be categorised into four criteria through Table 2.

Table 2. Categories Critical Thinking Skills

Score	Category
<75	Low
76 - 83	Enough
84 - 92	Good
93 - 100	Excellent

Students' critical thinking ability is measured by instruments derived from four dimensions of critical thinking developed by Ennis: 1) essential clarification; 2) further clarification; 3) strategy and tactics; and 4) inference. They are done to find out the improvement of thinking skills. Pretest and post-test scores were processed using the Paired Sample T-test and conducted to determine the effect of BBL-CRT on critical thinking skills in visual, auditory, and kinesthetic learning styles. Posttest scores are processed using a percentage average of grades.

RESULTS, FINDINGS, AND DISCUSSION

The calculation results show an F-count value of 0.038 > α = 0.05, so it can be said that research data is usually distributed. The calculation results show an F-Count value of 0.938 > α = 0.05, so it can be said that the research data is homogeneous. The independent sample t-test showed that the probability value or sig (2-tailed) was 0.022 < 0.05. Thus, there is a significant difference in values between experience classes with class control.

The results of the posttest calculation in the control groups in Figure 1 interpret that critical thinking skills are in the appropriate category.

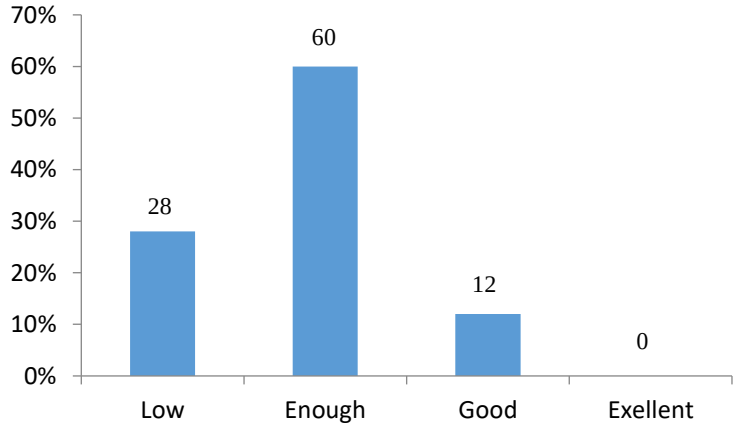

Figure 1. Control Group Critical Thinking Skills Score Per Category

The results of posttest calculations in the experimental group in Figure 2 interpret that critical thinking skills are in the appropriate category.

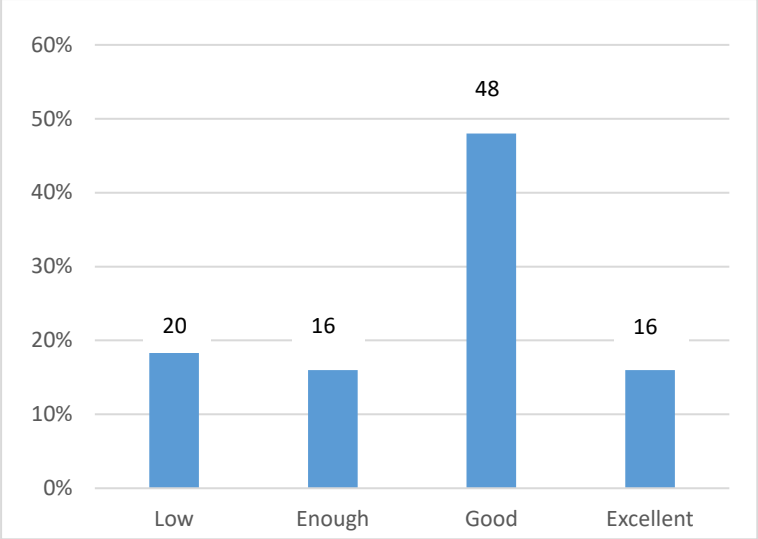

Figure 2. Categories Critical Thinking Skills Experimental Class

In the experimental group, the Interpretation dimension, the highest stage in critical thinking, has the most significant percentage of 33.20%. Percentage data is interpreted in Table 3.

Table 3. Percentage of Critical Thinking Skills Dimension

Group	Dimension				
	Interpretation	Analysis	Evaluation	Inference	
Experiment	33,20%	27,30 %	22,18%	17,33%	

The t-test results of paired samples show that the probability value or sig (2-tailed) is 0.00 < 0.05. Thus, there is an influence on the use of BBL-CRT with different learning style groupings in improving students' critical thinking skills in elementary school. The test results showed that the average score in the experimental learning style group was higher than in the control class. Here is the test result data in Table 2.

Table 4. Critical Thinking Skills in Groups Learning Styles

Groups	Average Grades			Mean
	Audio	Visual	Kinesthetic	
Control	80	82	77	79,6
Experiment	86,5	88	80	84,3

Based on the above research data, it is clear that the experimental class has superior value results than the control class. This can be seen from 1) the difference in pretest and posttest scores in the experimental class, 2) the difference in posttest scores between the control class and the experimental class, and 3) the average score in the experimental group learning style group higher than the control group. Based on these facts, it is known that integrating the

CRT approach with the BBL model improves critical thinking skills in different learning styles for primary school students.

In the development of educational technology, no single method has been found that is perfect for all circumstances. The degree of effectiveness of a method depends on factors such as the material taught, the age of the student, the characteristics of the student, and the time available to teach a topic. However, several studies have reported that using brain-based learning principles can overcome weaknesses in other methods (Bada &; Jita, 2022). This model significantly impacts elementary school students learning and teaching of science. Then another study specifically mentioned that using brain-based learning effectively improves students' critical thinking skills (Maryati et al., 2020).

The CRT approach aims to improve the quality of learners' learning and experience by acknowledging, respecting, and considering cultural background and life experiences. Through the CRT approach, students will be more accustomed to tackling learning problems. This is because learning is closely related to culture and everyday life. The cultural diversity of students in the classroom will provide diverse views in discussing a problem context so that the implementation of learning discussions will be deeper and more detailed.

Through the above facts, integrating the CRT approach with the BBL model can align learning objectives. This is to provide understanding and learning experience for students' texperiencestextual learning. In addition, teachers will also benefit in carrying out learning. These advantages are: 1) motivating learners to be actively involved in the learning process, resulting in deeper understanding and better thinking skills; 2) activities occur in building understanding, respect, and respect for intercultural differences so that learning activities can encourage student communication and collaboration; and 4) produce learning activities with inclusion and a sense of unity in the classroom environment (Samuels, 2018).

Based on the results of the analysis of post-test instrument answers, students in the experimental class can provide diversity in compiling ideas, more structured and detailed than in the control class. Students in experimental classes can better use logic and evidence to solve problems. The answers given are also the result of thinking from various points of view to create rational and critical decisions in solving learning problems. According to Samo & Kartasasmita's (2018) research, learning contextually can stimulate the ability to direct problems. This was done by students at the beginning of BBL-CRT learning who answered the acquisition of elementary school clarification dimension scores on the highest critical thinking skills in the experimental class, which was 33.20%.

The clarification process in practising critical thinking skills is crucial. At the beginning of learning, the teacher must be able to guide students to do problem orientation. Teachers will continue to work on lighter questions, such as basic and advanced question-and-answer activities. This activity will equip students with good reading, making it easier to stimulate critical thinking skills during the next stage of BBL learning. Because the experimental class uses the CRT approach treatment, the BBL learning process can be carried out optimally because of the stimulation of contextual knowledge. This explains the acquisition of critical thinking skills categories in the experimental class better than in the control class.

In addition to looking at the effect of integrating the CRT approach with the BBL model on critical thinking skills, the study also wanted to see if these skills impacted inclusive learning through grouping learning styles. Based on the study's results, it is known that the experimental class has a higher average score than the control class. Research (Marlina, 2020) explains that various forms of learning differentiation are needed to create good value outcomes through grouping learning styles. There are four types of learning differentiation 1) content

differentiation; 2) process; 3) products; and 4) the learning environment. Based on applying the CRT approach, teachers should consider cultural diversity to adapt teaching methods, content, and assessments to achieve better learning outcomes.

CONCLUSION

A culturally responsive teaching approach integrated with brain-based learning models positively influences elementary school students' critical thinking skills across all different learning style preference groups, whether visual, auditory, or kinesthetic.

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