Evaluating Bengkulu culture's role in mathematics learning outside classrooms for understanding measurement

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ABSTRACT

Connecting measurement concepts from informal to formal situations was challenging for students, specifically in understanding length and area measurements in elementary school. The use of cultural context in mathematics learning have been identified as a potential solution to address these challenges, although further exploration was required. Therefore, this study aimed to investigate the impact of mathematics learning designs outside classroom that integrate the culture of Bengkulu, Indonesia. A quasi-experimental design was used with a total of 83 fifth-grade students from two medium- and high-level elementary schools. The assessment instrument comprised six test questions and an observation sheet to record students' activities. The results showed that students in high-level schools understood teacher instructions and worksheets more quickly, providing additional time for measuring practice. Conversely, students at medium-level schools tended to wait for instructions. The inferential analysis showed that integrating mathematics learning designs outside classroom in Bengkulu cultural context did not significantly increase the understanding of area and length measurements for students in medium-level schools but positively impacted those in high-level schools. Therefore, this method had the potential to improve understanding of other mathematical concepts, specifically when effectively implemented in schools with higher levels of understanding.

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1. INTRODUCTION

Measurement material is important in connecting mathematical concepts and associated with physics, engineering, and other fields used in daily life [1]–[4]. Curriculum developers have incorporated measurement concepts into mathematics curriculum in schools [4], [5] to provide students with a better understanding of measurement and the applications. In the Indonesian context, measurement material was included in curriculum from elementary to high schools as a prerequisite for understanding several concepts, including plans, comparisons, scales, planes, and spatial geometry.

The concept of measurement in informal situations is part of students' daily activities and has been fundamental in several research where emphasis is placed on the use of non-conventional and conventional measures and the ethnomathematical connection linked to curricular materials such as textbooks [6]–[10], as well as the design of ethnomathematical tasks in search of the understanding of the mathematical object and its daily application [11] and the connections between measures from the use of the science, technology, engineering, arts and mathematics (STEAM) approach [12]. Research also works on geometry using measurements in the context of ethnomathematics and teacher training [13]–[15]. However, transition from informal to formal measurement situations presented challenges for students, and influenced the ability to understand formal measurement concepts. The difficulty of students in understanding measurement concepts, particularly length and area, requires a complex thinking transformation process. This is because measurement concepts are related to representation, visual-spatial understanding, reasoning, and numerical operation procedures [16]–[20]. The difficulty in visualizing 2D and 3D geometry objects [16] influenced the understanding of the relationship between the length, width, and height of objects [17]. Furthermore, a lack of reasoning abilities was another significant factor [18], that hindered students from connecting measurement concepts to broader mathematical principles. Other factors included basic calculation operations and early abilities [21], [22]. Misconceptions originating from early abilities can be a barrier, as students may approach mathematical concepts with inappropriate or even contradictory perspectives.

Previous studies explored various approaches to address students’ difficulty in understanding length and area measurement concepts. For example, Sarama *et al.* [23], [24] and Akdeniz and Argün [25] applied the trajectories approach. Furthermore, Clements *et al.* [26] used a micro genetic approach to evaluate area measurement material as a spatial arrangement in early childhood. In terms of learning media, Antić and Đokić [27] used a ruler to develop length measurement concepts. Other innovative media were tested, including using a magic board as a teaching tool in learning area concepts for third-grade students [28]. Technology was also used to address difficulties in length and area measurement material, as shown by İbili *et al.* [29] who used augmented reality (AR) to assist students in understanding 3D geometry area and volume measurement concepts. Research by Furner and Marinas [30] explained geometry, measurement, and algebra using GeoGebra to teach elementary mathematics. Another study was conducted by Battista [31] which applied cognition-based assessment to develop elementary school students' understanding of area and volume measurement.

Although several studies used various approaches and specific media and technology in teaching, the use of out-of-class learning through cultural connection, particularly in the context of Bengkulu culture in Indonesia, had not been conducted. In this study context, Bengkulu culture includes using Rejang traditional house, as shown in Figure 1. Rejang traditional house is one of the cultural heritage artifacts with structural characteristics that are highly relevant for assisting students in understanding length and area measurement concepts as shown in Figure 1. In this study, learning occurs not in the classroom but outside where students observe the structure and form of Rejang traditional house.

Figure 1. Rejang traditional house in Bengkulu

Implementing out-of-class learning design through Bengkulu cultural connection needs to consider the schools level, which indicates quality. Schools with excellent/good levels have very good/good quality in terms of learning or academic activities, non-academic activities, human resources, facilities, infrastructure, and various documents. On the contrary, schools with lower levels have less good academic and non-academic implementations, along with other components. Research by Nisa [32] showed that school accreditation results influenced the learning intensity of students. Nguyen and Ta [33] stated that the accreditation of most schools accreditation affected the teaching program activities of teachers. Based on the explanation, this study was formulated as:

i) how to design mathematics learning outside the classroom through cultural connections in Bengkulu?
ii) how are mathematics learning designs implemented outside the classroom through cultural connections in Bengkulu for student at medium- and high-level schools?
iii) does the design of mathematics learning outside the classroom through cultural connections from Bengkulu, affect increasing understanding of measurement concepts in medium- and high-level schools?

This research is important because most of the difficulties students and other people have in understanding the measurement are because they often ignore this activity even though they use it daily; for example, Suprayo *et al.* [34] argue that "Mathematics is a science that develops with society, but some people do not realize that they have used mathematics in their lives. This view indicates the assumption that mathematics is unrelated to real life, even though mathematics is in daily activities, for example, in games, buying and selling transactions, calculating, measuring, comparing, sorting, and designing buildings."

2. METHOD

2.1. Study design

This study used a quasi-experimental nonequivalent control group design, as it was considered the most suitable [35]. The design included two experimental and two control groups, examining the cause-and-effect relationship between the independent and dependent variables [35]. The experimental design is presented in Table 1.

This study comprised experimental and control groups from medium- and high-level schools, represented by T1/T2 and S1/S2, respectively. Students in medium- and high- level school experimental groups used mathematics learning design outside classroom through Bengkulu cultural connection (X1). Meanwhile, those in the control groups used traditional learning method (X2). Prior to the learning process, each group underwent a pre-test (O1). Subsequently to the treatment, students were given a post-test (O2) to assess the understanding of length and area measurement concepts.

Table 1. Nonequivalent control group design in medium and high-level schools

Group	Pre-test	Treatment	Post-test
Experimental T_1/T_2	O_1	X_1	O_2
Control S_1/S_2	O_1	X_2	O_2

2.2. Participants and treatment procedure

The population comprised fifth-grade students from state elementary schools (SD Negeri) in Bengkulu City, selected using stratified sampling. Sample characteristics were determined based on the school's accreditation status (accreditation A and B). Schools with accreditation A were categorized as high-level schools, while those with accreditation B were medium-level schools. One school was selected at each level, namely SD Negeri 09 for high-level, SD Negeri 20 for middle level, each having three fifth-grade study groups. Subsequently, two classes from each school are selected and used as the experimental and the control group. This study comprised 83 respondents (37 students in the experimental group and 46 in the control group). The sample size fell in the range recommended by Roscoe, stating that an appropriate sample size should be between 30 and 500 [36].

This study commenced by providing students with a briefing, instruction, and learning contract regarding out-of-class learning as shown in Figure 2. Teachers introduced the material to be covered and outlined the activities students should engage in during out-of-class learning. Subsequently, a pre-test of length and area measurement material was administered to assess the level of students' initial knowledge related to specific material or concepts. Pre-tests facilitated the measurement of the extent to which students mastered previous material. Teachers subsequently administered the treatment to experimental group students in medium- and high-level schools by applying mathematics learning design outside classroom through Bengkulu cultural connection. The control group used traditional learning, and the treatment process spanned three weeks. Moreover, a post-test was conducted to measure students' understanding of the material taught during the learning period.

2.3. Data collection

Data were collected using tests and observation sheets. The procedure for pre-test and post-test was similar, but the order of the numbers and the problems presented differed. Both tests were conducted to verify that students could apply the learned concepts rather than memorize the questions. For example, question one in the pre-test is number five in the post-test. Answer keys were used to assess the tests and ensure that all the pre-test and post-test scores were consistent.

Validity and reliability were conducted before the test. The test was validated by 17 experts and empirically examined on 68 sixth-grade elementary school students. The validity value was 0.818452, while the reliability value was 0.71096, showing high validity and reliability of the test. The empirical validity results for each test item are presented in Table 2, showing that all six items of the test were valid. The total test reliability value was 0.973575, showing very high reliability. Data were also collected through observation to provide information about the effectiveness of learning, the interaction between teacher and students, activities, and the overall conditions of the learning implementation. The process comprised direct observation, photographing, and documenting students' activities during learning.

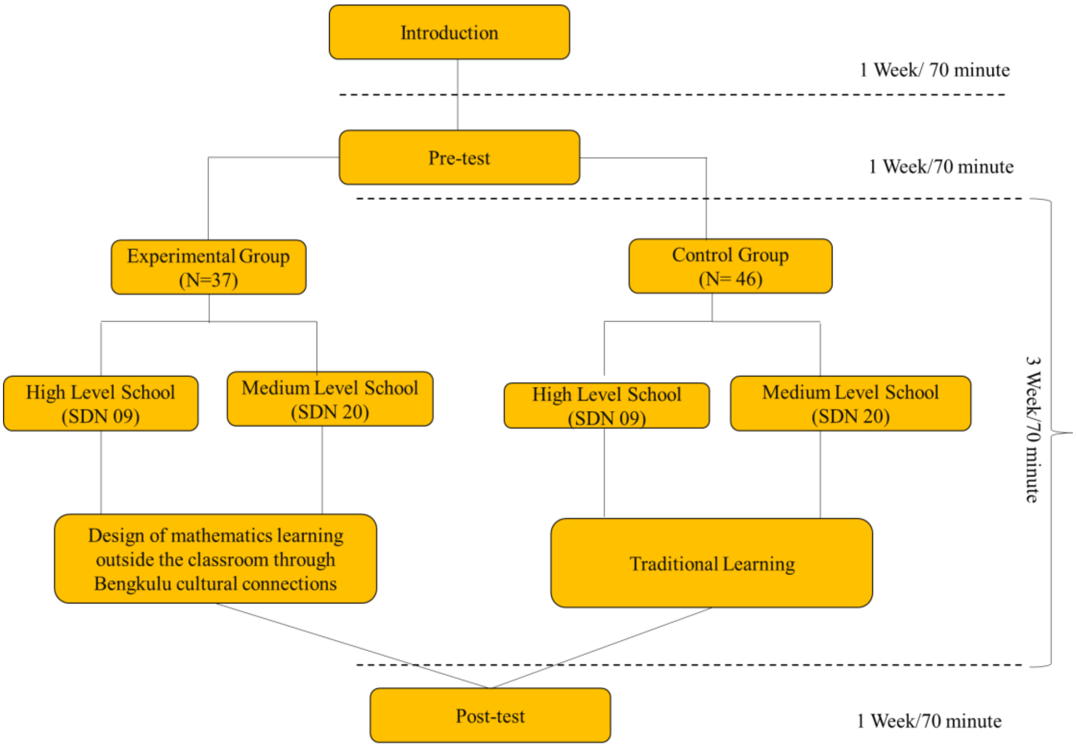

Figure 2. Study procedure

Table 2. Validity of each test item

Test item	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
Validity score	0.85	0.72	0.89	0.78	0.93	0.87

2.4. Ethical considerations and validity threats

Before implementing the treatment, permission was obtained from the school principal, class teacher, parents, and students. This is because the learning process was done outside the classroom by visiting a Bengkulu traditional house. The visits to the traditional house occur over three weeks (once a week), with a travel distance of approximately 10 minutes by mini-bus from the school. Ethical considerations were followed by not disrupting the ongoing learning process, as it was conducted on weekends each week. Furthermore, high and medium-level schools with similar characteristics were selected to minimize potential sample bias, such as gender ratio, age, grade level, study time, teaching approaches, and curriculum. Another potential threat to validity was the distance between the Bengkulu traditional house and the school. To address this threat, direct coordination with the parents of students was carried out. Subsequently, the parents willingly transport students to the learning location. In this research, one of the confounding variables is students' initial abilities. One way to control these confounding variables is to conduct a pre-test to measure students' initial knowledge before providing treatment or intervention. Apart from that, to control other confounding variables such as active learning, the researcher made consistent observations and recorded the level of participation and active learning of students during the implementation of the treatment or intervention.

2.5. Data analysis

The data collected from pre-test and post-test results were analyzed quantitatively using an independent samples t-test. The independent samples t-test was used for normally distributed data. However, the Mann-Whitney U test was used for data that did not follow a normal distribution. The choice between these tests depends on the distribution of the data. In this case, the independent samples t-test was selected to compare the means of two different groups and determine the statistical significance of the observed differences. The test results showed whether the observed differences were considered random or represent significant differences. All statistical analyses were carried out using SPSS Software version 28. Subsequently, the data obtained from observations were transcribed, reduced, abstracted, coded, presented, and analyzed using a content analysis approach. In this study, there were five stages in conducting content analysis, namely: i) organizing observation notes; ii) building categories; iii) coding observation notes; iv) analyzing the results; and v) presenting the results [37].

3. RESULTS AND DISCUSSION

3.1. Learning design

The design of out-of-class learning through Bengkulu cultural connection commences with the teacher inviting students to visit the traditional house. Traditional house was used as didactic situations by presenting problems related to length and area measurement, comparing length and area, and the concept of scale. In the first session, students were assigned to different groups and allocated with task of measuring the perimeter and area of the front floor as shown in Figures 3 and 4.

In the second session as shown in Figures 5 and 6, the students were instructed to measure the length and height of stairs and fences. In the third, students were tasked with measuring the length and width of the tiles in the Bengkulu traditional house and determining the number of square and wooden tiles to cover the floor and walls. An overview of the trajectory of learning activities using the context of Bengkulu traditional houses can be seen in Table 3.

Figure 3. Activities to measure the perimeter and area of Bengkulu traditional houses

Figure 4. Floor measurement activities and area of Bengkulu traditional houses

Figure 5. Wall height measurement activities

Figure 6. Stair measurement activity

Table 3. Learning trajectory for length and area measurement material

Activity	Math goals	Description of activity	Conjectures of students thinking
Measure the area of squares and rectangles.	– Therefore, students can solve problems related to measuring length. – Therefore, students can solve problems related to the perimeter of flat shapes. – Therefore, students can solve problems related to flat shapes.	– Teacher invites students to understand the situation of measurement problems through out-of-class learning by visiting traditional houses in Bengkulu, Indonesia. – Teacher invites students to discuss in groups the problems given by teacher. – After that, students are asked to explain the results of the thoughts through discussion in class. – Teacher invites students to continue formal thinking to gain reinforcement regarding the concept of the area of a square and rectangle.	– Students can take measurements of floor and wall tiles in traditional houses in Bengkulu, Indonesia. – Students can think informally through pictorial activities. – Students can connect informal to formal thinking processes.

Following the assignment of a sequence of tasks for each session, students commence discussions in each group. Students and teacher engage in collective discussions to formulate the formal concepts of the material that are set as learning objectives for each session. Figure 7 shows the series of activities in formulating conceptual thinking.

The series of activities for both teacher and students consist of three stages: concrete, pictorial, and abstract/formal as shown in Figure 7. The concrete stage directly observes Bengkulu traditional house and presents problems related to the context. Meanwhile, the pictorial stage refers to a learning process that uses pictures or illustrations to aid in understanding concepts or learning materials. This stage is represented in students' worksheets. Students were then asked to visualize the problem as a tool for constructing knowledge. After the pictorial stage, students and teachers formulate the formal concept of the problem. This was reinforced by guiding students in constructing formal mathematical concepts through the abstract/formal stage.

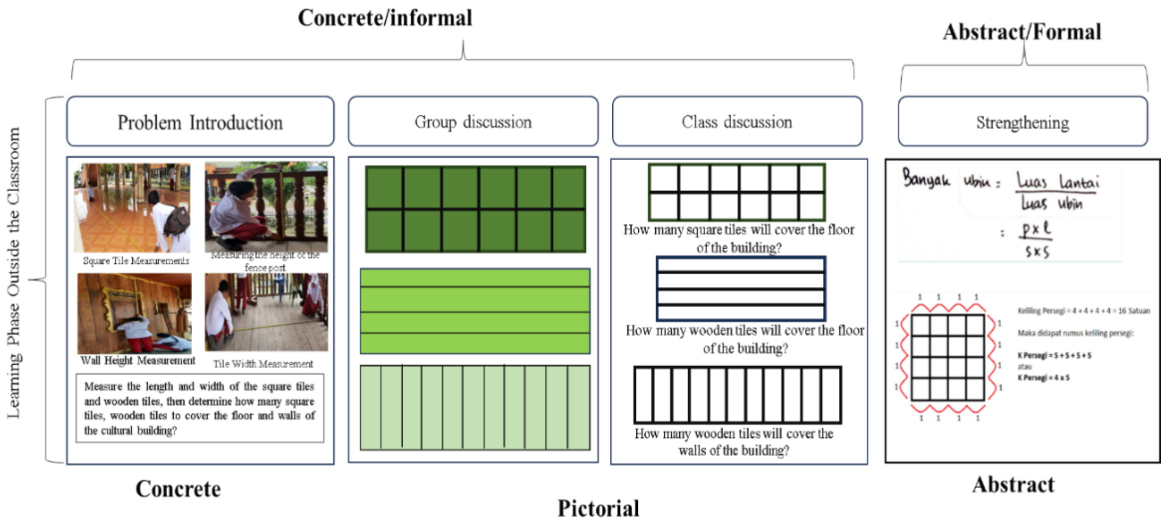

Figure 7. Thinking conception of mathematics learning outside classrooms design through Bengkulu cultural connection

3.2. Description of the implementation of mathematics learning outside classrooms design through Bengkulu cultural connection in medium and high-level schools

Data obtained from observations are analyzed using content analysis approach. This study has five stages in conducting content analysis, namely: i) compiling observation notes; ii) category construction; iii) coding of observation notes; iv) analysis; and v) presenting the results. Content analysis process flow is shown in Figure 8. In the initial stage, before the treatment was carried out, teacher reviewed the prerequisite material. This stage aimed to reactivate previous knowledge and required a relatively long period. At the core stage, students in both medium and high-level classes were still confused about following the instructions.

However, when teacher provided detailed direction, guidance, and instructions through the activities listed in worksheets, students perform the activities well. Students were still not skilled in using roll meter measuring instruments at the initial meeting. This difficulty is evident in directing the measuring instrument from the initial to the end of the measured object. Therefore, the teacher provided another example of correctly and adequately using a rolling meter measuring tool.

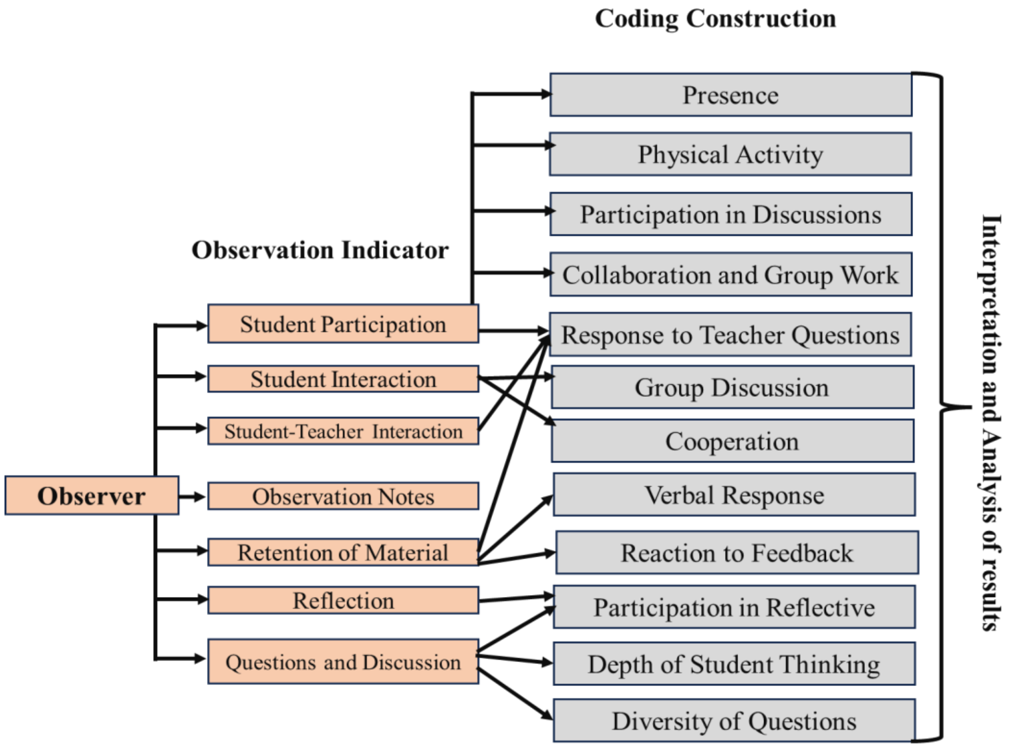

Figure 8. Construction of content analysis from observations on medium and high-level school students

Based on observations of students' activities, there are differences in several aspects, including attendance, participation, interaction, discussion, and responses to questions in the context of mathematics learning outside classrooms through Bengkulu cultural connection. In terms of attendance, students at the-level school showed an attendance rate of nearly 100% during the three meetings, while medium only reached 70%. This was due to the high level of support from parents, who were seen waiting outside the classroom until the learning process was completed. In the aspect of active participation in learning, both students in medium and high-level schools appear active and obedient to instructions. Students properly completed worksheets according to instructions. However, differences arise from the completion results of worksheets. Students at high level school were active with the groups in observing and measuring the structure of Bengkulu traditional house. Both groups follow teacher instructions well in writing, visualizing, and solving the given problems. After completing the activity, students from both levels were asked to explain to explain the results orally. Several groups experienced difficulty in solving problems given by teachers, specifically medium-level school students. Subsequently, teacher reinforced the thinking processes carried out by students. Observations also showed that students paid attention to the sequence of concept construction. To ensure a formal understanding of the concepts, teacher provided feedback in the form of questions each group should answer. A difference was observed where only a few medium-level students responded, while those at high-level school responded effectively from each group.

Based on the observation and reflection, the teacher needs to provide more intensive guidance, with active participation from one group to another, specifically in medium-level schools. Students in medium-level schools tend to be passive, only waiting for the teacher's instructions. On the contrary, those in high-level schools need less guidance. Students in high-level schools understand teacher instructions or worksheets more quickly as there is plenty of time to practice working on the problems. Therefore, the observation results show differences in students' activities during mathematics learning outside classrooms process through Bengkulu cultural connection.

3.3. The impact of mathematics learning outside classrooms design on improving understanding of length and area measurement material

Descriptive data on the achievement of pre-test and post-test results in medium and high-level schools is shown in Table 4. The table shows that the average score of the pre-test in the control group for medium-level schools before carrying out the treatment was greater than the pre-test in the experimental group. However, this difference is relatively small, showing that the initial ability of students is the same. For the post-test, the control group is greater than the experimental, but the difference is relatively small. N-Gain difference between the experimental and control groups in medium-level schools is consistent, with both showing a result of 0.44. This shows that the use of mathematics learning outside classrooms design through Bengkulu cultural connection has the same impact as traditional learning.

In high-level schools, the average pre-test scores in the experimental and control groups are relatively the same. After the intervention of mathematics learning outside classrooms, the average score of post-tests in the experimental group was greater than the control group. Based on the N-Gain value, the experimental group was more significant than the control. This result showed that statistically, mathematics learning outside classrooms design with Bengkulu cultural connection had a more positive impact than traditional learning. Figure 9 shows the information regarding the difference in average scores between the experimental and control groups.

Table 4. Achievement of test results for medium and high-level schools

School level	Statistic	Pre-test		Post-test		N-Gain	
		Control	Exp.	Control	Exp.	Control	Exp.
Medium	N	19	15	19	15	19	15
	Mean	11.26	8.47	40.68	38.47	0.44	0.44
	Std. Deviation	6.40	3.16	11.25	18.13	0.17	0.25
High	N	27	22	27	22	27	22
	Mean	18.00	13.45	42.37	52.23	0.41	0.61
	Std. Deviation	8.06	8.91	9.55	13.98	0.11	0.18

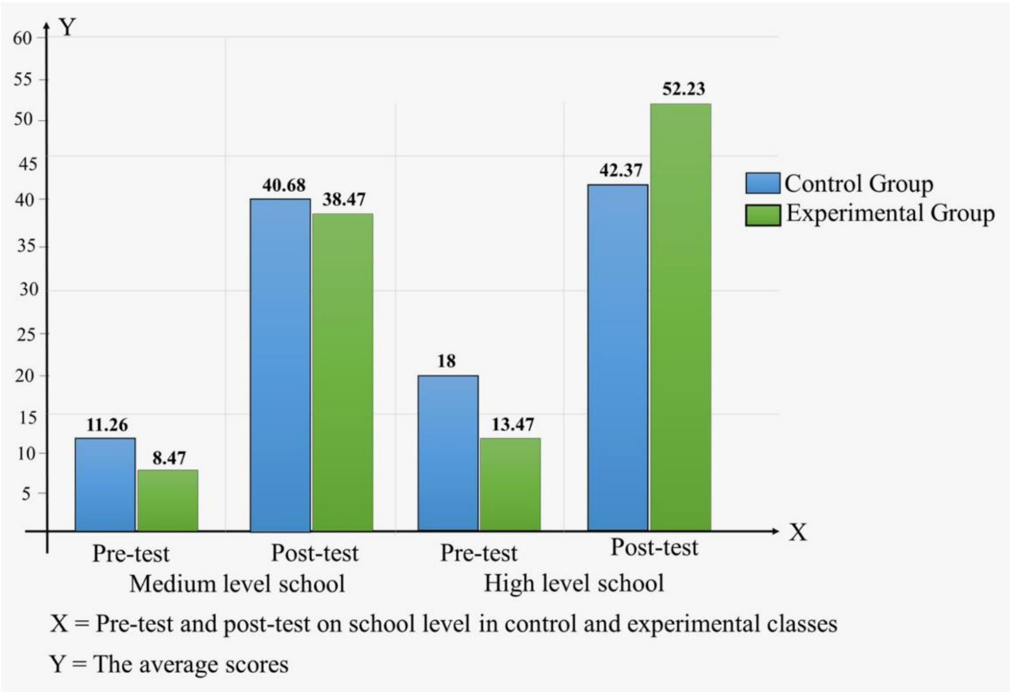

Figure 9. Graph of improvement in medium and high-level schools

The average pre-test and post-test scores in the control and experimental groups show an increase of 29.4 and 30, respectively. This increase indicates that there is no significant difference in improvement between the experimental and control groups. These results are also verified, where the N-Gain value of the control and experimental groups was relatively the same, namely 0.4. Similarly, the control and experimental groups in high-level schools showed an increase of 24.4 and 38.7, respectively. These results showed a significant improvement between the experimental and control groups. The results are consistent with N-Gain values as shown in Figures 9 and 10, showing 0.6 and 0.4 for the experimental and control groups, indicating improvement. The differences in achievement and test results for length and area measurement are shown in Table 5.

After describing the differences in pre-test and post-test scores, an independent samples t-test was conducted for the experimental and control groups. Furthermore, the achievement of understanding in length and area measurement material for medium-level schools has no significant difference between the groups. These results showed that using mathematics learning outside classrooms design through Bengkulu cultural connection had an equal impact on improving students' understanding of the material compared to traditional learning in medium-level schools. Meanwhile, the achievement of understanding in high-level schools differs significantly. These results showed that the use mathematics learning outside classrooms design through Bengkulu cultural connection had a better impact on the knowledge of the material than traditional learning for students in high-level schools.

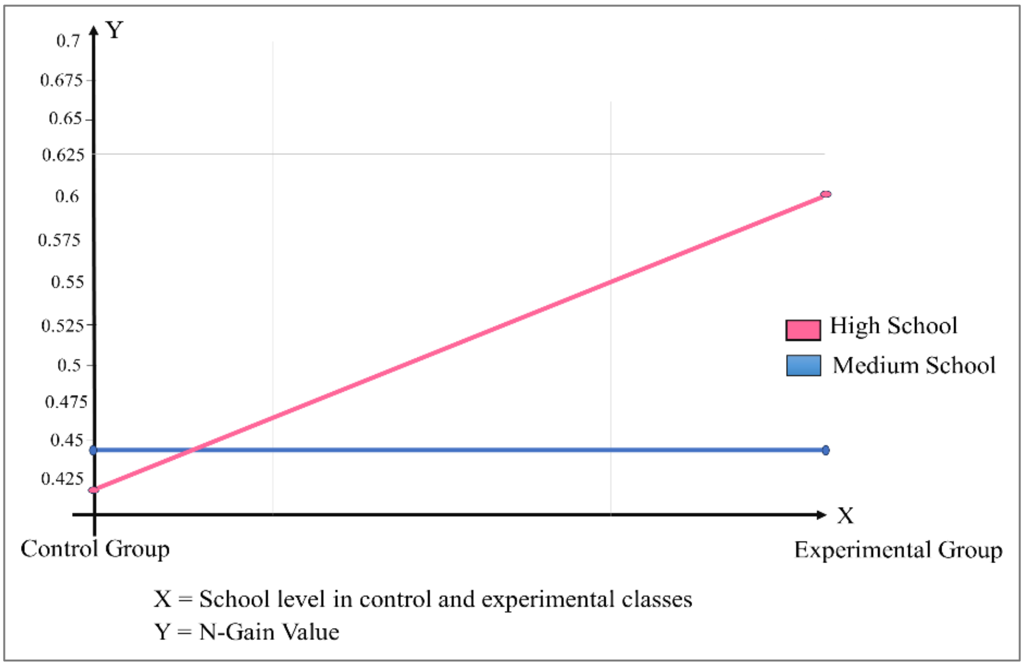

Figure 10. N-Gain test results for medium and high-level schools

Table 5. Test results of differences between control and experimental groups in medium and high-level schools

School level	Stat	Mean		t-test	Mann–Whitney U-test	Conclusion
		Cont.	Exp	Sig.(2-tailed)	Asymp. Sig. (2-tailed)	
Medium	Pre-test	11.26	8.47		0.240	No different
	Post-test	40.68	38.47	0.68		No different
	N-Gain	0.4352	0.44	0.99		No different
High	Pre-test	18.00	13.45		0.020	Different
	Post-test	42.37	52.23	0.008		Different
	N-Gain	0.41	0.61	0.000		Different

3.4. Discussion

This research found that at the beginning of learning, students still needed to be more skilled in using the roll meter measuring tool to measure the length and width of traditional Bengkulu houses. There are differences in several aspects, including attendance, participation, interaction, discussion activities, and responses to questions in the context of mathematics learning outside the classroom through cultural connections in Bengkulu for students at medium- and high-level schools. Students at high-levels were seen to be active with their groups in observing and measuring the structure of traditional Bengkulu traditional house. Next, the teacher provides feedback through questions each group must answer to ensure a formal understanding of the concept. The differences were as: only a few students from medium-level school responded, while students from high-level in each group responded adeptly. Teachers must provide more intensive guidance, involving themselves from one group to another, especially in medium-level schools. Students at medium-level schools tend to be passive and wait for instructions from the teacher. Meanwhile, students at high-level schools need less guidance. Students in high-level schools more quickly understand instructions from teachers and instructions on student worksheets, so students in high-level schools have lots of time to practice working on questions.

Inferential statistical analysis showed that using learning designs outside classroom through Bengkulu cultural connections for students at medium-level school had the same impact in increasing understanding of area and length measurement material as traditional learning. Meanwhile, the achievement of understanding of area and length measurement material at high-level schools differed significantly. These results showed that for high-level school students, using learning designs outside classroom through Bengkulu cultural connections had a more positive impact on increasing understanding of area and length measurement material than traditional learning.

This is consistent with the research by Pradeep *et al.* [38] who states that well-accredited schools provide a higher-quality learning environment. This can impact students' ability to achieve better learning outcomes and preparation for future careers. In contrast, accredited institutions with lower statuses may need help providing an optimal learning environment, impacting students' ability to reach their full potential. Likewise, Nguyen and Ta [33] stated that schools that are accredited as superior have higher standards of teaching and learning. In addition, the results of this research also show that the use of learning outside the classroom has the same impact on increasing students' understanding of length and area measurements at medium-level school, as evidenced in [9], [11].

Although the research findings indicate that employing learning designs outside classroom through Bengkulu cultural connections has a more significant impact on high-level schools, overall, in both high and medium-level schools, such learning designs can enhance students' understanding of length and area measurement. These results are consistent with previous studies that used Bengkulu cultural context to assist students in understanding mathematical concepts. For example, Haji *et al.* [39] showed Bengkulu culture can be integrated into mathematics learning and used to help students understand concepts. Study by Susanta *et al.* [40] also showed that the Bengkulu cultural context can be employed because it closely relates to students' daily environment and lives. The study developed four cultural context mathematical literacy tasks that met valid criteria and had the potential to impact the improvement of students' mathematical literacy activities. These tasks can also serve as learning resources to strengthen students' awareness of local culture.

The use of cultural contexts in learning mathematics has the potential to help students construct a formal understanding of length and area measurement concepts. This result was consistent with the study by Samo *et al.* [41] which showed a significant difference in the average improvement of mathematical problem-solving abilities. The average N-Gain of mathematical problem-solving skills using culturally contextual learning and the control group was 0.51 and 0.29, categorized as moderate and low, respectively [40]. Furthermore, Simamora *et al.* [42] concluded that guided discovery-based mathematics learning in the context of Batak Toba could enhance problem-solving abilities and self-efficacy. Based on these results, mathematics teachers were recommended to strive for high-quality learning material and integrate local culture into mathematics learning [42]. This result was also consistent with Owens [43], which emphasized the importance of teachers in connecting culture and school mathematics activities to build students' values and identity.

Research by Fägerstam and Blom [44] stated that biology and mathematics learning in an out-of-class environment had positive cognitive and affective effects on middle-level school students in Sweden aged 13 to 15 years. The result suggested that students participating in these activities have higher long-term knowledge retention. According to Haji *et al*. [39], realistic mathematics education (RME) with an outdoor approach has a more significant impact than conventional learning in improving understanding of mathematical concepts and disposition. Mann *et al.* [45] also recommended outdoor learning for teachers to assist students in recognizing the meaning of mathematics beyond the classroom.

The introduction of mathematical concepts, specifically the topics of length and area measurement through out-of-class learning design, does not significantly impact students at a medium-school level. This condition was attributed to various factors, such as teacher encouragement and parental and school support. Furthermore, factors such as lack of confidence, learning style suitability, and environmental conditions contributed to students' reluctance to engage in active learning engagements. These results are consistent with previous study [46], which identified four factors influencing the success of this learning. These factors include: i) teacher characteristics, such as interest/motivation to teach outside the classroom, readiness, and confidence in handling risks; ii) systemic factors, namely support from school principals, school/district policies, funding/resources, curriculum, school schedules; iii) cultural factors, such as school culture, community beliefs about education, family background; and iv) environmental factors, including weather, natural/building environment, and hazards. Additionally, the research by Mart and Waite [47] showed that the success of implementing out-of-class learning was influenced by national policy, spatial quality, and the pedagogical values of teachers concerning the management of 'freedom' and children's opportunities to act independently in activities.

Consistent with previous studies, mathematics learning outside classrooms design through Bengkulu cultural connection can be constructed from various learning theories, such as: i) constructivism [48], [49]; ii) social constructivism [50], [51]; and iii) collaborative learning [51]. Constructivism theory was evident as students were allowed to build an understanding of mathematics through observation and direct experience outside the classroom. Similarly, social constructivism theory was evident in interaction with others, including group activities outside the classroom, discussions and collaborations among students, and support from parents. Collaborative learning theory was also evident as students worked together to achieve shared understanding, including group activities where collective effort was used to explore mathematical concepts through Bengkulu cultural connection. Based on these theories, mathematics learning outside classrooms design through Bengkulu cultural connection can develop contextual, meaningful, and student-centered learning experiences. This approach potentially enhances motivation, understanding, and the application of mathematical concepts in the context of local culture.

The findings from this research provide an essential basis for developing innovative learning methods to improve students' understanding of subject matter. An out-of-class learning approach connected to local culture provides contextual and in-depth learning experiences, enriching the learning process. By utilizing the local environment and cultural heritage as learning resources, the results of this research encourage higher levels of student involvement in the learning process. Through direct interaction with the surrounding environment, students can be more active in understanding lesson material and hone critical thinking skills. By considering these findings, educators and policymakers can design more effective and relevant learning strategies for the future, strengthening the quality of education and preparing students to face complex global challenges. These findings also encourage the development of training programs for teachers, preparing them to design and implement meaningful and effective learning outside the classroom. In addition, the results of this research can be a stepping stone for further, more comprehensive research by exploring the impact of learning design outside the classroom through cultural connections on other aspects of learning, such as student learning motivation, information retention, or the development of social skills.

4. CONCLUSION

After implementing a mathematics learning design outside the classroom through cultural connections in Bengkulu, the conclusion is that using this design does not significantly impact increasing understanding of area and length measurement material for students at medium-level schools. On the other hand, for high-level school students, using mathematics learning designs outside the classroom through cultural connections in Bengkulu has proven effective in increasing understanding of area and length measurement material. These findings have important implications for curriculum development and school learning strategies. Teachers and educational policymakers need to consider local cultural factors in designing learning outside the classroom to improve students' understanding of the subject matter. Although this study provides valuable insights, further research is needed to understand better the mechanisms and factors underlying differences in the impact of learning outside the classroom between students in medium- and high-level schools. This will help identify more specific and practical strategies to improve learning at both level schools.

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