International Journal of Multicultural and Multireligious Understanding

http://ijmmu.com
editor@ijmmu.com
ISSN 2364-5369
Volume 12, Issue 5
May, 2025
Pages: 444-455

The Effectiveness of Contextual Teaching and Learning Approach Based on Multiple Intelligences in Terms of Students' Mathematical Literacy Skills and Self-Efficacy

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http://dx.doi.org/10.18415/ijmmu.v12i5.6900

Abstract

The purpose of this study was to describe (1) the effectiveness of mathematics learning with contextual teaching and learning approach based on multiple intelligences in terms of students' mathematical literacy and self efficacy, (2) the effectiveness of mathematics learning with scientific approach in terms of students' mathematical literacy and self efficacy, (3) the effectiveness of mathematics learning with contextual teaching and learning approach based on multiple intelligences compared to mathematics learning with scientific approach in terms of students' mathematical literacy and self efficacy. This research is a quasi-experiment using pretest-posttest control group design. In this design, two groups were randomly selected. The group that is given treatment (learning with contextual teaching and learning approach based on multiple intelligences) is called the experimental group and the group that is not given treatment (learning with a scientific approach) is called the control group. The research was conducted in one of the public junior high schools in Depok District with a sample of 2 classes randomly selected. The instruments used were a test of mathematical literacy skills with a type of description question of 4 items and a self efficacy questionnaire consisting of 18 statements. The results of the analysis concluded that (1) mathematics learning with contextual teaching and learning approach based on multiple intelligences is effective in terms of students' mathematical literacy ability and self efficacy, (2) mathematics learning with scientific approach is effective in terms of self efficacy but not effective in terms of mathematical literacy ability, (3) mathematics learning with contextual teaching and learning approach based on multiple intelligences is more effective than mathematics learning with scientific approach in terms of mathematical literacy ability but equally effective in terms of students' self efficacy ability.

Keywords: *Contextual Teaching; Learning Approach; Mathematical Literacy Skills; Multiple Intelligences; Self-Efficacy*

Introduction

Education is a formal step that provides a platform for the next generation to develop their best abilities. Education emphasizes a process where students do not only gain experience values. Education

should also focus on shaping students' character for the better. Humans are born with different potentials, therefore each individual tends to have their own innate intelligence. If students have the opportunity to learn through their strengths, there will be positive and amazing cognitive, emotional, social and even physical changes. This intelligence must be empowered so that it becomes an asset for children to master their potential. In addition, this potential provides the basis for children to develop into qualified individuals.

According to the theory of multiple intelligences, all humans have a variety of intelligences and further develop into nine different intelligences. By knowing these intelligences, it is important for a teacher to recognize the characteristics that are not the same in each student. Teachers can consider and prepare learning activities through the same characteristics as students' intelligence abilities well [1]. This has a direct effect on learning as well as on the ease with which students respond and capture a learning that already exists in themselves. Therefore, by understanding the concept of multiple intelligences, namely the diverse intelligences that are already owned by an individual, the teacher will find it easier to know what intelligence is the potential in students. Among the intelligences are: 1) verbal/linguistic intelligence; 2) mathematical logic intelligence; 3) visual spatial intelligence; 4) musical intelligence; 5) intrapersonal intelligence; 6) interpersonal intelligence; 7) kinesthetic/physical intelligence; 8) naturalist intelligence; and 9) existentialist intelligence [2].

The diverse intelligence of students does not mean that it demands that learning activities must be individualized. On the contrary, the diversity of students' intelligence should be the basis for teachers to develop their learning methods and create learning tools that can facilitate students through their intelligence diversity [3]. Intelligence-based learning will make students feel recognized in the classroom and make them value their intelligence more. Theoretically, student learning outcomes, including mathematical literacy, can be improved by implementing learning by considering students' intelligence tendencies [4].

According to NCTM (National Council of Teachers of Mathematics) in 2000 stipulates that students must master five mathematical abilities when learning, namely mathematical reasoning, mathematical representation, mathematical connection, mathematical communication, and mathematical problem solving. Mathematical literacy is an ability that supports the development of the other five mathematical abilities [5]. Therefore, mathematical literacy is referred to as the minimum ability in mathematics that can be used to complete tasks related to their field of expertise. Test results conducted by the Organization for Economic Cooperation and Development (OECD) on 15-year-old students in Indonesia show that students' ability to be literate in reading, math literacy and science literacy is still low. The results show that the learning objectives of mathematics have not been achieved [6]. PISA divides student literacy achievement into six levels of proficiency, from level 1 (lowest) to level 6 (highest) for math and science. These levels represent the level of reasoning in problem solving. The majority of Indonesian students have not reached level 2 for math (75.7%) and science (66.6%), which is concerning 42.3% of students have not even reached the lowest proficiency level (level 1) for math and 24.7% for science [7].

Since 2000, Indonesia has taken the PISA test seven times. Of the three categories tested, Indonesia's scores have always been below average. Students who have poor math skills can only reach level 1 of the PISA questions presented from level 1 to level 6. In addition, students have the ability to answer questions with a general context, indicating that they are not familiar with literacy questions. Research conducted by [8] found that students can survive when facing easy questions and can use the knowledge they gain from previous experiences when solving problems. The track record of Indonesian students in working on mathematics problems organized by PISA shows that they have not yet reached the criteria in mathematical literacy skills. Therefore, mathematical literacy skills must be given more attention in the classroom learning process.

Student success in academics is not only determined by cognitive factors, affective factors also play a role, one of which is self-efficacy or self-belief. Self-efficacy is one of the important requirements for mathematical literacy. Students with good mathematical literacy skills usually have strong motivation such as a sense of challenge, self-confidence, high commitment to goals, and a desire to learn about things related to mathematics [9]. Self-efficacy is one of the affective domains that is important to show how cognitive abilities, affective abilities, and behaviors and beliefs, because it is the main basis for a person's actions [10]. Students who have higher levels of self-efficacy are more determined to achieve any goal, and students who have lower levels of self-efficacy do not make that effort [11].

Belief in effectiveness has a positive impact on students' mathematics performance. Students' feelings and thoughts about math do not change as their education level increases. Therefore, the role of teachers is needed in facilitating students' abilities. The teacher has an active role in learning and is certainly a very important position for effective learning. A teaching method is considered effective if and only if it achieves the set goals, both in terms of learning outcomes and student performance.

An approach to teaching mathematics is needed to engage students more effectively in the learning process. The scientific approach is an activity-oriented approach that begins with observing followed by collecting data, analyzing data, associating and ending with communicating [12]. The scientific approach is an organization of learning experiences with a logical sequence that includes the process of observing, questioning, gathering information / trying, reasoning / associating and communicating. With this learning sequence, it is expected to achieve the established learning competencies [13]. The Contextual Teaching and Learning learning approach encourages students to actively participate in the development of their own knowledge and the application of that knowledge in the context of the real world, with the teacher acting as a facilitator, and the learning process focusing on students.

The Contextual Teaching and Learning (CTL) approach is one that works well. The advantages of learning by using the Contextual Teaching and Learning approach are: 1) Learning becomes more meaningful because students are required to find the relationship between material and real life. 2) Learning becomes more productive and able to increase concept reinforcement to students because CTL adheres to the flow of constructivism. 3) CTL learning emphasizes students' physical and mental activities. 4) The classroom is used as a data testing ground based on student learning outcomes. 5) Students construct their own learning materials. 6) CTL learning creates a meaningful learning atmosphere [14]. Learning strategies must be changed towards contextual learning where students actively involve themselves in learning [15]. Contextual teaching and learning based on multiple intelligences has a positive relationship or correlation to students' cognitive abilities [16].

Learning using contextual teaching and learning based on multiple intelligences makes the learning process more meaningful where learning using CTL, students will become active in exploring and discovering new concepts, besides that CTL by stimulating multiple intelligences makes students able to improve student skills so that it can facilitate understanding of learning materials and students are able to find their own concepts learned and train students through scientific research and experiments. Based on what is stated above, the following problems can be formulated: (1) Is mathematics learning with Contextual Teaching and Learning approach based on multiple intelligences effective in terms of students' mathematical literacy and self efficacy, (2) Is mathematics learning with scientific approach effective in terms of students' mathematical literacy and self-efficacy, (3) Is mathematics learning with Contextual Teaching and Learning approach based on multiple intelligences more effective than mathematics learning with scientific approach in terms of students' mathematical literacy and self efficacy? Thus, the objectives of this study are (1) to describe the effectiveness of mathematics learning with Contextual Teaching and Learning approach based on multiple intelligences in terms of students' mathematical literacy and self efficacy, (2) to describe the effectiveness of mathematics learning with scientific approach in terms of students' mathematical literacy and self efficacy, (3) to describe the effectiveness of

mathematics learning with Contextual Teaching and Learning approach based on multiple intelligences compared to mathematics learning with scientific approach in terms of students' mathematical literacy and self efficacy.

Method

Research Design

The type of research conducted was a quasi experiment research using two classes as research objects with different treatments. The first class was given treatment (experimental class) learning with contextual teaching and learning approach based on multiple intelligences and the second class (control class) learning with scientific approach. The design used was pretest posttest control group design. In this design, two groups were selected using purposive sampling technique in which the sample determination was based on the selected characteristics. In this study there are characteristics in the form of samples derived from balanced initial abilities based on student learning outcomes in the previous semester where overall abilities are almost the same.

Research Variables

Research variables are attributes or properties or values of people, objects, or activities that have certain variations set by researchers to study and draw conclusions (Sugiyono, 2017: 61). The independent variable in this study is the approach consisting of mathematics learning with Contextual Teaching and Learning (CTL) approach based on multiple intelligences and scientific approach. The dependent variables studied in the study were students' mathematical literacy skills and self-efficacy. The control variables in the study were the number of meetings, allocation of lesson hours, subject matter, and teacher quality.

Data Collection

The data collection technique in this study used a test before treatment, namely the pretest of mathematical literacy and prescale self efficacy, then a test after treatment, namely the posttest of mathematical literacy and postscale self efficacy. The instruments of this study consisted of two ways, namely tests and non-tests. Tests were used to measure students' mathematical literacy skills and non-tests were used to measure students' self efficacy. In addition, observation sheets were also used to obtain data on the continuity of the learning process related to student and teacher activities and learning activities.

Multiple Intelligences Questionnaire

The multiple intelligences questionnaire aims to obtain information about students' intelligence tendencies according to the nine categories of intelligence that have been determined. This questionnaire was given to students in the form of google forms through the experimental class math teacher before the research was carried out.

Mathematical Literacy Skill Questions

The research instrument in the form of test questions to measure students' mathematical literacy skills consists of 4 essay questions prepared based on mathematical literacy indicators. Each question contains different contexts and the same indicators. Giving test questions is done twice, namely before treatment or pretest and after treatment or posttest.

Self-Efficacy Questionnaire

The research instrument in the form of a questionnaire to measure students' self eff icacy ability consists of 18 statements arranged based on self efficacy indicators. Each indicator has 3 positive statements and 3 negative statements. The questionnaire was given twice, namely before treatment or prescale and after treatment or postscale.

Observation Sheet

In this study, there were two learning implementation observation sheets, namely the learning implementation observation sheet for the experimental class and the observation sheet for the control class. The observation sheet consists of indicators that contain teacher and student activities during the learning process that have been arranged in the teaching module.

Data Analysis

Descriptive analysis was used to describe the research data and find out the general description of students' mathematical literacy skills and self-efficacy. The data described in this study are in the form of pretests and posttests that have been tested in experimental and control classes. The data that has been obtained is then analyzed descriptively to obtain the average data, variance, standard deviation, maximum score and minimum score. Effective criteria for mathematical literacy skills with a Minimum Completeness Criteria value of 70, while effective criteria for students' self-efficacy abilities are obtained from converting scores into qualitative data.

Assumption Test

The assumption test was carried out to determine the multivariate normality of the data and the homogeneity of the experimental class variants. Multivariate normality test is conducted to determine whether the sample comes from a normally distributed population or not, while the homogeneity test is conducted to determine whether the data has a homogeneous variant or not. The normality test in this study is a multivariate normality test using the Mahalanobis distance formula ($_{di}^2$). The data tested include pretest and posttest data of mathematical literacy skills and student self-efficacy. The homogeneity test of the experimental class and control class needs to be done to find out whether the two classes have a homogeneous covariance matrix. If both classes have the same covariance matrix, then both classes are homogeneous.

Learning Effectiveness Test

The learning effectiveness test was conducted to see that mathematics learning with the contextual teaching and learning approach based on multiple intelligences and the scientific approach was effective in terms of students' self eff icacy if the average score of students' self efficacy was in the high category, namely more than 68.4. Then, the contextual teaching and learning approach based on multiple intelligences and the scientific approach is said to be effective in terms of students' mathematical literacy skills if the average score is more than the KKM value of 70. Before the effectiveness test is carried out, a one-sample average vector test is carried out to test whether the average is significantly different from the specified criteria. The one sample t-test was conducted to determine the two dependent variables, namely mathematical literacy skills and student self-efficacy, which is effective in learning by using the contextual teaching and learning approach based on multiple intelligences and the scientific approach.

Comparative Test of Learning Effectiveness

The comparative test of learning effectiveness is conducted to test the average of two independent samples. This test was conducted after the prerequisite analysis test (normality and homogeneity) and the learning effectiveness test. Then the final stage is further testing to find out which approach is more effective in terms of students' mathematical literacy and self-efficacy.

Results and Discussion

Description of Research Results

Before the implementation of this study, researchers gave a multiple intelligences questionnaire first consisting of 32 students. Determination of the type of intelligence of students based on the maximum value on the intelligence indicator obtained from the multiple intelligences questionnaire results that have been filled in by students before the research. Table 10 contains the diversity of students' types of intelligence which is the result of giving multiple intelligences questionnaires in percentages obtained from the number of students who have this type of intelligence compared to the number of students in one class, namely 32 students.

Table 1. Distribution of Students' Intelligence Types

No.	Intelligence Type	Number of Students	Percentage
1.	*Verbal Linguistic*	6	19%
2.	*Logistic Matematics*	18	56%
3.	*Visual Spatial*	14	44%
4.	*Musical*	8	25%
5.	*Bodily Kinesthetic*	2	6%
6.	*Interpersonal*	17	53%
7.	*Intrapersonal*	5	16%
8.	*Naturalist*	7	22%
9	*Existentialist*	6	19%

Table 1 shows that students have more tendency towards *logistic mathematics, visual spatial,* and *interpersonal* intelligence. Based on the observation results of the learning implementation in the experimental class, the results show that the learning steps contained in the teaching module have been implemented well by teachers and students during the learning process. The same results were obtained in the control class with respective percentages of 92.87% for teacher activities and 85.71% for student activities, and 86.11% for teacher activities and 83.33%.

Data Description

Table 2 summarizes the data of students' mathematical literacy test results in the experimental class treated with *contextual teaching and learning* approach based on *multiple intelligences* and the control class with scientific approach.

Table 2. Mathematical Literacy Test Results of Experimental and Control Classes

Description	Experiment Class		Control Class	
	Pretest	*Postest*	*Prestest*	*Postest*
Average	32	74	30	60
Maximum Value	72	93	63	83
Theoretical Maximum Value	100	100	100	100
Minimum Value	2	40	2	25
Theoretical Minimum Value	0	0	0	0
Standard Deviation	19.18	15.22	14.57	13.68

In the experimental class, the average score of mathematical literacy skills was 32 then became 74 in the posttest results so it was concluded that there was an increase of 42 points. The increase in the average score of the control class group was 30 points on the pretest to 60 points on the posttest, a large increase of 30 points.

Table 3 summarizes the data from the students' mathematics self-efficacy questionnaire scores in the experimental class treated with contextual teaching and learning approach based on multiple intelligences and the control class with a scientific approach.

Table 3. Results of Self Efficacy Questionnaire for Experimental and Control Classes

Description	Experiment Class		Control Class	
	Pretest	*Postest*	*Prestest*	*Postest*
Average	54,97	74,22	55,19	74,47
Maximum Value	72	81	75	86
Theoretical Maximum Value	90	90	90	90
Minimum Value	43	63	39	62
Theoretical Minimum Value	18	18	18	18
Standard Deviation	7,11	5,046	9,13	6,763

In the experimental and control classes, the average score of mathematical self-efficacy was 55 then in the prescale then became 74 in the postscale results so it was concluded that there was an increase of 19 points.

Assumption Test Results

The normality test is based on a scatter plot between the mahalanobis distance and chi square. If the chi square tends to form a straight line and about 50% of the mahalanobis distance value is less than or equal to thechi square, then it is accepted, meaning that the sample comes from a normally distributed population. Next, look at the correlation coefficient between the two data. If the correlation coefficient is greater than $_{rtabel}$ or Sig < 0.05, the correlation between the two data variables is significant. The critical point value for the correlation coefficient test is 0.9652 which is obtained from the critical point table with a significance level of 0.05.

Table 4. Results of the Pretest and Posttest Data Normality Assumption Test

Data	Class	r_Q	Correlation Coefficient	Decision
Pretest	Experiment	0,986	0,9652	Normal
	Control	0,976	0,9652	Normal
Posttest	Experiment	0,966	0,9652	Normal
	Control	0,973	0,9652	Normal

Thus it can be concluded that the sample data for mathematical literacy skills and mathematical self efficacy of experimental class students after being treated with learning with a contextual teaching and learning approach based on multiple intelligences comes from a normally distributed population. then it can also be concluded that the posttest data of mathematical literacy skills and self efficacy of the control class after being treated with learning with a scientific approach comes from a normally distributed population.

The results of the covariance matrix homogeneity test before and after being given the learning treatment in the experimental class and control class are presented in Table 5.

Table 5. Covariance Matrix Homogeneity Test Results

Data	Box's M	Sig.	Decision
Pretest	4,334	0,242	Homogen
Posttest	3,147	0,386	Homogen

It can be concluded that the covariance matrix of the two classes before treatment is homogeneous. While after the treatment, the value obtained is 3,147 with sig. 0,386 > 0,05. Thus it can be concluded that the covariance matrix of the two classes after treatment is homogeneous.

Learning Effectiveness Test Results

The effectiveness of learning with contextual teaching and learning approach based on multiple intelligences and scientific approach in terms of students' mathematical literacy and self-efficacy using one-sample average vector test and continued with one sample t-test. The results of the one-sample t-test in the class with contextual teaching and learning approach based on multiple intelligences and class with scientific approach are presented in Table 6.

Table 6. One Sample t-test Results Class

Variable	Experiment		Control	
	t	*Sig.*	*t*	*Sig.*
Math Literacy	5,201	0,000	-0,065	0,4745
Self Efficacy	6,523	0,000	5,076	0,000

Based on the inference criteria, it is rejected, so it can be concluded that the average score of students' mathematical literacy skills in the experimental class is more than 70 and the average total score of students' self efficacy in the experimental class is more than in other words, learning with contextual teaching and learning approach based on multiple intelligences is effective in terms of students' mathematical literacy skills and self efficacy. Meanwhile, Sig. one sample t-test test is more than 0.05 for the variable math literacy skills in learning with a scientific approach. Based on the inference criteria, it is accepted, so it can be concluded that the average score of students' mathematical literacy skills in the control class is less than 70 in other words, learning with a scientific approach is not effective in terms of

students' mathematical literacy skills.

Results of Excellence Test

Based on the results of the effectiveness comparison test, it is concluded that there are differences in the effectiveness of the two experimental classes in terms of students' mathematical literacy and self-efficacy. Therefore, further tests will be conducted to determine which learning approach is more effective for each variable. Further tests were carried out using independent sample t-test analysis of the posttest results of mathematical literacy skills and students' self efficacy final scores. The results of the independent sample t-test of the difference in learning effectiveness between the contextual teaching and learning class and the scientific class can be seen in Table 7.

Table 7. Independent Sample t-test Results

Variable	t	*Sig.*
Math Literacy	3,907	0,000
Self Efficacy	-0,168	0,4335

The average posttest score of students' mathematical literacy ability in the class with contextual teaching and learning approach based on multiple intelligences is more than the average posttest score of students' mathematical literacy ability in the class with scientific approach, in other words, learning with contextual teaching and learning approach based on multiple intelligences is more effective in terms of mathematical literacy ability. The average final score of students' self efficacy in the class with contextual teaching and learning approach based on multiple intelligences is not more than the average final score of students' self efficacy in the class with scientific approach, in other words, learning with contextual teaching and learning approach based on multiple intelligences is not more effective in terms of students' self efficacy.

Research Discussion

Learning based on multiple intelligences has been well implemented and in accordance with the plan, as evidenced by the increase in the average score of both variables. However, in order for the results to be more optimal, teachers need to pay attention to the characteristics and psychological conditions of students. This is so that the psychological condition of students is completely immersed in learning so that they are interested and enthusiastic about the mathematics learning process. In addition, teachers also need to be more creative in presenting a variety of learning activities so that they are truly appropriate in empowering students' intelligence tendencies.

The results of the posttest of mathematical literacy skills in the experimental group showed an increase through the average score of the class achievement. However, some students still made mistakes in answering the questions. In the experimental class, there were students who were able to identify the right mathematical concepts to apply and interpret their answers. But there are still students who have not even been able to identify concepts correctly so that their scores or scores are not maximized. There were also some students in the control group who used scientific learning to improve their mathematical literacy skills. Although there was an improvement, more students still made mistakes in answering students on math literacy questions. Students in the experimental group showed more ability than the control class in identifying mathematical contexts suitable for problem solving, using these mathematical concepts, to interpret their answers, it's just that it is not optimal and has not been evenly distributed among all students.

The implementation of learning for experimental and control classes, both prioritize student

activeness in the learning process. However, there are differences with classes that use multiple intelligences, namely, researchers are more empowering the various dominant intelligences owned by students in designing media and learning activities in the classroom. For example, in mathematics learning with contextual teaching and learning approach based on multiple intelligences, constructivism is done by presenting colored pictures with the context of everyday life, to facilitate students with visual intelligence, inquiry is done by presenting commands to draw objects with certain sizes and angles to facilitate spatial visual intelligence, questioning is done by asking questions related to the material to be discussed in group discussions to facilitate mathematical and interpersonal logical intelligence. In contrast to the mathematics learning approach with a scientific approach without the multiple intelligences approach. Students who experience mathematics learning with a scientific approach are faced with science-based learning or science to find a mathematical concept.

In general, students take each other's roles in completing worksheets according to their respective intelligences, students with visual spatial intelligence make drawings of flat buildings with details of the size of the sides and angles, students with mathematical logical intelligence play a role in making conjectures and proving theories, students with interpersonal intelligence play a role in organizing groups to discuss and explain the results of group work that has been discussed. In learning mathematics with a scientific approach, the learning designed tends not to be as varied as the contextual teaching and learning approach based on multiple intelligences. This causes not all students' intelligences can be accommodated in learning so that students find the learning less enjoyable.

Conclusion

Based on the results of research, hypothesis testing, and discussion, the researcher concludes that the results of research with quadrilateral material are mathematics learning with Contextual Teaching and Learning approach based on multiple intelligences is effective in terms of students' mathematical literacy and self eff icacy, mathematics learning with a scientific approach is effective in terms of self efficacy but not effective in terms of students' mathematical literacy, mathematics learning with contextual teaching and learning approach based on multiple intelligences compared to mathematics learning with a scientific approach is more effective in terms of mathematical literacy but equally effective in terms of self efficacy.

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