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The Differences in Effectiveness of Learning Using Contextual Teaching and Learning (CTL) and the Missouri Mathematics Project (MMP) in Terms of Mathematics Learning Outcomes

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ABSTRACT

This study aims to compare the effectiveness of learning using Contextual Teaching and Learning (CTL) and the Missouri Mathematics Project (MMP) in terms of students' mathematics learning outcomes. The research method employed was an experiment with a pretest-posttest non-equivalent comparison-group design. The research employed an experimental method with a pretest-posttest non-equivalent comparison-group design. The independent variable is the learning model, while the dependent variable is the mathematics learning outcomes. The instruments used were a learning outcome test and an observation sheet for the implementation of learning. The results of the study indicate that both learning models, CTL and MMP, are effective in improving students' mathematics learning outcomes. The Wilcoxon test analysis showed that the significance values for both models were less than 0.05, indicating their effectiveness. However, the Mann-Whitney test revealed no significant difference in effectiveness between the two learning models. These findings suggest that both CTL and MMP can be used as effective alternative teaching methods to enhance students' mathematics learning outcomes. This study contributes to the selection of appropriate teaching methods to improve understanding and learning outcomes in mathematics. It is recommended for future researchers to investigate other aspects such as cognitive, psychomotor, or affective domains, and for teachers to consider using CTL and MMP in their teaching activities.

Keywords: Contextual Teaching and Learning (CTL), Missouri Mathematics Project (MMP), Mathematics Learning Outcomes, Pretest-Posttest Non-Equivalent Comparison-Group Design

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Introduction

Mathematics remains a subject considered difficult by students, resulting in some students still achieving low learning outcomes in mathematics (Ramadhantri et al., 2019). Several factors contribute to these low outcomes, primarily because what they learn does not get stored in their long-term memory.

Instead, the mathematical knowledge they acquire is only temporarily stored in their short-term memory. To address this issue, the role of the teacher in mathematics instruction is crucial (Backfisch et al., 2020).

Teachers play a significant role in planning instruction that helps students acquire and retain knowledge in their long-term memory (Santrock, 2011). Instruction should be meaningful for students, allowing them to have enjoyable learning experiences through specific learning activities. Therefore, teachers are required to create innovative and meaningful instructional methods, so students' learning experiences can be fulfilled, leading to the retention of knowledge in long-term memory and, consequently, improved learning outcomes (Arends & Kilcher, 2010).

Innovative instructional methods can include the contextual teaching and learning (CTL) model and the Missouri Mathematics Project (MMP) (Marliani, 2015). In the CTL model, students learn through contextual matters in their daily lives. This model involves inquiry activities to construct students' knowledge through everyday experiences. Through CTL, students are expected to gain their learning experiences independently (Sukniasih et al., 2023). Meanwhile, the MMP model can enhance students' mathematics learning outcomes and creative thinking skills by completing projects individually or in groups (Ndiung et al., 2021). The Missouri Mathematics Project (MMP) has specific implementation steps: review, development, group/cooperative work, seatwork, and homework (Dalimunthe & Ariani, 2023). A characteristic of the MMP model is the presence of project worksheets (student work sheets). The application of CTL and MMP is expected to help students gain learning experiences that can improve their learning outcomes (Jannah et al., 2013).

In junior high school, specifically within SMP/MTs, the instruction of mathematics presents significant challenges due to the inherently abstract nature of certain topics. This abstract nature often leads to difficulties in comprehension and negatively impacts students' learning outcomes. A prime example of such a challenging topic is linear equations, which is a fundamental part of the mathematics curriculum and is frequently featured in various critical examinations such as AKM, UTBK, and other national written tests. Due to the importance of these exams in assessing students' academic abilities and determining their future educational opportunities, it is imperative that students achieve a solid understanding of linear equations. The difficulties associated with teaching this topic necessitate the exploration of effective instructional methods to enhance student comprehension and performance. In light of this, a study was conducted titled “The Difference in the Effectiveness of Instruction Using Contextual Teaching and Learning (CTL) and the Missouri Mathematics Project (MMP) in Terms of Mathematics Learning

Outcomes." This study aims to investigate and compare the effectiveness of two distinct instructional approaches: Contextual Teaching and Learning (CTL) and the Missouri Mathematics Project (MMP). The effectiveness of these teaching methods is assessed by examining the changes in students' mathematics learning outcomes before and after the application of each instructional strategy. By evaluating these changes, the study seeks to determine which method provides a more substantial improvement in student understanding and performance in the topic of linear equations. The findings of this study are expected to provide valuable insights into the most effective teaching practices for overcoming the challenges associated with abstract mathematical concepts in junior high school education.

Methods

The research conducted is an experimental study with a pretest-posttest non-equivalent comparison-group design (Amiluddin & Sugiman, 2016). The population in this study is seventh-grade students. The samples in this study are seventh-grade classes A and B, each implementing the CTL and MMP instructional models (Palobo, 2016). The independent variable in this study is the instructional model used, namely CTL and MMP (Anggraeni, 2020). The dependent variable in this study is mathematics learning outcomes. Meanwhile, the control variables in this study are the teaching teacher, instructional materials, and learning time. The instruments used to collect data in this study are learning outcome test instruments and observation sheets for the implementation of learning (Ahmad Hasan et al., 2023). The data are then analyzed descriptively for observational data. Meanwhile, for pretest and posttest data obtained, they are analyzed through tests of normality, homogeneity, and ANOVA tests for equality of means in each experimental class (Wiswasta et al., 2017). If the analysis results show normal and valid data, parametric statistical tests such as one-sample t-tests and ANOVA tests will be conducted (Wahyuni, 2020). However, if the prerequisites analysis results are not met, the data will be analyzed using non-parametric statistical tests such as the Wilcoxon test and the Mann Whitney U test (Verma & Abdel-Salam, 2019).

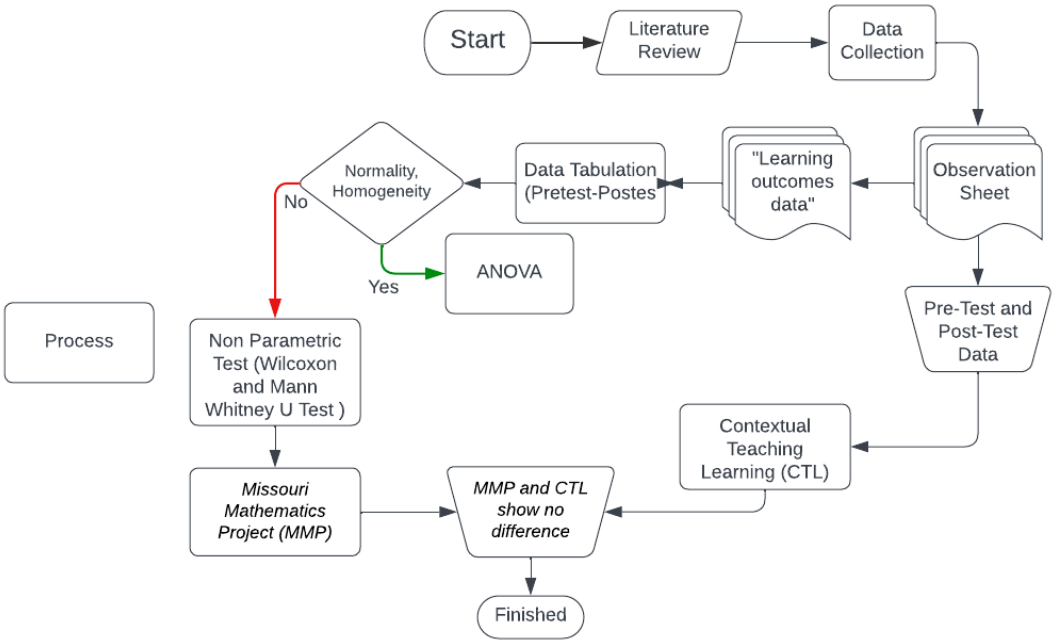

Figure 1. *Research Flowchart*

Results and Discussion

This study employs two experimental classes: the Missouri Mathematics Project (MMP) class and the Contextual Teaching Learning (CTL) class. After the data was collected, it was then analyzed descriptively as shown in Tables 1 and 2. It is evident that the number of students in the MMP class is 27, whereas the CTL class has 26 students. The lowest pretest score for both the MMP and CTL classes is 11, while the lowest posttest score is 0 for the MMP class and 11 for the CTL class. The highest pretest score for the MMP class is 33, whereas for the CTL class it is 44. The highest posttest score for the MMP class is 67, whereas for the CTL class it is 66.

Table 1. *MMP Class*

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	27	11	33	16.30	7.070
Posttes	27	0	67	29.44	18.262
Valid N (listwise)	27				

Table 2. *CTL Class*

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pre	26	11	44	18.62	10.210
Post	26	11	66	32.58	14.420
Valid N (listwise)	26				

After presenting the data descriptively, a prerequisite test was conducted to determine whether to use parametric or non-parametric statistical tests. The prerequisite test involved the Normality Test. Data can be considered normally distributed univariately if the significance value for each research variable is greater than or equal to 0.05. The results of the normality test, shown in Table 3, indicate that the significance values for each variable are less than 0.05, thus concluding that the data is not normally distributed. Since the data does not meet the prerequisite test, the subsequent statistical test used is the non-parametric statistical test.

Table 3. *Normality Test for Each Data Set*

Tests of Normality

	Kelas	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pretest	MMP	.366	27	.000	.708	27	.000
	CTL	.311	26	.000	.738	26	.000
Posttest	MMP	.214	27	.003	.909	27	.022
	CTL	.230	26	.001	.880	26	.006

a. Lilliefors Significance Correction

1. Wilcoxon Test

The Wilcoxon test aims to determine the effectiveness of a learning model based on learning outcomes (Krishnamoorthy, 2020). The data used for this analysis are pretest and posttest scores. The hypotheses used in this test for the first experimental class are H_0, the MMP learning model is not effective based on learning outcomes, and H_1, the MMP learning model is effective based on learning outcomes (Abidin, 2020). For the second experimental class, the hypotheses are H_0, the CTL learning model is not effective based on learning outcomes, and H_1, the CTL learning model is effective based on learning outcomes (Renaldi et al., 2022).

The Wilcoxon test results for the MMP class can be seen in Table 4. Referring to Table 4, it is evident that the significance value is 0,01 less than 0,05 leading to the rejection of H_0. Therefore, the decision is

that the MMP learning model is effective based on learning outcomes. The results of the Wilcoxon test for the MMP class can be observed in Table 4. Referring to Table 4, it is evident that the significance value 0,01 is less than the chosen significance level 0,05, leading to the rejection of the H_0. Therefore, the decision made is that the MMP learning model is effective based on learning outcomes.

Table 4. *Wilcoxon Test Results for MMP Class*

Test Statistics	Kelas MMP
	Post - Pre
Z	-3.258[b]
Asymp. Sig. (2-tailed)	.001
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Table 5 shows the results of the Wilcoxon test for the CTL class. Referring to this table, it is evident that the significance value 0,01 is less than the chosen significance level 0,05, leading to the rejection of the H_0. Therefore, the decision made is that the CTL learning model is effective based on learning outcomes.

Table 5. *Wilcoxon Test Results for CTL Class*

Test Statistics[a]	
	Post - Pre
Z	-3.984[b]
Asymp. Sig. (2-tailed)	.000
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

2. Mann-Whitney Test

The Mann-Whitney test aims to determine whether there is a difference in the means of two independent samples (Bird, 2019; Prabowo Hadi, Suwanda Dadang, 2022). The hypotheses used in this test are H_0, the MMP learning model is not more effective than the CTL learning model based on learning outcomes, and H_1, the MMP learning model is more effective than the CTL learning model based on learning outcomes (Adha & Refianti, 2018). The test results can be seen in Table 6. Referring to Table 6, it is evident that the significance value 0,191 > 0,05, leading to the acceptance of H_0 . Therefore, the decision made is that the MMP learning model is not more effective than the CTL learning model based on learning outcomes.

Table 6. *Mann-Whitney Test Results*

Test Statistics[a]	
	Nilai
Mann-Whitney U	269.000
Wilcoxon W	620.000
Z	-1.307
Asymp. Sig. (2-tailed)	.191

a. Grouping Variable: Kelas

Discussion

1. Effectiveness of the MMP Learning Model in Terms of Learning Outcomes

The research findings indicate that the MMP is effective in terms of learning outcomes. This is attributed to the numerous problem-solving exercises given to students, which helps them become proficient in understanding mathematical concepts. This discovery aligns with Thorndike's theory of the law of exercise, stating that habitual practice leads to proficiency (Hermansyah, 2020). MMP proves effective as it aids students in comprehending the conveyed materials and encourages active learning (Rahman & Nasryah, 2020; Rusdiyana & dkk, 2018).

2. Effectiveness of the CTL Learning Model in Terms of Learning Outcomes

This study was conducted at SMPN Neonbat, class VIIIB, as the second experimental group. The subject matter of this research is linear equations. The primary objective of implementing the Contextual Teaching and Learning (CTL) model is to facilitate students in understanding mathematics, specifically linear equation topics, through real-life problems. Based on the analysis of student learning completeness before treatment (pretest), none of the students achieved mastery. However, after treatment, only 2 students reached mastery. This indicates a change before and after treatment, although not to its fullest extent. Additionally, the statistical test results indicate the effectiveness of CTL on learning outcomes. One of the reasons CTL is effective in learning outcomes is that it helps students connect the subject matter with real-life contexts, allowing them to apply the learned material. Students strive to utilize their previous experiences, build existing knowledge, and make connections between what they learn and its real-life applications (Berns, R. G. & Eriskson, 2001; Rahmawati ES & Harta, 2014). Another factor contributing to the effectiveness of CTL on learning outcomes is the teacher factor. Based on the observation sheets filled out by observers, the teacher successfully manages the CTL class and collaborates with students to discover knowledge. Additionally, the teacher effectively provides information, manages the class, acts

as a facilitator, and motivates students. Another factor contributing to the effectiveness of CTL from the students' perspective is their enthusiasm and motivation in learning using Constructive Student Worksheets (LKS) prepared by the teacher. During the learning activities, students successfully discover knowledge with the teacher's assistance. However, the final results show that only 2 students passed the exam. This is presumed to be due to students feeling unprepared as the test schedule was given immediately after the learning activities.

3. Discussion on Differences in Effectiveness

The hypothesis test results indicate no difference in effectiveness between the two experimental classes. This could be due to the similarity between both learning models, as they both demand critical thinking from students, whether contextually or through problem-solving exercises. Additionally, teachers successfully implement the models, as observed from the observation sheets, which show a fairly good percentage of learning activity implementation. Provide as sufficient information about the formula and place information for each aspect parallel to the right. Not in descending order. Avoid excessive formula descriptions. The characteristic of the discussion is connecting research results with in line theories or previous research results. The discussion is also an answer to the question of why facts such as those findings in the research. It should be remembered that the discussion does not repeat the data in the research results.

Conclusion

Based on the research findings and discussions, it can be concluded that 1) the Missouri Mathematics Project (MMP) learning model is effective in terms of learning outcomes, 2) the Contextual Teaching Learning (CTL) learning model is effective in terms of learning outcomes, and 3) there is no difference in effectiveness between MMP and CTL in terms of mathematics learning outcomes.

These research findings can serve as a reference for other researchers to investigate the MMP and CTL learning models from other aspects (cognitive, psychomotor, or affective). Additionally, teachers can utilize both MMP and CTL models in their teaching activities as alternative learning methods.

References

Abidin, Z. (2020). MISSOURI MATHEMATICS PROJECT DALAM PEMBELAJARAN BANGUN RUANG. *Integral : Pendidikan Matematika*, *11*(2). https://doi.org/10.32534/jnr.v11i2.1593

Adha, I., & Refianti, R. (2018). Missauri Mathematics Project Berbasis Soal Open Ended terhadap Kemampuan Komunikasi Matematika. *Jurnal Pendidikan Matematika (JUDIKA EDUCATION)*, *1*(2). https://doi.org/10.31539/judika.v1i2.403

Ahmad Hasan, N. F., Upu, H., & Rosidah. (2023). Perbandingan Hasil Belajar Matematika Siswa Melalui Metode Pembelajaran Kooperatif Tipe Jigsaw dengan Strategy Genius Learning. *Journal of Contemporary Issue in Elementary Education*, *1*(1). https://doi.org/10.33830/jciee.v1i1.5054

Amiluddin, R., & Sugiman, S. (2016). Pengaruh problem posing dan PBL terhadap prestasi belajar, dan motivasi belajar mahasiswa pendidikan matematika. *Jurnal Riset Pendidikan Matematika*, *3*(1). https://doi.org/10.21831/jrpm.v3i1.7303

Anggraeni, P. (2020). Penerapan Model Pembelajaran Realistik Mathematic Education Dengan Pendekatan Contextual Teaching And Learning Terhadap Keterampilan Abad 21. *Jurnal Pendidikan Utile*, *VI*(1).

Arends, R. I., & Kilcher, A. (2010). *Teaching for Student Learning Becoming an Accomplished Teacher*.

Backfisch, I., Lachner, A., Hische, C., Loose, F., & Scheiter, K. (2020). Professional knowledge or motivation? Investigating the role of teachers' expertise on the quality of technology-enhanced lesson plans. *Learning and Instruction*, *66*. https://doi.org/10.1016/j.learninstruc.2019.101300

Berns, R. G. & Eriskson, P. M. (2001). *Contextual teaching and learning*.

Bird, J. (2019). The Mann-Whitney test. In *Mathematics Pocket Book for Engineers and Scientists*. https://doi.org/10.1201/9780429294402-205

Dalimunthe, A., & Ariani, N. (2023). Peningkatan Kemampuan Berpikir Kritis Matematis Siswa melalui Model Pembelajaran Missouri Mathematics Project. *Jurnal Basicedu*, *7*(1), 1023–1031. https://doi.org/10.31004/basicedu.v7i1.4812

Hermansyah. (2020). Analisis teori behavioristik (Edward Thordinke) dan implementasinya dalam pembelajaran SD/MI. *Jurnal Program Studi PGMI*, *7*(1), 15–25.

Jannah, M., Triyanto, & Ekana, H. (2013). Penerapan model Missouri Mathematics Project (MMP) untuk meningkatkan pemahaman dan sikap positif siswa pada materi fungsi. *Jurnal Pendidikan Matematika Solusi*, *1*(1).

Krishnamoorthy, K. (2020). Wilcoxon Signed-Rank Test. In *Handbook of Statistical Distributions with Applications*. https://doi.org/10.1201/9781420011371-34

Marliani, N. (2015). Peningkatan Kemampuan Berpikir Kreatif Matematis Siswa melalui Model Pembelajaran Missouri Mathematics Project (MMP). *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *5*(1). https://doi.org/10.30998/formatif.v5i1.166

Ndiung, S., Sariyasa, Jehadus, E., & Apsari, R. A. (2021). The effect of treffinger creative learning model with the use rme principles on creative thinking skill and mathematics learning outcome. *International Journal of Instruction*, *14*(2). https://doi.org/10.29333/iji.2021.14249a

Palobo, M. (2016). Keefektifan pendekatan problem posing dan problem solving dalam pembelajaran kalkulus II. *Jurnal Riset Pendidikan Matematika*, *3*(2). https://doi.org/10.21831/jrpm.v3i2.9369

Prabowo Hadi, Suwanda Dadang, dan S. W. (2022). *[3] Holle E.S (2011) "Pelayanan Publik Melalui E-Government: Upaya meminimalisir*. PT. Remaja Rosdakarya.

Rahman, A. A., & Nasryah, C. E. (2020). Efektivitas Model Pembelajaran Missouri Mathematics Project untuk Meningkatkan Hasil Belajar Siswa SMA. *Mosharafa: Jurnal Pendidikan Matematika*, *9*(2), 335–346. https://doi.org/10.31980/mosharafa.v9i2.650

Rahmawati ES, Y., & Harta, I. (2014). Keefektifan Pendekatan Open-Ended Dan Ctl Ditinjau Dari Hasil Belajar Kognitif Dan Afektif. *Jurnal Riset Pendidikan Matematika*, *1*(1), 113. https://doi.org/10.21831/jrpm.v1i1.2669

Ramadhantri, I., Achmad, A., Sukoco, A., & Suryandari, K. C. (2019). ERROR ANALYSIS OF STUDENTS IN GRADE VI OF BUMIREJO ELEMENTARY SCHOOL 1 IN COMPLETING FLOWCHART DEBIT STORY PROBLEMS. *Social, Humanities, and Educational Studies (SHEs): Conference Series*, *1*(2). https://doi.org/10.20961/shes.v1i2.26854

Renaldi, R., Abidin, A. R., Irawan, Y., Hamid, A., & Wulansari, R. E. (2022). Contextual Based E-learning (CBE): A New Model for Online Teaching in Public Health Department for Learning During the Covid-19 Pandemic. *International Journal of Interactive Mobile Technologies*, *16*(11). https://doi.org/10.3991/ijim.v16i11.29787

Rusdiyana, E., & dkk. (2018). Efektivitas Model Pembelajaran Missouri Mathematics Project (MMP) dengan Media Permainan pada Pokok Bahasan Persamaan Garis Lurus. *Kadikma*, *9*(1), 52–60.

Santrock, J. W. (2011). Educational Psychology 5th Edition. In *Educational Psychology* (Vol. 1). Mc Graw Hill. https://doi.org/10.1017/CBO9781107415324.004

Sukniasih, Wardani, S., & Saptono, S. (2023). Development of Pop-Up Books in Improving Reading Skills through an Inquiry Learning Model in Grade I Elementary School Students. *International Journal of Research and Review*, *10*(7). https://doi.org/10.52403/ijrr.20230742

Verma, J. P., & Abdel-Salam, A. S. G. (2019). Testing statistical assumptions in research. In *Testing Statistical Assumptions in Research*. https://doi.org/10.1002/9781119528388

Wahyuni, M. (2020). Statistik Deskriptif Untuk Penelitian Olah Data Manual dan SPSS versi 25. In *Angewandte Chemie International Edition, 6(11), 951–952.* (Issue Mi).

Wiswasta, I. G. N. A., Sukamerta, I. M., Wedagama, D. M., & Agung, I. G. A. A. (2017). Metode Penelitian dan Analisis Statistik Kuantitatif Deskriptif. In *UNMAS Press*.