Jurnal Pembelajaran Matematika Inovatif
Volume 8, No. 1s, February 2025

DOI 10.22460/jpmi.v8i1s.xxxxx ISSN 2614-221X (print) ISSN 2614-2155 (online)

APPLICATION OF THE CONTEXTUAL TEACHING AND LEARNING MODEL ASSISTED BY GEOGEBRA TO ENHANCE EIGHTH-GRADE STUDENTS' MATHEMATICAL UNDERSTANDING OF SYSTEMS OF LINEAR EQUATIONS IN TWO VARIABLES

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ARTICLE INFO

Article History
Received Dec 5, 2024
Revised Dec 29, 2024
Accepted Jan 11, 2025

Keywords:
Contextual Teaching and Learning;
Mathematical Understanding;
SPLDV

ABSTRACT

The purpose of this study is to obtain descriptive results regarding the application of the ctl model assisted by geogebra to improve mathematical understanding before and after the implementation of the ctl teaching approach assisted by geogebra in class viii smpn satap jayakerta for systems of linear equations in two variables material. 10 students were the subjects in this study. experiments in the form of comprehension ability test questions are the methods applied in this study. data analysis was carried out by implementing the pre-experimental design with the one group pretest-posttest design design. the findings in this study indicate that there is an influence of the ctl teaching approach using geogebra, found in the data analysis that has a sign value ≤0.05 which means that there is an increase in mathematical understanding before and after the implementation of the ctl teaching model assisted by geogebra for systems of linear equations in two variables material.

Maksud penelitian ini ialah guna memperoleh hasil uraian perihal pengaplikasian model CTL bantuan geogebra guna meningkatkannnya pemahaman matematik sebelum serta sesudah diterapkannya pendekatan pengajaran CTL bantuan geogebra kelas VIII SMPN SATAP Jayakerta untuk materi SPLDV. 10 orang siswa menjadi subjek pada penelitian ini. Eksperimen berupa soal tes kemampuan pemahaman yaitu metode yang diterapkan pada penelitian ini. Penganalisisan data yang dilaksanakan dengan menerapkan pre-Eksperimental Desain dengan rancangan *One Group Pretest-Posttest Design*. Penemuan dalam penelitian ini mengindikasikan terdapatatnya pengaruh pendekatan pengajaran CTL dengan memakai geogebra, terdapat pada analisis data yang memiliki nilai *sign* $\leq 0{,}05$ yang mengandung makna terdapat meningkatnyakannya pemahaman matematik sebelum dan sesudah diterapkannya model pengajaran CTL berbantuan geogebra untuk materi SPLDV.

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How to cite:

Sihombing, K. M., Fitriani, N., & Amelia, R. (2025). Application of the contextual teaching and learning model assisted by geogebra to enhance eighth-grade students' mathematical understanding of systems of linear equations in two variables. *JPMI – Jurnal Pembelajaran Matematika Inovatif, 8*(1s), 15-22.

INTRODUCTION

Mathematics is an essential field of study in daily life and school activities. Likewise, mathematics is a lesson with concepts that are interrelated between materials. According to Kusumawardani et al. (2018) mathematics develops from human thought, which is related to ideas, reasoning, and concepts. According to Yunita & Imami (2022) conceptual understanding and mathematics are interrelated because solving abstract mathematics requires conceptual understanding. Furthermore, as stated by Alan & Afriansyah (2017) the process of learning mathematics emphasizes the importance of mathematical comprehension, as it teaches that the material delivered to students is not just memorizing but more than that, enabling students to grasp the concepts being taught. Therefore, it is necessary to understand the basic mathematical principles to understand the following materials.

Mathematics learning that aims to understand the mathematical concepts needed to solve various problems in mathematics is crucial and inevitable in the current context of mathematics (Putra et al., 2018). Instilling mathematical understanding is not just memorization, but also the process of understanding the concept of understanding in a material. Students with a strong mathematical understanding can master and understand various mathematical concepts in depth. An understanding of basic mathematical concepts is necessary to comprehend more advanced material. However, in practice, mathematics is often perceived as a challenging subject by junior high school students, as can be seen when teachers assign practice problems—especially those related to systems of linear equations in two variables. During the lesson, the teacher gave questions different from the examples and many students had difficulty solving them. Most students tend to rely on rote memorization of formulas rather than comprehending the reasoning and processes behind their development. As a result, students have difficulty designing steps to meet the required information based on the available data. Then, when faced with story problems that are deceptive in nature, many students are trapped by the assumption that all the data in the question must be used to find the solution (Suraji et al., 2018).

Based on the problems that occur, it is necessary to implement a teaching model that can support or increase students' mathematical understanding. According to Kadir (Fikriyatus et al. 2019) contextual teaching is an effective teaching concept that allows teachers to link teaching materials to students' direct environment while encouraging students to connect the insights they have and their implementation in daily activities. This learning includes seven elements of teaching, including constructivism, asking, discovery, learning communities, modeling, and authentic assessment. The CTL model has one characteristic, namely Constructivism. According to the constructivist perspective, insight is not delivered directly to students but must be built by students themselves with their active participation in the learning process. In teaching activities, students develop their knowledge gradually, through teaching stages that are carefully arranged and planned by the teacher. In the CTL model, there is also discovery (inquiry). Discovery is a key element in CTL-based learning activities. The insights and skills gained by students are expected not only to come from the process of remembering or memorizing but also from the fruit of the guided search stage. Teaching is planned to provide opportunities for students to encounter concepts or knowledge directed by educators. Based on these two characteristics, it is suspected that the CTL model is proven to be effective in improving mathematical understanding.

One of the teaching methods that supports understanding of mathematical concepts is teaching using GeoGebra. As stated by Suweken (Purwanti et al. 2016) Geogebra is specifically designed to support mathematics learning. The interface offered effectively accommodates the

representation of mathematical concepts in various modes or representations. In addition, Geogebra software has the advantage of helping students understand the concept of systems of linear equations in two variables through the use of geometric objects. this ability can help students understand the material in depth, especially on topics that are less effective when taught using conventional methods by teachers. therefore, geogebra is expected to be able to describe and present learning materials that are more relevant to the "real world" of students. interesting and interactive visualizations in geogebra allow students to better understand concepts. based on this explanation, the ctl model and the use of geogebra can support the improvement of mathematical understanding skills, especially for systems of linear equations in two variables materials.

METHOD

The technique applied in this study is an experimental approach, with the aim of exploring ways that can improve student understanding. Participants in this study were 10 eighth-grade students in SATAP Jayakerta Junior High School. The method used to obtain samples in this study was a purposive sampling approach. Based on Asrulla et al. (2023) Purposive sampling is a method for obtaining samples by sorting samples from groups according to standards applied by researchers. The tests conducted in the pretest and posttest contained five essay questions, each question was specifically designed to measure the indicators of systems of linear equations in two variables mathematical understanding ability. The data analysis method in this study used the One Group Pretest-Posttest design, as shown in the following table.:

Tabel 1. Research Design One Group Pretest and Posttest Design

Pre-Test	Treatment	Post-Test
O1	X	O2

Tabel 2. Student Mathematical Understanding Achievement Categories

Value	Category
$\leq 33\%$	Low
$> 33\%$	Middle
$> 66\%$	High

The initial condition test to test normality in this study was carried out using the Shapiro-Wilk test where the significance level was ≥ 0.05. The assumption put forward is that Ho states that the data distribution is normal, while Ha states that the data distribution is not normal. "If the significance value is greater than or equal to 0.05, then the null hypothesis (Ho) is accepted, indicating that the data are normally distributed. Conversely, if the significance value is less than 0.05, the null hypothesis is rejected, suggesting that the data are not normally distributed. A parametric test will be used if the data follow a normal distribution, whereas a non-parametric test will be employed if the data do not (Nasrum, 2018).

RESULTS AND DISCUSSION

Result

The initial step in this research is to provide mathematical understanding questions for systems of linear equations in two variables. The percentage of mathematical understanding before the implementation of the learning process using the geogebra rock ctl model (pretest) was 15%. Meanwhile, the percentage of mathematical understanding after implementing learning using

the ctl model assisted by geogebra (posttest) was 36%. Referring to the preliminary data analysis conducted by researchers and grade viii mathematics teachers at satap jayakerta junior high school on 10 students who completed the pretest questions based on the category of mathematical understanding of systems of linear equations in two variables material, it was in the low classification.

The next stage is to work together with mathematics teachers of smpn satap jayakerta to prepare teaching tools that implement the ctl model. After the tools in the form of lkpd assisted by geogebra ctl model systems of linear equations in two variables material are completed, the researcher will conduct a learning treatment with class viii teachers of smpn satap jayakerta implementing the ctl model systems of linear equations in two variables material. Then a posttest is carried out using similar questions. Next, the researcher will process the post-test data to conclude. The following is data that describes the ability to understand mathematics before and after teaching using the ctl model assisted by geogebra for systems of linear equations in two variables material.

Tabel 3. Percentage of mathematical understanding before and after action

Pretest score	Posttest score
21	50
17	41
14	35
12	29
10	26
15%	36%

From the data, it can be seen that the percentage of assessment results before being implemented or pretest is lower than the percentage of assessment results after implementing teaching using the ctl model (posttest). Based on the category of achievement of mathematical understanding ability, the pretest result is 15% with a low category and the posttest result is 36% with a medium category. Before conducting a hypothesis test, a premise test is carried out. In the premise test, a sign <0.05 is obtained, resulting in the rejection of ho. The sign obtained is:

Tabel 4. Results of the normality test of mathematical understanding before and after teaching the ctl approach assisted by geogebra

	Kolmogorov-smirnov[a]			*Shapiro-wilk*		
	Statistic	Df	*Sig.*	*Statistic*	Df	*Sig.*
Pretest	0,324	10	0,004	0,794	10	0,012
Posttest	0.172	10	0,200	0,917	10	0,329

Based on the table above, the pretest and posttest sign values are 0.012 and 0.329. In the pretest sign, there is <0.05 so h0 is rejected. The following shows that the sample was obtained from a group that was not normally distributed. Thus, because the data was not normally distributed, a nonparametric test was carried out, namely the wilcoxon test.

The assumptions to be tested and formulated are ho, which means that mathematical understanding at the end of learning is not better or equal to understanding at the beginning, and ha, which means that mathematical understanding mastered by students at the end of learning is better than understanding at the beginning of learning. The testing criteria are ho is approved if the sign $\geqslant$ 0.05 and ho is rejected if the sign <0.05. Based on the results of data processing, the results are as follows:

Tabel 5. Pretest and posttest statistical test

Information	*Pretest-posttest*
Z	-2.812[b]
Asymp.sig (2-tailed)	0,005

According to the results of the data review referring to the table above, it can be concluded that the sign value $\leqslant$ 0.05 so ho is rejected. This means that mathematical understanding after the implementation of learning using the ctl model assisted by geogebra is more optimal than before the implementation of the ctl model assisted by geogebra in teaching systems of linear equations in two variables material in eighth grade at satap jayakerta junior high school.

Discussion

This study uses the ctl model assisted by geogebra which is intended to enhance mathematical understanding. The initial phase in the study was the submission of questions with indicators of understanding for systems of linear equations in two variables material. After the submission of the questions, the results were obtained and data analysis was carried out using microsoft excel to determine the level of mathematical understanding ability for systems of linear equations in two variables material. The results obtained were in the low category.

According to skemp (hanipah et al. 2019), the indicators of relational understanding ability include various important aspects of understanding concepts, including the ability to repeat concepts that have been studied in a clear and structured manner, the ability to describe objects based on the fulfillment or failure to fulfill the provisions that make the concept, and the capability to apply these concepts through systematic procedures. In addition, the ability to provide relevant examples based on mastered concepts, put forward concepts in the form of appropriate mathematical manifestations, and connect various concepts, both internal and external to the context of mathematics, are also crucial elements in this relational understanding.

In line with that, according to skemp (syarifah, 2017) relational understanding ability refers to the ability to identify and conclude certain rules based on broader mathematical relationships. This ability involves an understanding of existing patterns or structures, as well as the ability to connect basic principles in a broader and more complex context. According to riyani et al. (2017) relational understanding ability refers to an individual's ability to apply mathematical procedures to solve problems, with a deep understanding of the function and usefulness of these procedures in the context of problem-solving. In this case, students not only understand the material conceptually but also master the procedural steps needed to achieve the right solution. This indicator is used by researchers as a tool to evaluate the level of mathematical understanding mastered by junior high school students in eighth grade.

In a study conducted at satap jayakerta junior high school, it was found that several students still showed limitations in expressing problems and situational/story questions in mathematical form. The results of the observation indicated that the mathematical understanding mastered by students was still very lacking. In addition, teaching that is still traditional in nature, this matter can be viewed as an element that results in low student ability to understand what they are learning, thus affecting the mathematical understanding mastered by students. To optimize the improvement of abilities, especially mathematical understanding, it is necessary to adjust the teaching method or model based on the situation and lessons learned..

This research model is by paying special attention to a group of students and observing its impact. However, before the action is carried out, a pretest is first carried out to evaluate the

level of mathematical understanding of the systems of linear equations in two variables material. The pretest aims to obtain valid and accurate data so that it allows for a comparison of pretreatment and posttreatment results. In this study, an experimental lesson study process was used and a pretest was given. The next stage in providing ctl model treatment supported by geogebra was applied during the learning process, followed by a posttest containing questions that were identical to the pretest.

Based on the results of the data review obtained, it can be seen that a very significant discrepancy was found in the mathematical understanding possessed by students before and after being given teaching treatment using the ctl model assisted by geogebra for systems of linear equations in two variables material. Based on the guidelines for the category of achievement of mathematical understanding abilities, mathematical understanding in students after the implementation of teaching using the ctl model assisted by geogebra for systems of linear equations in two variables material experienced progress in the mathematical understanding mastered by grade viii students, namely in the moderate category.

Next, a normality test was conducted again to determine the distribution of the data. The predetermined analysis method was used as an evaluation tool. At this stage, the data were found to be not normally distributed. As a result, a non-parametric test was subsequently applied. Based on the analysis using the non-parametric test, it was concluded that there was an improvement in students' understanding after the implementation of the contextual teaching and learning (ctl) model assisted by geogebra on the systems of linear equations in two variables material. This outcome indicates that students' abilities improved after the implementation of the model compared to their performance before the intervention. This improvement occurred because students were allowed to independently discover, explore, and analyze concepts from the learning materials, solve problems on their own, and actively summarize the ideas and concepts they acquired.

According to the findings of the hypothesis test, the average increase in mathematical understanding after participating in systems of linear equations in two variables teaching using the ctl model assisted by geogebra was higher than in traditional teaching. This statement is in line with sunarto et al. (2021) who stated that students with teach using the ctl model have superior mathematical understanding compared to students who learn using traditional methods. What distinguishes this study from previous studies is using the ctl model assisted by lkpd for teaching and equipped with geogebra. The current era increasingly emphasizes the use of technology, so this study is adjusted to the current situation of students. Let's increase the use of technology to arouse student focus. Therefore, teaching with the ctl model assisted by geogebra has a significant impact on increasing mathematical understanding of systems of linear equations in two variables material.

Teaching using the ctl model in this study, students construct their understanding. This study adopts the ctl teaching approach which is divided into six stages, namely: (1) constructivism, (2) asking, (3) inquiry, (4) learning community, (5) modeling, and (6) authentic assessment. When teaching using the ctl model, students learn to use lkpd assisted by geogebra in small groups. According to asmara (2019) in this constructivism stage, students construct their understanding and learning must be packaged as a construction process, not a reception process. Furthermore, at the investigation and questioning stage, the teacher provides space for students to develop their understanding through observation. The teacher motivates students to ask questions about things they do not understand.

In the learning community stage, students in groups review information collected through observations of library literature, focus on questions on the worksheet, process the information obtained, and provide responses to information collected from the literature. Next, in the modeling stage, students in small groups summarize the results of the discussion and answer previous questions. In the reflection stage, students successfully find information to verify the formulation of the hypothesis and match it with other questions related to the lessons that have been studied to compare their application. The authentic assessment stage identifies the level of knowledge and understanding of students in the lessons taught by completing lkpd questions with the help of geogebra.

The main distinction in conventional learning lies in the passive role of students, who primarily listen and receive information. When teachers ask questions related to the material, students tend to write down answers without fully processing the content. If the questions differ slightly from previous examples, many students struggle to respond, indicating a superficial understanding. This difficulty often stems from a lack of mastery of the material. As a result, teachers must repeatedly explain the same concepts, leading to inefficient use of class time and the need to give extra attention to students who have not yet understood the lesson.

In line with panjaitan's research (2016), it is explained that high school students in statistics teaching using the ctl model have good grades compared to high school students in statistics teaching not using the ctl model or conventional learning. The difference between this study and the study above is in the material and abilities tested. The difference in this study is using geogebra which successfully attracts students' interest in teaching. This condition shows that teaching the ctl model assisted by geogebra can improve mathematical understanding abilities compared to conventional teaching, especially in systems of linear equations in two variables material.

CONCLUSION

The research findings and discussion show a significant increase in mathematical understanding obtained through teaching systems of linear equations in two variables material using the ctl model supported by geogebra. Based on these results, the researcher provides several recommendations: mathematics learning that integrates the ctl approach assisted by geogebra should be considered as an effective alternative in improving mathematical understanding in the classroom. Then teachers are advised to continue to advance and experiment with various learning methods and approaches to enrich the learning process and ensure the achievement of the desired learning objectives. Further researchers are also advised to examine other aspects and materials and explore other abilities.

REFERENCES

Alan, U. F., & Afriansyah, E. A. (2017). Kemampuan pemahaman matematis siswa melalui model pembelajaran auditory intellectualy repetition dan problem based Learning. *Jurnal Pendidikan Matematika*, *11*(1). https://doi.org/10.22342/jpm.11.1.3890.67-78

Asmara, Y. (2019). Pembelajaran sejarah menjadi bermakna dengan pendekatan kontektual. *Kaganga:Jurnal Pendidikan Sejarah Dan Riset Sosial-Humaniora*, *2*(2), 105–120. https://doi.org/10.31539/kaganga.v2i2.940

Asrulla, Risnita, Jailani, M. S., & Jeka, F. (2023). Populasi dan sampling (kuantitatif), serta pemilihan informan kunci (kualitatif) dalam pendekatan praktis. *Jurnal Pendidikan Tambusai*, *7*(3), 26320–26332.

Fikriyatus, S., Akhwani, & Nafiah, D. W. R. (2019). Model pembelajaran contextual teaching and learning untuk meningkatkan hasil belajar pkn di sekolah dasar. *Jurnal Basicedu*, *vol 5*(No 5), 3118. https://doi.org/https://doi.org/10.31004/basicedu.v5i5.1285

Hanipah, R., Noornia, A., & Sampoerno, P. D. (2019). Pmri Materi Relasi Fungsi. *Prima: Jurnal Pendidikan Matematika*, *3*(2), 103–115.

Kusumawardani, D. R., Wardono, & Kartono. (2018). Pentingnya penalaran matematika dalam meningkatkan kemampuan literasi matematika [The importance of mathematical reasoning in improving mathematical literacy skills]. *PRISMA, Prosiding Seminar Nasional Matematika*, *1*(1), 588–595.

Nasrum, A. (2018). Uji normalitas data untuk penelitian. In *Jayapangus Press Jl. Ratna No.51 Denpasar-Bali*. http://book.penerbit.org/index.php/JPB/article/view/115

Panjaitan, D. J. (2016). Penerapan pendekatan contextual teaching and learning (ctl) untuk meningkatkan hasil belajar statistika. *Jurnal Penelitian Pendidikan MIPA*, *1*(1), 1–10.

Purwanti, R. D., Pratiwi, D. D., & Rinaldi, A. (2016). Pengaruh pembelajaran berbatuan geogebra terhadap pemahaman konsep matematis ditinjau dari gaya kognitif. *Al-Jabar : Jurnal Pendidikan Matematika*, *7*(1), 115–122. https://doi.org/10.24042/ajpm.v7i1.131

Putra, H. D., Setiawan, H., Nurdianti, D., Retta, I., & Desi, A. (2018). Kemampuan pemahaman matematis siswa SMP di bandung barat. *Jurnal Penelitian Dan Pembelajaran Matematika*, *11*(1). https://doi.org/10.30870/jppm.v11i1.2981

Riyani, R., Maizora, S., & Hanifah, H. (2017). Uji validitas pengembangan tes untuk mengukur kemampuan pemahaman relasional pada materi persamaan kuadrat siswa kelas VIII SMP. *Jurnal Penelitian Pembelajaran Matematika Sekolah (JP2MS)*, *1*(1), 60–65. https://doi.org/10.33369/jp2ms.1.1.60-65

Sunarto, M. T., Laa, S. P. Y. O., Mahtuum, Z. A., Siagian, G. T., & Afrilianto, M. (2021). Meningkatkan kemampuan pemahaman matematis siswa SMP melalui pendekatan kontekstual. *Mosharafa: Jurnal Pendidikan Matematika*, *10*(1), 85–94. https://doi.org/10.31980/mosharafa.v10i1.730

Suraji, Maimunah, & Saragih, S. (2018). Analisis kemampuan pemahaman konsep matematis dan kemampuan pemecahan masalah matematis siswa SMP pada materi sistem persamaan linear dua variabel (SPLDV). *Suska Journal of Mathematics Education*, *4*(1), 9–16. https://doi.org/10.24014/sjme.v3i2.3897

Syarifah, L. L. (2017). Analisis kemampuan pemahaman matematis pada mata kuliah pembelajaran matematika SMA II. *Jurnal Penelitian Dan Pembelajaran Matematika*, *10*(2), 57–71. https://doi.org/10.30870/jppm.v10i2.2031

Yunita, M. R., & Imami, A. I. (2022). *Analisis kemampuan pemahaman konsep matematis siswa smp dalam pembelajaran tatap muka terbatas pada materi himpunan*. *5*(6), 1595–1606. https://doi.org/10.22460/jpmi.v5i6.1595-1606.