Journal of Mathematics Education Research
Volume 01, No. 1, 2026, pp. 16-21
ISSN:

Revolutionizing Mathematics Learning: Implementing GeoGebra in the Topic of Systems of Linear Equations in Two Variables

Nining Cartini[1]*, Sandi Nurahmadani[2]

[1]SMAN 3 Kuningan, Jawab Barat, Indonesia.
[2]Universitas Terbuka, Indonesia
*Correspondence: cartinininingg8@gmail.com

Abstract
This article examines the implementation of GeoGebra in teaching systems of linear equations in two variables and its potential contribution to students' mathematical understanding. The study involved Grade XI students in class MIPA 6 and used pretest and posttest assessments, classroom observation, and interviews to examine learning before and after the GeoGebra-supported instruction. GeoGebra was used to visualize linear equations, manipulate their graphs, and identify the intersection point representing the solution to a system. The manuscript reports that students' posttest scores increased compared with their pretest scores and describes improvements in conceptual understanding, engagement, and problem-solving. The findings suggest that dynamic visualization can provide an accessible way to connect algebraic procedures with graphical representations. However, the original manuscript does not provide a complete account of the sample size, full descriptive statistics, statistical testing, or detailed qualitative analysis. Therefore, the results are presented descriptively and should not be interpreted as definitive evidence of causal effectiveness.

Keywords: Geogebra, Mathematics Education, Problem-Solving, Technology.

INTRODUCTION

Advances in educational technology have changed how mathematics can be taught and learned. Digital learning tools and interactive platforms allow teachers to present mathematical concepts through multiple representations and enable students to explore ideas beyond static textbook examples. Technology can also expand access to learning resources and support collaborative and flexible learning (Yaniawati, 2020; Juandi, 2021).

Systems of linear equations in two variables require students to coordinate algebraic and graphical representations. Students must understand that a solution is an ordered pair satisfying both equations and can be represented by the intersection of their graphs. Difficulties may arise when instruction focuses mainly on procedural calculations without making the relationship between equations and graphs explicit. GeoGebra is a dynamic mathematics application that supports the construction and manipulation of mathematical objects. In the context of Systems of Linear Equations in Two , students can graph two linear equations, observe how the lines intersect, and relate the intersection point to algebraic solutions. The source manuscript cites

previous studies describing GeoGebra's role in visualization, exploration, engagement, and mathematical problem-solving (Juandi, 2021; Nuritha & Tsurayya, 2021). This study discusses the implementation of GeoGebra in an Systems of Linear Equations in Two lesson with Grade XI students. It focuses on changes in students' assessment results and classroom experiences associated with the use of the application.

METHODS

The original manuscript describes a combined qualitative and quantitative approach to exploring GeoGebra implementation in Systems of Linear Equations in Two learning. The participants were students from class XI MIPA 6. The reported procedures included reviewing relevant literature, preparing learning and assessment materials, administering pretest and posttest assessments, observing classroom activity, and interviewing the teacher and selected students after the lesson.

The intervention involved teaching Systems of Linear Equations in Two with GeoGebra. Students used the application to construct and explore graphs of linear equations and examine the intersection points. The stated instruments included a pretest and posttest to assess understanding, classroom observation to document student interaction and application use, and interview guides to gather feedback from the teacher and selected students.

The manuscript does not specify the exact number of participants, duration and sequence of all instructional sessions, instrument validation and reliability, interview protocol, or a formal procedure for qualitative coding. It also does not report inferential statistical procedures. Accordingly, the results are summarized descriptively based on the information available in the source.

RESULTS AND DISCUSSION

Students' Pretest Performance

Before the GeoGebra-supported lesson, students completed a pretest on the topic of systems of linear equations in two variables. The source manuscript provides individual pretest scores for 35 students. In the listed data, scores ranged from 20 to 50, and the mean was 34.77. The distribution indicates that students entered the lesson with differing levels of prior understanding. Several students received scores in the lower range, while a smaller number achieved scores closer to 50. This variation suggests that the class had heterogeneous levels of readiness and that students could benefit from learning activities that make the relationship between algebraic equations and their graphical representations more explicit.

Students' Posttest Performance

After instruction using GeoGebra, the same 35 listed students completed a posttest. Their scores ranged from 50 to 93, with a mean of 73.94. Compared with the pretest results, the posttest mean was higher by 39.17 points. A comparison of the individual scores listed in the manuscript shows that all 35 students recorded a higher posttest score than pretest score. The size of the increase, however, varied across students: some achieved scores in the 80s and 90s, whereas others improved to scores between 50 and the low 70s. Thus, the results show an overall upward pattern while also indicating that students did not reach the same level of achievement after the lesson. Table 1 summarizes the pretest and posttest results.

The posttest distribution reported in the source manuscript classifies 42.85% of students in the low category, 28.57% in the medium category, and 28.57% in the high category. These percentages should be checked against the stated score intervals and the individual score list before publication. In particular, the narrative accompanying the original table contains score values for some students that differ from the individual posttest list.

Table 1. Summary of Pretest and Posttest Results

Assessment	Number of students	Score range	Mean score
Pretest	35	20–50	34.77
Posttest	35	50–93	73.94

Discussion

The reported increase is consistent with the instructional affordances of GeoGebra. By displaying equations as dynamic graphs, the application can help learners connect symbolic expressions with visual representations. Students can change coefficients and observe how the lines move, which may make the relationship between algebraic form and graphical behavior more tangible. In systems of linear equations in two variables, this can support recognition of the intersection point as a common solution to both equations.

The source manuscript argues that GeoGebra supports student engagement and problem-solving by allowing learners to explore and manipulate mathematical objects in real time. Such exploration can create opportunities for conjecturing, checking solutions, and comparing graphical and algebraic methods. These interpretations align with the cited literature on interactive visualization and discovery-oriented learning (Juandi, 2021; Nuritha & Tsurayya, 2021). Nevertheless, the manuscript provides limited direct observational and interview evidence, so claims about changes in engagement or critical thinking should be supported with specific observation records or participant quotations.

The classroom account suggests that GeoGebra can be incorporated as a

supporting tool when teaching systems of linear equations in two variables, particularly when the learning objective involves interpreting the meaning of a system's solution. Teachers may combine graph exploration with algebraic methods so that technology complements rather than replaces mathematical reasoning. Effective implementation also requires teacher preparation, access to suitable devices, and tasks that prompt students to explain the patterns they observe.

Several limitations should be considered. The source manuscript does not fully document the participant count, complete score summaries, statistical analysis, or systematic qualitative findings. Without these details and a comparison group, the observed score increases cannot establish that GeoGebra alone caused the improvement. Future studies should report participant characteristics, validated instruments, descriptive and inferential analyses where appropriate, and a transparent account of observation and interview analysis.

CONCLUSION

The article describes the use of GeoGebra to support the teaching of systems of linear equations in two variables among Grade XI students. The source manuscript reports that posttest scores increased for all participating students compared with their pretest scores. GeoGebra's dynamic graphing and manipulation features may help students connect algebraic equations with graphical intersections and explore solutions interactively. These findings provide a descriptive account of classroom implementation rather than conclusive causal evidence. Further research should provide complete participant and assessment data and systematically analyze classroom observations and interviews.

Acknowledgments

The authors may express their appreciation to the participating school, teacher, and students for their valuable support and contributions to the research, subject to appropriate verification of the acknowledgment statement.

Declarations

Author Contribution	: Author 1: Conceptualization, Writing - Original Draft, Editing; Author 2: Writing, Review & Editing, Formal analysis, and Methodology.
Funding Statement	: The authors gratefully acknowledge the financial support provided by the Directorate General of Research and Development Strengthening, Ministry of Research, Technology, and Higher Education of the Republic of Indonesia.
Conflict of Interest	: The authors declare no conflict of interest.

Additional Information : Additional information is available for this paper.

REFERENCES

Andini, R., Winarti, E. R., & Mintarsih, M. (2022). Kemampuan berpikir kritis matematis siswa pada model problem-based learning berbantuan bahan ajar dengan pendekatan STEM [Students' mathematical critical thinking in problem-based learning supported by STEM-oriented teaching materials]. *PRISMA, Prosiding Seminar Nasional Matematika, 5*, 467–474. https://journal.unnes.ac.id/sju/prisma/article/view/54566

Cao, Y., AlKubaisy, Z. M., Stojanović, J., Denić, N., Petković, D., Zlatković, D., & Zakić, A. (2022). Appraisal of information and communications technologies on the teaching process by neuro fuzzy logic. *Computer Applications in Engineering Education, 30*(3), 779–802. https://doi.org/10.1002/cae.22486

Daroini, A. F., Wiryokusumo, I., & Leksono, I. P. (2022). Interaksi manusia dengan komputer: Modul matematika dengan aplikasi GeoGebra [Human–computer interaction: A mathematics module using GeoGebra]. *JIPI (Jurnal Ilmiah Penelitian dan Pembelajaran Informatika), 7*(2), 429–440. https://doi.org/10.29100/jipi.v7i2.2696

Hamzah, N. A. H., & Hidayat, R. (2022). Peranan perisian GeoGebra dalam pendidikan matematik: Sorotan literatur bersistematik [The role of GeoGebra software in mathematics education: A systematic literature review]. *Jurnal Pendidikan Sains dan Matematik Malaysia, 12*(1), 24–38. https://doi.org/10.37134/jpsmm.vol12.1.3.2022

Hanifah, H., & Antasari, M. (2022). Kendala dan kiat sukses penerapan LKPD geometri berbasis model APOS berbantuan GeoGebra [Challenges and strategies for implementing APOS-based geometry worksheets with GeoGebra]. *Dharma Raflesia: Jurnal Ilmiah Pengembangan dan Penerapan IPTEKS, 20*(1), 88–104. https://doi.org/10.33369/dr.v20i1.20014

Hasibuan, Y. R., Khairani, N., & Surya, E. (2023). Pengaruh kemampuan awal matematis dan model Learning Cycle 5E berbantuan GeoGebra untuk meningkatkan kemampuan pemecahan masalah matematis siswa dan kemandirian belajar matematis siswa [Effects of prior mathematical ability and the GeoGebra-assisted 5E learning cycle on students' mathematical problem-solving and independent learning]. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 7*(1), 740–750. https://doi.org/10.31004/cendekia.v7i1.2168

Hidayat, T. (2021). Penggunaan aplikasi GeoGebra sebagai media pembelajaran matematika SMK [Using GeoGebra as a mathematics teaching tool in vocational high school]. *Inovasi Pendidikan, 8*(1), 118–127. https://doi.org/10.31869/ip.v8i1.2573

Juandi, D., Kusumah, Y. S., Tamur, M., Perbowo, K. S., Siagian, M. D., Sulastri, R., & Negara, H. R. P. (2021). The effectiveness of dynamic geometry software applications in learning mathematics: A meta-analysis study. *International Journal of Interactive Mobile Technologies (iJIM), 15*(2), 18–37. https://doi.org/10.3991/ijim.v15i02.18853

Maulidiya, D., Utari, T., Irsal, N. A., & Aziza, M. (2023). Investigasi pemanfaatan GeoGebra untuk pembelajaran matematika di Indonesia: Sebuah analisis bibliometrik [Investigating the use of GeoGebra in mathematics education in Indonesia: A bibliometric analysis]. *Delta-Pi: Jurnal Matematika dan Pendidikan Matematika, 12*(1), 121–138. https://doi.org/10.33387/dpi.v12i1.6557

Muhartini, Mansur, A., & Bakar, A. (2023). Pembelajaran kontekstual dan pembelajaran problem based learning [Contextual learning and problem-based learning]. *Lencana: Jurnal Inovasi Ilmu Pendidikan, 1*(1), 66–77. https://doi.org/10.55606/lencana.v1i1.881

Muzdalipah, I., Rustina, R., Patmawati, H., & Yulianto, E. (2023). Pengembangan bahan ajar dengan menggunakan GeoGebra pada materi segitiga dan segiempat [Developing teaching materials on triangles and quadrilaterals using GeoGebra]. *Teorema: Teori dan Riset Matematika, 8*(1), 181–195. https://doi.org/10.25157/teorema.v8i1.10090

Nuritha, C., & Tsurayya, A. (2021). Pengembangan video pembelajaran berbantuan GeoGebra untuk meningkatkan kemandirian belajar siswa [Developing GeoGebra-assisted instructional videos to improve students' independent learning]. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 5*(1), 48–64. https://doi.org/10.31004/cendekia.v5i1.430

Putri, A. D., Hasnita, S., Vilardi, M., & Setiawan, W. (2019). Analisis pengaruh minat belajar siswa MA dengan menggunakan aplikasi GeoGebra pada materi SPLDV [Analyzing Islamic senior high school students' interest in learning systems of linear equations in two variables using GeoGebra]. *Edumatica: Jurnal Pendidikan Matematika, 9*(1), 47–52. https://doi.org/10.22437/edumatica.v9i1.6348

Rangkuti, R. K., Suprihatiningsih, S., Rahayu, S., & Razy, M. A. (2023). Pengembangan media pembelajaran matematika berbantuan GeoGebra untuk meningkatkan kemampuan pemahaman konsep matematis siswa [Developing GeoGebra-assisted mathematics learning media to improve students' conceptual understanding]. *Riemann: Research of Mathematics and Mathematics Education, 5*(1), 29–44. https://doi.org/10.38114/riemann.v5i1.294

Sopanda, L., Sari, S. K. N., & Mardiana, M. (2022). Integrasi GeoGebra dan problem-based learning dalam meningkatkan pemahaman konsep materi SPLDV [Integrating GeoGebra and problem-based learning to improve conceptual understanding of systems of linear equations in two variables]. *Juwara: Jurnal Wawasan dan Aksara, 2*(1), 25–36. https://doi.org/10.58740/juwara.v2i1.36

Yaniawati, P., Kariadinata, R., Sari, N. M., Pramiarsih, E. E., & Mariani, M. (2020). Integration of e-learning for mathematics on resource-based learning: Increasing mathematical creative thinking and self-confidence. *International Journal of Emerging Technologies in Learning (iJET), 15*(6), 60–78. https://doi.org/10.3991/ijet.v15i06.11915

Yessi, Y. K., Kartika, Y., & Yusnaini, Y. (2021). Upaya meningkatkan hasil belajar siswa melalui model pembelajaran discovery learning dengan berbantuan software GeoGebra pada materi limit fungsi aljabar di kelas XI MAN 2 Bireuen [Improving students' learning outcomes on limits of algebraic functions through GeoGebra-assisted discovery learning in Grade XI at MAN 2 Bireuen]. *Jurnal Gamma-Pi, 3*(1), 8–14. https://doi.org/10.33059/jgp.v3i1.3850