Jurnal Pendidikan Matematika (Kudus)
P-ISSN 2615-3939 | E-ISSN 2723-1186
https://journal.iainkudus.ac.id/index.php/jmtk
DOI: http://dx.doi.org/10.21043/jpmk.v9i1.36714
Volume 9, Number 1, June 2026, pp. 1-26

Patterns of Use and Relationships Between Digital Tools and Mathematics Learning Outcomes among Junior High School Students

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Abstract

Information and communication technology has expanded the availability of digital tools for mathematics learning; however, studies that simultaneously compare junior high school students' usage patterns of GeoGebra, Photomath, and ChatGPT and examine their relationships with mathematics learning outcomes remain limited. This study aimed to analyze the usage patterns of these three digital tools and examine the relationship between their use and students' mathematics learning outcomes. A non-experimental quantitative approach with a descriptive-correlational design was employed, supported by semi-structured interviews. The sample comprised 43 eighth-grade students from a public junior high school in Padang City, Indonesia, selected through purposive sampling. Data were collected through a Likert-scale questionnaire, midterm mathematics exam scores, and semi-structured interview guides, and were analyzed through descriptive statistics, normality tests, Kendall's tau-b, and Spearman's rho. Data analysis was conducted using nonparametric correlation tests, specifically Kendall's tau-b and Spearman's rho. The results showed that ChatGPT was the most frequently used tool, followed by Photomath, and GeoGebra was the least used. Interviews indicated that students considered ChatGPT more practical for obtaining explanations, while GeoGebra was less used because students were unfamiliar with its menus. Correlation analysis showed a moderate, significant positive relationship between digital tool use and midterm exam scores, with Kendall's tau-b = 0,421, $p < 0,001$, and Spearman's rho = 0,521, $p < 0,001$. These findings provide a preliminary indication that digital tool use may be associated with mathematics learning outcomes, while highlighting the need for structured teacher guidance in integrating digital tools pedagogically and ethically.

Keywords: ChatGPT; Correlation; Digital Tools; GeoGebra; Mathematics Learning; Photomath

Abstrak

Teknologi informasi dan komunikasi telah memperluas ketersediaan alat digital untuk pembelajaran matematika; namun, penelitian yang secara bersamaan membandingkan pola penggunaan GeoGebra, Photomath, dan ChatGPT oleh siswa sekolah menengah pertama serta mengkaji hubungannya dengan hasil belajar matematika masih terbatas. Penelitian ini bertujuan untuk menganalisis pola penggunaan ketiga alat digital tersebut dan mengkaji hubungan antara penggunaannya dengan hasil belajar matematika siswa. Pendekatan kuantitatif non-eksperimental dengan desain deskriptif-korelatif digunakan, didukung oleh wawancara semi-terstruktur. Sampel terdiri dari 43 siswa kelas delapan dari sebuah SMP negeri di Kota Padang, Indonesia, yang dipilih melalui purposive sampling. Data dikumpulkan menggunakan kuesioner skala Likert, nilai ujian tengah semester matematika, dan panduan wawancara semi-terstruktur, serta dianalisis menggunakan statistik deskriptif, uji normalitas, Kendall’s tau-b, dan Spearman’s rho. Analisis data dilakukan menggunakan uji korelasi non-parametrik, yaitu Kendall’s tau-b dan Spearman’s rho. Hasil menunjukkan bahwa ChatGPT adalah alat yang paling sering digunakan, diikuti oleh Photomath, sedangkan GeoGebra adalah yang paling jarang digunakan. Wawancara menunjukkan bahwa siswa menganggap ChatGPT lebih praktis untuk mendapatkan penjelasan, sementara GeoGebra kurang digunakan karena siswa tidak familiar dengan menunya. Analisis korelasi menunjukkan hubungan positif dan signifikan dengan tingkat sedang antara penggunaan alat digital dan nilai ujian tengah semester, dengan Kendall’s tau-b = 0,421, $p < 0,001$, dan Spearman’s rho = 0,521, $p < 0,001$. Temuan ini memberikan indikasi awal bahwa penggunaan alat digital mungkin berhubungan dengan hasil belajar matematika, sekaligus menyoroti perlunya bimbingan guru yang terstruktur dalam mengintegrasikan alat digital secara pedagogis dan etis.

Kata Kunci: Alat Bantu Digital; ChatGPT; GeoGebra; Korelasi; Pembelajaran Matematika; Photomath

Introduction

The development of Information and Communication Technology (ICT) has significantly changed the education landscape (Hong & Songan, 2011). Innovations in this field continue to evolve, particularly in the provision of technology-based tools to support the learning process, including mathematics learning. In this context, the term "tool" refers to digital devices or aids used to help students understand concepts and solve math problems. This term refers to the general framework for using technology in mathematics, Drijvers (2011). In mathematics education, the use of digital tools is becoming increasingly important because technology no longer serves merely as a supplement to learning; rather, it has transformed the way students explore concepts, solve problems, receive feedback, and represent mathematical ideas (Engelbrecht & Borba, 2024; Weigand et al., 2024). Therefore, research on the use of digital tools in mathematics education is important for understanding how students actually use technology in a learning

context, rather than simply determining whether such technology is available or popular (Chechan et al., 2026; Drijvers & Sinclair, 2024).

Three digital tools that are increasingly popular and widely used in mathematics learning by students and teachers are GeoGebra (Hanč et al., 2011), Photomath (Siahaan et al., 2025), and ChatGPT (Wardat, Tashtoush, Al Ali, & Jarrah, 2023). These three tools represent various technological approaches to support the mathematics teaching and learning process. GeoGebra, Photomath, and ChatGPT can be categorized as learning aids in mathematics because each provides tools to help students understand and solve mathematical problems through visual, computational, and interactive approaches. These three tools are important to compare because each represents a different form of mathematics learning support: GeoGebra is as a tool for visualizing and exploring concepts, Photomath is as a procedural aid based on step-by-step solutions, and ChatGPT is as a dialogic tool capable of providing interactive explanations and feedback (Juandi et al., 2021; Saundarajan et al., 2020; Turmuzi et al., 2026; Wardat et al., 2023). Thus, a study of these three tools is not only relevant for determining their usage rates but also for understanding the differences in the pedagogical functions they offer in students' mathematics learning activities (Chechan et al., 2026; Drijvers & Sinclair, 2024).

GeoGebra is a dynamic mathematics software that integrates geometry, algebra, spreadsheets, graphs, statistics, and calculus into a single platform that is easy to access and use, both online and offline (Dahal et al., 2022; Hall & Chamblee, 2013; Nuralam et al., 2024). This tool has been implemented at various educational levels and is available in over 100 languages (Jancheski & Jancheska, 2019). Meanwhile, Photomath is an Artificial Intelligence (AI)-based tool that allows users to scan handwritten or printed math problems and provides step-by-step solutions automatically (Nurlaelah et al., 2024; Saundarajan et al., 2020). Unlike GeoGebra, which focuses more on visualization and concept exploration, Photomath is an AI-based problem solver. ChatGPT is a language model developed by OpenAI that can generate natural-sounding text, enable interactive dialogue, provide personalized feedback, and support various learning tasks, including mathematics (Miraz et al., 2025; Wardat et al., 2023). ChatGPT can function as a virtual tutor in learning (Naik et al., 2024).

It is important to compare GeoGebra, Photomath, and ChatGPT because each has distinct technical capabilities, offering unique strengths and limitations. GeoGebra excels primarily in supporting conceptual understanding of mathematics (Haj-Yahya & Haj-Yahya, 2026) by allowing students to visualize abstract concepts such as algebra, geometry, vectors, and calculus (Aliu et al., 2025; Zagoto et al., 2025). Nevertheless, the

effectiveness of GeoGebra depends heavily on the user's proficiency, so practice is required to optimize its use (Aliu et al., 2025). Thus, GeoGebra is best understood as a powerful tool for building conceptual understanding, but it still requires users to be prepared to operate it effectively.

Unlike GeoGebra, Photomath offers easy access by providing step-by-step solutions to math problems when scanned with a smartphone (Aziz et al., 2024; Suherman, 2024). This advantage makes Photomath practical to use, especially in helping students obtain answers quickly and procedurally. However, Photomath has limitations in solving problems that require higher-order thinking skills (Rahayu et al., 2026). Additionally, the app may produce less accurate solutions, and its interaction is also limited because it does not provide two-way dialogue between the user and the system regarding the generated answers (Dimitriadou & Lanitis, 2026). Therefore, although Photomath is effective at supporting instant problem-solving, its contribution to developing a deeper understanding remains relatively limited.

Meanwhile, ChatGPT has characteristics that distinguish it from Photomath, namely its ability to engage in two-way dialogue and provide real-time feedback, which gives it the potential to support self-directed learning while facilitating the development of critical thinking (Pepin et al., 2025). However, using ChatGPT is not without its drawbacks. Overreliance on this technology can weaken students' critical thinking skills (Aziz & Jupri, 2025; Thomsen et al., 2025), and its accuracy remains an issue, particularly when solving complex mathematical problems (Turmuzi et al., 2026). Thus, a comparison of these three digital tools shows that each platform contributes differently to mathematics learning, underscoring the importance of considering their functions, potential, and limitations in a balanced manner.

In practice, students can use these three tools alternately or even simultaneously; for example, using GeoGebra to visualize concepts (Aliu et al., 2025; Zagoto et al., 2025), Photomath to check solution steps (Aziz et al., 2024; Suherman, 2024), and ChatGPT to request additional explanations (Aziz & Jupri, 2025; Pepin et al., 2025). This approach can enrich students' learning experiences by providing simultaneous visual, procedural, and dialogic support. However, the simultaneous use of multiple tools also has the potential to cause certain cognitive effects, such as reliance on instant assistance (Turmuzi et al., 2026), a reduced incentive to reason independently (Zhai et al., 2024), or fragmented learning attention if tool use is not properly managed (Ayres & Sweller, 2021). Therefore,

comparing these three tools is important not only to determine their popularity but also to understand how each tool's characteristics relate to how students learn mathematics. In this study, usage patterns are not merely interpreted as the frequency or popularity of using GeoGebra, Photomath, and ChatGPT, but also encompass how students use these tools and for what specific purposes in mathematics learning they are employed (Chechan et al., 2026; Drijvers & Sinclair, 2024). The scope of these usage patterns includes using digital tools to visualize concepts, check solution procedures, seek additional explanations, obtain feedback, and support practice or self-directed learning (Saundarajan et al., 2020; Turmuzi et al., 2026; Wardat et al., 2023). Understanding this broader scope of usage patterns is important because digital tools can play different roles in students' mathematical activities, ranging from concept exploration and answer verification to procedural assistance and dialogic support in understanding problem-solving (Chechan et al., 2026; Drijvers & Sinclair, 2024).

Although these three tools (GeoGebra, Photomath, and ChatGPT) are becoming increasingly popular in mathematics education, a literature review indicates that most existing research remains limited to one or two of them. For example, bibliometric studies over the past two decades have highlighted only the use of GeoGebra (Awaji et al., 2025), while other studies have examined ChatGPT and Photomath only to a limited extent, without comparing all three simultaneously (Şimşek & Yaşar, 2019; Yunianto et al., 2024). Research also has indicated that studies on GeoGebra are primarily conducted at the high school and university levels, with very few at the elementary and middle school levels (Yohannes, 2023). Other study also has indicated that Photomath is the most popular AI tool among students, followed by ChatGPT and Mathway, but GeoGebra was not included in the comparison (Funny et al., 2024). Another study supports this finding, stating that Photomath ranks first in popularity, followed by ChatGPT and Mathway (Kusi et al., 2025). However, no comprehensive study has been specifically designed to determine which tool is most widely adopted across different educational contexts, age groups, or geographical regions. Research on Photomath has showed its effectiveness in improving students' mathematics learning outcomes (Kusi et al., 2025; Saundarajan et al., 2020). However, to date, no study has explicitly examined the popularity and adoption rates of these three tools simultaneously within the same educational context. Based on the literature above, no research has yet focused on all three tools (GeoGebra, Photomath, and ChatGPT) simultaneously. The limitations of previous research lie not only in the lack of a simultaneous comparison of these three tools but also in the scarcity of studies explaining the

purposes for which students use digital tools in their daily mathematics learning activities (Chechan et al., 2026; Drijvers & Sinclair, 2024). In fact, an understanding of the purposes of digital tool use is necessary so that teachers can distinguish whether students are using technology to build conceptual understanding, check procedures, obtain answers quickly, or seek additional explanations (Saundarajan et al., 2020; Turmuzi et al., 2026; Wardat et al., 2023).

Extensive research on GeoGebra in mathematics education exists, but no studies compare its popularity with other tools such as Photomath or ChatGPT. Existing research focuses only on GeoGebra and ChatGPT, ChatGPT and Photomath, or Photomath and GeoGebra, but there is no research on the popularity of all three tools simultaneously. The popularity referred to the frequency distribution of use among GeoGebra, Photomath, and ChatGPT, measured on a Likert scale. To align with the research objectives, the term "popularity" in this study is positioned as one component of usage patterns, while usage patterns are understood more broadly as a combination of frequency of use, methods of use, and purposes of using digital tools in mathematics learning (Chechan et al., 2026; Drijvers & Sinclair, 2024). Thus, this study not only identifies the digital tools most frequently used by students but also provides an overview of usage trends for GeoGebra, Photomath, and ChatGPT in supporting various mathematics learning activities.

In addition to differences in popularity, research examines the relationship between the use of GeoGebra, Photomath, and ChatGPT and students' mathematics learning outcomes remains limited. The use of these mathematical tools and digital technologies is expected to be related to learning outcomes, including performance on assessments such as midterm exams, as the frequency of their use can reflect the intensity of student engagement in learning activities that support conceptual understanding, problem-solving practice, feedback, and the reinforcement of mathematical representations. Generally, various meta-analyses indicate that educational technology has a positive impact on mathematics learning outcomes (Cheung & Slavin, 2013). In this context, the more frequently students use digital tools for meaningful learning, the greater their opportunities to gain additional learning experiences, such as conceptual visualization with GeoGebra, procedural support with Photomath, and personalized feedback and explanations with ChatGPT. The strongest empirical support is evident for GeoGebra (Juandi et al., 2021), while ChatGPT shows potential in supporting self-regulated learning, real-time feedback, and personalized learning, although it should still be positioned as a complementary tool, not a substitute for meaningful mathematics learning (Pepin et al., 2025; Turmuzi et al., 2026), and

Photomath has also been reported to have a positive impact on algebra achievement in specific contexts (Mensah et al., 2025). However, the relationship between the frequency of technology use and learning outcomes is neither automatic nor linear, as its effectiveness is heavily influenced by the quality of technology integration—such as the alignment between the tool and learning objectives, how teachers implement it, and whether the technology is used to support problem-solving and conceptual development or merely as an instant aid (Li & Ma, 2010). Thus, the frequency of digital tool use is better understood as an indicator of opportunities for student engagement in mathematics learning experiences that can impact learning outcomes when integrated and purposeful.

The urgency of this research is further underscored by meta-analytic evidence indicating that technology-supported mathematics learning can positively affect learning outcomes, though these effects depend on the type of tool, the learning context, and the quality of its pedagogical integration (Cheung & Slavin, 2013; Hillmayr et al., 2020). Therefore, examining the relationship between the usage patterns of GeoGebra, Photomath, and ChatGPT and students' mathematics learning outcomes is important, so that the integration of digital tools into learning is based not only on popularity but also on empirical evidence regarding their association with learning achievements.

A recent study in Indonesia found a very weak correlation between the use of GeoGebra and student test scores in West Sumatra (Ayyubi et al., 2025), whereas another study found a significant effect of ChatGPT use on final student scores in Bandung, West Java (Hakiki et al., 2023). Furthermore, most previous studies have focused on the performance of these tools in specific contexts rather than on general learning outcomes, such as geometry or algebra (Etcuban, 2025; Puspitasari et al., 2023; Siahaan et al., 2025; Wardat et al., 2023; Yunianto et al., 2024). However, these studies were conducted separately and not in a research design that compared all three simultaneously. Understanding the relationship between the use of these tools and learning outcomes is crucial for providing evidence-based guidance to educators and policymakers in integrating technology into learning. Furthermore, the results of separate studies are insufficient to explain how the use of multiple digital tools with different characteristics can occur within the same learning context, particularly among junior high school students. By examining GeoGebra, Photomath, and ChatGPT simultaneously, this study can provide a more comprehensive picture of the use of digital tools in mathematics learning, including frequency of use, purpose, and their relationship to learning outcomes.

Based on this gap, this study was designed to address these gaps by analyzing which of the three tools—GeoGebra, Photomath, and ChatGPT—is most popular among junior high school students. This study aims not only to describe the usage patterns of these three tools but also to test the potential relationship between the intensity of the use and students' mathematics learning outcomes, measured through Midterm Exam (ME) scores. Thus, the findings of this study are expected to contribute new insights (novelty) to the mathematics education literature, specifically a comprehensive understanding of the popularity and effectiveness of these three technological tools when used together. Based on the above discussion, this study interprets usage patterns as indicators of how frequently students use GeoGebra, Photomath, and ChatGPT, how they use these three tools, and for what purposes they are used in mathematics learning. Thus, the main contribution of this study lies in the usage patterns of GeoGebra, Photomath, and ChatGPT, as well as in the relationship between their use and the mathematics learning outcomes for junior high school students. The findings of this study are expected to provide an empirical basis for teachers and education policymakers to integrate digital tools in a more targeted, proportionate, and appropriate manner aligned with mathematics learning objectives.

Method

This study used a non-experimental quantitative approach with a descriptive-correlational design, which aims to analyze the usage patterns of the three tools, GeoGebra, Photomath, and ChatGPT, and also analyze the relationship between the use of those three tools and students' mathematics learning outcomes at junior high school level. Additionally, interviews incorporated qualitative data to a limited extent to strengthen the quantitative findings (not as primary findings but as interpretative material). This approach can be categorized as a limited mixed methods approach with a sequential design. This sequential design includes explanatory and transformative designs, where one type of data collection follows another (Abeza, 2024; Molina-Azorín & Font, 2016).

The study was conducted at one of State Junior High Schools in Padang City, West Sumatra. The study population consisted of 8 eighth-grade classes with 30–33 students per class, for a total of 255 students. The sample was drawn from two classes. Due to some students' absence during data collection, the sample size from both classes was 43. The sample was selected using purposive sampling, in which participants were selected based on specific characteristics or qualities aligned with the research objectives (Campbell et al., 2020; Tongco, 2007). This selection

considered the similarity of the mathematics material studied during data collection. Classes with material related to circles were selected.

Data were collected through three main instruments. First, students' mathematics learning outcomes were measured using Midterm Exam (ME) scores administered in March 2025, with multiple-choice questions as indicators of learning outcomes. ME scores were classified as secondary data because they were not collected during the research process but were obtained from midterm exams that the school had already administered before the study began. Second, a closed-ended Likert-scale questionnaire (1–5) was distributed in April 2025 to measure students' frequency of the use of GeoGebra, Photomath, and ChatGPT. Each tool was represented by one question, with the following response options: 1 = never, 2 = rarely (1 time a week), 3 = sometimes (2–3 times a week), 4 = often (4 times a week), and 5 = always (5–7 times a week). The collection of questionnaire data was anonymous and did not affect students' academic grades; this was also explicitly stated in the questionnaire consent form. Third, semi-structured interviews were conducted with a selected group of students to explore the reasons behind their usage patterns of digital tool and their experiences in preparing for the ME using these tools. Semi-structured interviews were conducted after the survey data were collected. These interviews were used on a limited basis as supplementary data to explain the quantitative results, particularly regarding why students rarely or frequently used certain assistive devices, the difficulties they encountered when using digital assistive devices, their experiences seeking help from teachers, and barriers to accessing digital devices such as smartphones. Because the interviews were semi-structured, the researcher used a set of key questions but also asked follow-up questions based on the students' responses to obtain more detailed explanations (James et al., 2024).

This study addressed two main research questions. The first question concerned to the students' usage patterns of digital tool (GeoGebra, Photomath, and ChatGPT), which were analyzed using descriptive statistics. Data from the questionnaire were processed and presented in bar charts to show the frequency distribution for each usage scale of the three tools. From this visualization, it can be seen which tools students use most frequently and which they use least frequently. To complement this descriptive analysis, interviews were conducted to understand students' reasons for choosing specific tools in more detail and why they tend to use other tools less frequently.

The second research question corelated the potential relationship between using the three digital tools (GeoGebra, Photomath, and ChatGPT) and students'

mathematics learning outcomes (ME). This relationship was analyzed using correlation tests. If the data were normally distributed, Pearson's correlation test was used (Song et al., 2020), while Spearman's correlation test or Kendall's Tau was used when the data were not normally distributed or ordinal (Xiao et al., 2016). Spearman's correlation or Kendall's Tau is more robust to outliers and is often preferred when Pearson's correlation assumptions are not met (Xu et al., 2013). The null hypothesis (H_0) stated that there is no significant relationship between the frequency of use of the three digital tools (GeoGebra, Photomath, and ChatGPT) and students' mathematics learning outcomes (ME), while the alternative hypothesis (H_1) stated that there is a significant relationship. The decision-making criteria were determined based on a significance level (p-value) < 0,05, which indicates that H_0 is rejected (Biau et al., 2010). Correlation coefficients are generally categorized as low (≤ 0,35), moderate (0,36–0,67), strong (0,68–0,89), and very strong (≥ 0,90) (Taylor, 1990; Wahyuni et al., 2021). To support the correlation test results, interviews were also used to determine why students most or least often used digital tools during learning and the extent to which digital tool was helpful for them when preparing the midterm exam. The interview data were analyzed descriptively. Students' responses were examined to identify information relevant to the questionnaire results and correlation tests, particularly regarding difficulties with GeoGebra, reasons for choosing ChatGPT or Photomath, limitations of teacher assistance, and barriers to smartphone access. In this study, the interview data were not treated as the main findings but rather as supporting data to clarify the quantitative results (Fetters et al., 2013).

Overall, this study combines quantitative, descriptive, and correlational analyses into a single integrated approach, which is then supplemented with semi-structured interviews to provide a deeper understanding of students' reasons, goals, experiences, and challenges in using digital tools for mathematics learning. Semi-structured interviews were chosen because they allow researchers to use flexible question guides and follow-up questions to explore participants' thoughts, experiences, and beliefs in greater depth (Lewis-Beck et al., 2004). Therefore, the interview findings in this study were presented in the results section as complementary qualitative findings and further interpreted in the discussion section in accordance with the explanatory sequential mixed-methods approach, which uses qualitative data to help explain the quantitative results (Fetters et al., 2013).

Results

Students Usage Patterns of GeoGebra, Photomath, and ChatGPT

Table 1 presents the descriptive statistics for 43 students. The average score on the questionnaire regarding the use of digital tools was 35,1930 with a standard deviation of 17,04811, while the average score on the midterm exam in mathematics was 42,2249 with a standard deviation of 17,37258. Since both the questionnaire scores and midterm exam scores were on a 100-point scale, these results indicate that the frequency of students' use of GeoGebra, Photomath, and ChatGPT remains relatively low, as do their mathematics learning outcomes, which also fall into the low category. The relatively large standard deviations for both variables indicate substantial variation in the data, suggesting differences in digital tool use and mathematics learning outcomes among students.

Table 1. Descriptive Statistics of Questionnaire Results and Midterm Exam (ME)

	N	Mean	Std. Deviation
Questionnaire	43	35,1930	17,04811
Midterm Exam	43	42,2249	17,37258

To address the first research question, "What is the pattern of GeoGebra, ChatGPT, and Photomath usage among junior high school students?", a descriptive analysis was conducted using a bar chart shown in Figure 1. This chart presents the frequency distribution of the three tools' usage based on a Likert scale of 1 to 5, with the following categories: 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = always.

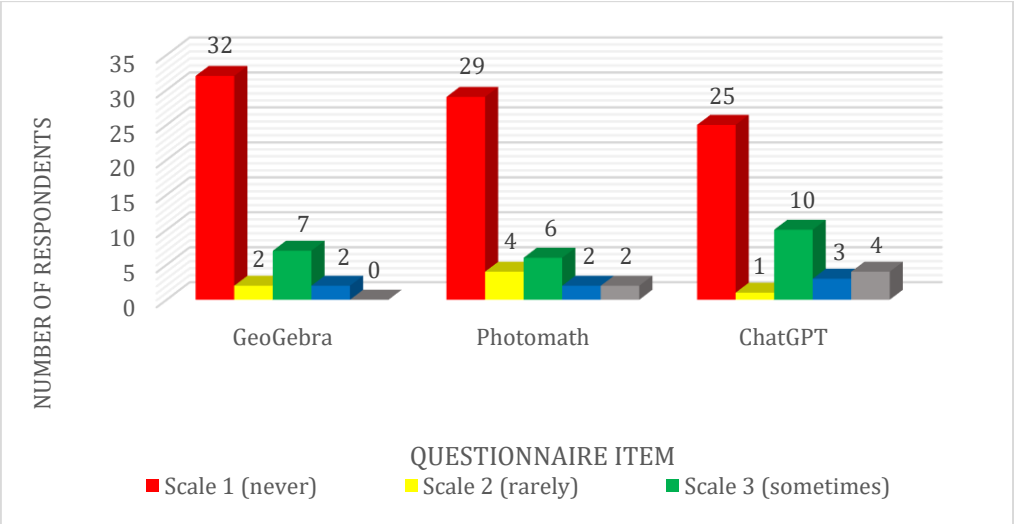

Figure 1. Frequency Distribution of GeoGebra, Photomath, and ChatGPT Usage Based on a Likert Scale (1–5)

Based on the data shown in Figure 1, GeoGebra was the least-used tool among students. A total of 32 out of 43 students (74,42%) stated that they had never

used GeoGebra, while two students (4,65%) stated that they rarely used it, seven students (16,28%) stated that they sometimes used it, and only two students (4,65%) stated that they often used it. None of the students stated that they always used GeoGebra in learning.

Meanwhile, Photomath also showed a low level of use, although slightly higher than GeoGebra. This is indicated by the number of students who stated they had never used Photomath, which was 6.98% lower than GeoGebra. In addition, unlike GeoGebra, which has no regular users, two students (4,65%) stated that they always use Photomath in mathematics learning.

Unlike the two previous tools, ChatGPT showed a higher tendency to be used among students. Although there is a similar pattern in the "never used" category, as seen in Photomath and GeoGebra, the number of students who chose the "often" category for ChatGPT is higher than for the other two tools. The number of students who consistently use ChatGPT is twice that of those who always use Photomath.

Based on the frequency distribution in Figure 1, it can be concluded that ChatGPT is the most popular tool used by junior high school students in the sample of this study, followed by Photomath. At the same time, GeoGebra is the least used tool. Interview results with several students also supported these survey findings, particularly regarding the low usage of GeoGebra. Some students stated they had used GeoGebra only once during classroom instruction. Additionally, some students also mentioned that they did not understand the various menus and features available in the GeoGebra tool. One student said, "I often get confused using GeoGebra because there are too many menus and I do not know where to start. Also, when using GeoGebra's menus, things often pop up unexpectedly." The interviews also revealed that some students viewed ChatGPT as easier to use compared to GeoGebra. According to some students, ChatGPT is more practical because it can be used on demand with direct questions. However, the interview results also showed that ChatGPT still faces access barriers. Some students stated that not all students have personal smartphones or are allowed to use them during lessons, making this a barrier to accessing the digital tool. Additionally, when students were asked why they did not ask their teachers when facing difficulties, some stated that teachers could not always provide adequate help or explanations. These findings suggest that the patterns of digital tool usage in this study are not only related to frequency of use but are also influenced by students' experiences with the tools, ease of operation, availability of assistance when facing difficulties, and access to digital devices.

The Potential Relationship Between the Use of Digital Learning Tools (GeoGebra, ChatGPT, and Photomath) and Students Learning Outcomes

The first step in analyzing the relationship between the use of GeoGebra, ChatGPT, and Photomath and student learning outcomes is to test whether the data is normally distributed. The results of the normality test are shown in Table 2.

Table 2. Normality Test of Student Questionnaire and Midterm Exam Test Data

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Questionnaire	0,209	43	0,000	0,831	43	0,000
Midterm Exam	0,166	43	0,004	0,881	43	0,000

Based on Table 2, both the survey data on the use of learning tools and the midterm exam results showed significance values (Sig.) below 0,05, as follows: for the survey, Kolmogorov-Smirnov = 0,000 and Shapiro-Wilk = 0,000; for the midterm exam, Kolmogorov-Smirnov = 0,004 and Shapiro-Wilk = 0,000. This indicates that neither dataset (the survey nor the midterm exam) follows a normal distribution.

The results of the prerequisite tests indicate that the data meet the assumptions required for conducting a correlation analysis between the use of digital tools and students' mathematics learning outcomes. The linearity test yielded a Linearity significance value of 0,001 (< 0,05) and a Deviation from Linearity value of 0,166 (> 0,05), indicating that the relationship between the use of GeoGebra, Photomath, and ChatGPT and students' mathematics learning outcomes is linear. Additionally, an examination of the scatterplot between standardized predicted values and standardized residuals showed that the data points were scattered relatively randomly around the zero line and did not form a discernible pattern, providing no strong indication of a deviation in the relationship between the variables. The Durbin-Watson value of 1,841 also indicate that the data do not suggest serious autocorrelation. Thus, the data in this study meet the prerequisites for conducting a correlation test between the use of digital tools and the mathematics learning outcomes of junior high school students.

Since neither of the data sets are not normally distributed, correlation analysis was conducted using nonparametric methods, namely Kendall's Tau-b and Spearman's rho. The correlation test results are presented in Table 3.

Table 3. Correlation Test Results for Questionnaire and Midterm Exam Data

		Correlations	Questionnaire	Midterm Exam
Kendall's tau-b	Questionnaire	Correlation Coefficient	1,000	0,421**
		Sig. (2-tailed)	.	0,000
		N	43	43
Spearman's rho	Questionnaire	Correlation Coefficient	1,000	.521**
		Sig. (2-tailed)	.	0,000
		N	43	43

Based on the results of the nonparametric correlation test shown in Table 3, there is a significant relationship between the questionnaire data on the use of the three digital tools (GeoGebra, ChatGPT, and Photomath) and students' mathematics learning outcomes (midterm exam). Kendall's tau-b test showed a correlation coefficient of 0,421 with a p-value of 0,000 (< 0,05), indicating a positive and significant correlation between the two variables. This is further supported by Spearman's rho test results, which showed a higher correlation coefficient of 0,521 with the same significance level of 0,000. The number of respondents for both tests was 43 students.

The Spearman's rho correlation coefficient of 0,521 and Kendall's tau-b of 0,421 indicate a moderate positive relationship (Taylor, 1990; Wahyuni et al., 2021). A moderate correlation indicates a positive and meaningful relationship, though not strong or perfect, between the frequency or intensity of using these tools and students' mathematics learning outcomes. In other words, the more frequently students use GeoGebra, Photomath, or ChatGPT, the better their mathematics learning outcomes tend to be. However, this relationship is not absolute and may still be influenced by other factors. When considering the frequency of the use of three tools shown in Figure 1, it is clear that GeoGebra is the tool least frequently used by students.

The interview findings provided additional support for these correlation results. Some students reported using digital tools when they encountered learning difficulties or when preparing the midterm exams. In the interviews, students described that ChatGPT and Photomath were more frequently used as supplementary aids when they needed explanations or to check their answers. However, the interview findings in this study are supplementary. They are used to support the interpretation of quantitative results, not as a basis for concluding that the use of digital tools causes the learning outcomes.

Discussion

The findings of this study indicate that among the three digital tools analyzed, ChatGPT is the most frequently used by students, followed by Photomath and GeoGebra, which are the least frequently used. These results provide a clear picture of junior high school students' digital tool preferences for using technology to support mathematics learning.

The strong preference for ChatGPT aligns with the global trend of increased use of generative AI in education. This trend is driven by several factors highlighted in previous studies. Several studies over the past three years have shown that generative AI, including ChatGPT, is viewed as a transformative force in education, offering new methods for learning and teaching (Jones & Logan, 2025; Schimanke, 2024; Wang, 2023). This enables personalized learning experiences that meet individual students' needs and enhance engagement (Ambikairajah et al., 2024; Gervacio, 2024; Jauhiainen & Garagorry Guerra, 2024). These findings support the working hypothesis that AI-based tools like ChatGPT, which are responsive, user-friendly, and customizable (tailored to students' preferences), are preferred by students over tools that require specific technical skills, such as GeoGebra.

Although GeoGebra excels at specific tasks such as Geometric and Algebraic construction, it lacks the flexibility and breadth of tools offered by ChatGPT. This aligns with the findings of Botana and Recio (2024), who noted that GeoGebra is highly effective for Geometry and Algebra but does not provide the same level of personalized feedback or support across diverse subjects.

The low usage of GeoGebra at the junior high school level indicates challenges in integrating visualization-based mathematical technology into learning. One of the main factors influencing this situation is teachers' proficiency in using GeoGebra. When teachers are not proficient with the application, students are unlikely to use it effectively.

This finding is reinforced by interviews with several students who expressed confusion about GeoGebra. One student said, "*I am often confused when using GeoGebra because there are too many menus, and I do not know where to start. In addition, something often pops up suddenly when using the GeoGebra menu*". Based on the researcher's experience, this phenomenon usually occurs when students accidentally click a feature or tool that is still active.

These findings align with the research by Chytas et al. (2024), which stated that GeoGebra users often experience obstacles such as features not appearing or unexpected elements appearing, which slows down the learning process. This

shows that GeoGebra remains complex and not very user-friendly, especially for students unfamiliar with its interface.

The questionnaire data also support this finding, showing that GeoGebra is the least used digital tool compared to Photomath and ChatGPT. Students are reluctant to use GeoGebra as a math learning tool because of its unfamiliar interface and complexity.

When students were asked why they did not ask their teachers when encountering difficulties, most responded that teachers could not always provide satisfactory assistance or explanations. Ideally, teachers should be the primary source of assistance in technology-based learning, such as GeoGebra. This emphasizes the importance of teachers' competence in using technology. As Ortiz-Laso et al. (2023) stated, teachers should have the skills to use technology to support students' learning processes.

This condition aligns with the findings of Santos et al. (2025), who emphasized that the successful integration of GeoGebra into learning depends on adequate teacher training and support. Students also mentioned that they were not always allowed to use smartphones at school. This restriction makes them less familiar with using digital devices in an educational context, including GeoGebra. This is reinforced by the findings of Gath et al. (2024), who stated that the ban on phone use in the classroom is one of the barriers to the utilization of educational technology.

Photomath ranks in the middle in terms of digital tools usage among students. This finding contradicts the results of studies by Funny (2024) and Kusi (2025), which stated that Photomath is the most popular digital tool in mathematics learning, followed by ChatGPT and Mathway. However, based on the previous discussion, ChatGPT was the most widely used digital tool among students compared to GeoGebra and Photomath. No other studies have explicitly shown that ChatGPT is more popular than the other two tools. Thus, this finding contributes new theoretical and empirical evidence, indicating that ChatGPT is students' most popular digital tool in supporting mathematics learning.

The analysis results indicate a positive and significant relationship between the level of digital tool usage (GeoGebra, ChatGPT, and Photomath) and students' mathematics learning outcomes (ME). Although this relationship is not strong, the Spearman correlation coefficient value of 0,521 and Kendall's tau-b of 0,421 indicate a statistically significant relationship and fall into the moderate category. These findings support the working hypothesis that using mathematics learning technology positively contributes to students' academic achievement.

These results align with previous studies indicating that using technology in mathematics learning can enhance students' conceptual understanding and learning outcomes. According to Wardat et al. (2023), ChatGPT provides real-time feedback that helps students correct errors and understand mathematical concepts more deeply. This improvement in learning outcomes is also consistent with students' problem-solving ability. This aligns with the findings of Faldi et al. (2024) that ChatGPT has been proven to improve students' problem-solving abilities. Kusi et al. (2025) also found that using Photomath significantly impacts improvements in mathematics performance by providing step-by-step solutions to problems.

Although this study's correlation does not yet show a causal relationship, it provides initial indications that the higher frequency or quality of the use of these tools, the greater the likelihood of students achieving better learning outcomes. This is also supported by the findings of Miraz et al. (2025), who stated that student engagement with educational AI, such as ChatGPT, contributes to motivation and academic outcomes.

Interview results with students support quantitative findings showing a positive relationship between the use of digital tools and mathematics learning outcomes. Several students stated that regular use of ChatGPT and Photomath helped them understand the material and prepare for midterm exams by explaining concepts and providing step-by-step solutions. One student revealed, "*If I am confused, I ask ChatGPT or check Photomath rather than GeoGebra. It helps me practice and makes me more prepared for exams*". Meanwhile, although GeoGebra was considered helpful for visualizing graphs, some students admitted they had difficulty using it, so its use tended to be lower. These statements reinforce the results of the Spearman correlation (0,521) and Kendall's tau-b (0,421), which indicate that the higher the frequency of digital tool usage, the better the student's learning outcomes. However, the relationship is moderate and does not indicate a causal relationship.

In the context of ChatGPT, students' perceptions on its usefulness and ease of use are key factors that can explain their tendency to use ChatGPT in learning. Students who feel that ChatGPT is easily accessible, easy to use, and capable of providing explanations that meet their academic needs tend to have higher levels of satisfaction and intent to use (Alshammari & Babu, 2025). Therefore, the use of ChatGPT in mathematics learning can be understood not only as a phenomenon of technological popularity but also as a form of technology acceptance influenced by students' perceptions of the tool's usefulness and ease of use.

However, these results also emphasize the importance of using tools wisely and purposefully. Naik et al. (2024)caution that while ChatGPT and similar tools can improve performance, their use without teacher guidance can lead to dependency and a decline in independent problem-solving skills. Therefore, the correlation results in this study can serve as a foundation for developing technology-based learning strategies at the junior high school level while also opening opportunities for further research with experimental or longitudinal designs to examine the causal effects of using these tools on students' mathematical learning outcomes.

The uniqueness of this study lies in analyzing three types of digital tools with different functional approaches: mathematical visualization (GeoGebra), question scanning (Photomath), and text-based generative artificial intelligence (ChatGPT). This cross-platform comparison is still rare in previous literature, making it a significant original contribution to understanding secondary school students' digital patterns and preferences. This approach provides a more comprehensive picture of the dynamics of student interaction with various forms of technology in mathematics learning.

In terms of practical implications, these findings indicate that more structured and continuous training is needed for teachers and students on the use of GeoGebra, given its high potential as a tool for visualizing abstract concepts, but its underutilization. On the other hand, ChatGPT's ethical and controlled integration into the mathematics learning process should be considered, given its ability to provide explanations and instant feedback, thereby enhancing students' motivation and understanding.

Based on the discussion, further research is recommended to explore the effectiveness and efficiency of using the three digital tools, particularly ChatGPT, in the context of formal mathematics learning. Further research could use an experimental design with a larger sample size and random sampling methods to increase the generalizability of the findings to a broader population. In addition, an in-depth study of the impact of these three tools on students' mathematical learning outcomes is also needed. Approaches such as quasi-experiments, longitudinal studies, or further analyses of the influence of digital tools on specific mathematical thinking skills, such as mathematical critical thinking, could be the direction of future research.

Previous findings indicating that ChatGPT can facilitate various important aspects of critical thinking skills, including programming and debugging, in mathematics learning (Yunianto et al., 2024) support this opportunity for further research. Furthermore, future research is also recommended to consider contextual

factors such as gender, grade level, and school type (public or religious) to gain a more comprehensive and inclusive understanding of the use of digital tools in mathematics learning.

Conclusion

This study addressed questions regarding usage patterns, student preferences, and the relationship between the level of use on digital tools (GeoGebra, Photomath, and ChatGPT) and students' mathematics learning outcomes. The results indicated that ChatGPT is the students most widely used digital tool, while GeoGebra is the least utilized. This pattern suggests that students tend to prefer digital tools that provide direct explanatory support, instant responses, and step-by-step assistance, whereas tools requiring more visual exploration and conceptual manipulation, such as GeoGebra, are less frequently used. In the learning ecosystem, ChatGPT appears to function mainly as a conversational and explanatory aid, Photomath as a procedural support tool for checking or solving mathematical problems, and GeoGebra as a visual-representational tool that remains underutilized despite its potential for strengthening conceptual understanding. The relationship between the usage frequency of these digital tools and students' mathematics learning outcomes was positive and statistically significant, although it did not fall into the strong category (only moderate). Therefore, the findings should not be interpreted as evidence that digital technology in general automatically improves learning outcomes. Rather, the contribution appears to depend on the type of tool used, how students engage with it, and the extent to which the tool supports mathematical reasoning, problem-solving, visualization, and conceptual understanding. In this regard, ChatGPT and Photomath may help students obtain explanations and procedural guidance, while GeoGebra may support deeper conceptual and visual understanding when integrated more effectively into classroom instruction.

The findings of this study imply the need for schools to develop more structured policies regarding the pedagogical use of GeoGebra, Photomath, and ChatGPT in mathematics instruction. These policies should include equitable access to digital devices, reliable internet connectivity, rules for using digital devices in the classroom, and guidelines on when and how each digital tool should be used. Additionally, teachers require professional development not only in operating tools such as GeoGebra, Photomath, and ChatGPT, but also in designing learning activities that position these tools as aids to the mathematical thinking process, rather than as substitutes for students' reasoning. Special attention must also be given to academic integrity, including preventing excessive reliance on instant answers,

encouraging students to verify outputs generated by digital tools, and asking students to explain the reasoning or thought process behind solutions obtained or assisted by digital tools. However, this study has several limitations. The quantitative approach used has not provided a detailed account of how students actually use GeoGebra, Photomath, and ChatGPT in the mathematical problem-solving process. Furthermore, the significant correlations found in this study cannot be interpreted as causal relationships, and no partial correlation tests have been conducted for each digital technology with students' math test scores. Therefore, future research needs to move beyond general recommendations, such as increasing the sample size, and focus more on the specific roles of each digital tool. For example, future research could compare how ChatGPT-based explanations, Photomath-assisted procedural checks, and GeoGebra-assisted visualizations differently influence students' conceptual understanding, problem-solving strategies, mathematical reasoning, and learning autonomy. Qualitative studies or mixed-methods approaches are also needed to investigate whether students use these tools reflectively as learning aids or passively as answer generators. Such studies can provide a more nuanced understanding of how specific digital tools can be integrated ethically, effectively, and contextually into mathematics instruction.

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