

## EFFECTS OF MICROSOFT MATHEMATICS 4.0 ON PROSPECTIVE MATHEMATICS TEACHERS' COMPUTATIONAL THINKING AND LEARNING MOTIVATION

Rafika Meiliati<sup>1\*</sup>, Dima Marillah<sup>2</sup>, Fitri<sup>2</sup>, Achmad Salido<sup>1</sup>, Aswin<sup>1</sup>, Dayana Sabila Husain<sup>1</sup>

<sup>1</sup> Department of Mathematics Education, Universitas Sembilan belas November Kolaka,  
Southeast Sulawesi, Indonesia

<sup>2</sup> Students of The Department of Mathematics Education, Universitas Sembilan belas November  
Kolaka, Southeast Sulawesi, Indonesia

### ARTICLE INFO

#### Article History

Received: 10 Nov 2025

Revised: 26 Apr 2026

Accepted: 09 Jun 2026

Published: 21 Jun 2026

#### Keywords:

Computational thinking

Learning motivation

Microsoft mathematics 4.0

Prospective Mathematics Teachers'



This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/)

### ABSTRACT

This study aimed to examine the effect of Microsoft Mathematics 4.0 on prospective mathematics teachers' computational thinking (CT) skills and learning motivation in learning functions. A quantitative approach with a quasi-experimental one-group pre-test–post-test design was employed, involving 17 first-semester mathematics education students at Universitas Sembilanbelas November Kolaka. The participants were prospective mathematics teachers who studied the topic of functions using Microsoft Mathematics 4.0 as an interactive learning tool. Data were collected using CT tests and learning motivation questionnaires and analyzed using descriptive statistics, the Shapiro–Wilk normality test, and paired-samples t-tests. The results revealed a statistically significant improvement in students' CT skills ( $t(16) = -5.33, p < 0.05$ ) and learning motivation ( $t(16) = -13.93, p < 0.05$ ) after learning functions with the support of Microsoft Mathematics 4.0. These findings suggest that integrating interactive mathematical software in learning functions can effectively enhance both students' computational thinking and their learning motivation.

Copyright © 2026 Rafika Meiliati, Dima marillah,  
Fitri, Achmad Salido, Aswin, Dayana Sabila Husain

### Corresponding Author:

Rafika Meiliati, Pendidikan Matematika, Universitas Sembilan belas November Kolaka, Southeast Sulawesi, Indonesia,

Email: [rafikameiliati@gmail.com](mailto:rafikameiliati@gmail.com)

### How to cite:

Meiliati, R., Marillah, D., Fitri, Salido, A., Aswin, & Husain, D.S. (2026). Effects Of Microsoft Mathematics 4.0 On Prospective Mathematics Teachers' Computational Thinking And Learning Motivation. *Koordinat Jurnal MIPA*, 7(1), 104-116. <https://doi.org/10.24239/koordinat.v7i1.194>

## INTRODUCTION

The rapid advancement of digital technology in the 21st century has brought profound changes to higher education, requiring students to master not only conceptual knowledge but also higher-order thinking skills. Martín-Lucas and Dujo (2022) emphasize that integrating digital technology into higher education fosters the development of these skills. Among the key competencies essential in this context and highly relevant to the digital era is computational thinking (CT). CT refers to a systematic, logical, and algorithmic process of analyzing and solving problems (Angraini & Abdurrahman, 2024; Sarah, 2021). In educational contexts, CT is not limited to the field of informatics. Rather, it represents a fundamental competency that should be developed across disciplines, including mathematics. Mathematics learning naturally aligns with CT because both emphasize analytical reasoning, abstraction, and structured problem-solving processes (Irawan et al., 2024).

Integrating CT into mathematics learning has been shown to enhance students' logical reasoning, foster creativity in problem-solving, and deepen their understanding of complex mathematical concepts (Chan et al., 2023; Nurlaelah et al., 2024; Pérez, 2018). However, successful learning outcomes are influenced not only by computational thinking skills but also by students' learning motivation. Motivation plays a crucial role in shaping students' engagement, persistence, and overall academic achievement (Siregar et al., 2024). Students with high learning motivation tend to show greater persistence and willingness to explore complex mathematical ideas. In contrast, students with low motivation are more likely to disengage and experience difficulties when dealing with abstract mathematical concepts (Higgins et al., 2019; Hossein-Mohand & Hossein-Mohand, 2023).

One mathematical topic that frequently poses challenges for students is the concept of functions. This topic serves as a fundamental building block for more advanced areas of mathematics, such as calculus and mathematical analysis. However, due to its abstract nature, many students find it difficult to connect symbolic representations, graphical forms, and their underlying real-world meanings (Salsabilah & Rahaju, 2022; Saputri et al., 2024). Students often struggle to interpret function graphs and relate them to symbolic expressions. They also experience difficulties in connecting mathematical representations with contextual meanings. These difficulties underscore the need for interactive and visually oriented learning strategies that can help students develop deeper conceptual understanding. Digital learning technologies, particularly interactive mathematical software, offer opportunities to support conceptual understanding while simultaneously strengthening computational thinking and learning motivation in mathematics learning (Murtianto et al., 2019; Wu et al., 2025).

Several studies have examined the relationships among the use of educational technology, conceptual understanding, and learning motivation. For instance, Miguens et al. (2024) investigated the impact of robotics and programming activities on students' motivation and engagement in learning mathematical functions. Their findings demonstrated that game-based learning activities using *mBot* and *micro:bit* enabled students to learn meaningfully, enhance engagement, and construct new knowledge based on prior experiences. Similarly, Wang and Wang (2024) examined the application of no-code machine learning platforms to improve design students' motivation and CT skills. Their findings showed that students using technological learning tools demonstrated higher learning motivation and stronger algorithmic thinking than those in conventional learning environments.

Furthermore, Abar et al. (2025) highlighted the integration of automatic feedback features in GeoGebra as an innovative approach in mathematics education. Their study revealed that incorporating automatic feedback into learning tasks enhanced students' engagement, problem-solving abilities, and algorithmic thinking skills. Similarly, Zhou and Tsai (2023) demonstrated that implementing the Socially Shared Regulation of Learning (SSRL) strategy within the Collaborative Learning by Teaching framework improved students' computational thinking, motivation, and engagement in technology-enhanced learning environments.

Numerous studies have demonstrated the positive impact of digital technology on the development of CT and learning motivation. However, most of these studies have been conducted

in primary and secondary education contexts (Abar et al., 2025; Miguens et al., 2024) or in non-mathematics disciplines such as design and technology (Wang & Wang, 2024). Research focusing on higher education mathematics learning remains relatively limited. Moreover, these studies generally employed advanced technological approaches such as robotics, machine learning, and automated feedback systems. These technologies are often complex and may not be easily accessible to all students. In contrast, there is limited research on the use of simpler and more accessible mathematical software such as Microsoft Mathematics 4.0 to enhance computational thinking and learning motivation in higher education mathematics. Microsoft Mathematics 4.0 is regarded as accessible and user-friendly because it is freely available, has an intuitive interface, and does not require programming skills.

While tools such as GeoGebra emphasize dynamic exploration and visual experimentation, they mainly support conceptual discovery through manipulation. In contrast, Microsoft Mathematics 4.0 provides step-by-step computational procedures that explicitly demonstrate the logical structure of mathematical problem solving. This procedural support is theoretically relevant to computational thinking because it promotes decomposition, sequencing, and algorithmic reasoning. These elements represent core components of CT. Therefore, from a theoretical perspective, learning with Microsoft Mathematics 4.0 can facilitate the development of students' computational thinking while simultaneously increasing their learning motivation through structured and interactive problem-solving experiences. Despite extensive research on exploratory digital tools, limited attention has been given to how procedurally oriented software may contribute to the development of CT and learning motivation.

This study introduces a new perspective by exploring the potential of Microsoft Mathematics 4.0 in facilitating students' understanding of the concept of functions. The software enables students to visualize functions dynamically and explore multiple mathematical representations. It also provides structured computational procedures that guide students through systematic problem-solving processes. Through these features, students can develop problem-solving strategies grounded in computational thinking principles (Mendezabal & Tindowen, 2018; Naganjaneyulu et al., 2020). Consequently, students are expected not only to understand the theoretical foundations of functions but also to apply these concepts through logical and algorithmic reasoning processes.

Despite previous research and pedagogical efforts, many students continue to experience significant challenges in comprehending the concept of functions. Common difficulties include interpreting function graphs, formulating mathematical models for contextual problems, and designing effective solution strategies (Jamna et al., 2022; Latifah & Afriansyah, 2021). Students also frequently struggle to connect symbolic representations with graphical representations because the visualization of functions is inherently abstract. These challenges often lead to low academic performance and reduced confidence in mathematical problem solving. Furthermore, low learning motivation exacerbates these difficulties. Students with low motivation tend to show passive learning behaviors and limited initiative in exploring mathematical concepts independently (Siregar et al., 2024).

This situation highlights the need for innovative learning strategies that simultaneously improve computational thinking and learning motivation. Technology-based learning environments that incorporate visual and interactive elements offer a promising solution to these challenges. Microsoft Mathematics 4.0 provides students with opportunities to explore functions visually, examine relationships between symbolic and graphical representations, and develop algorithmic thinking aligned with CT principles (Naganjaneyulu et al., 2020; Siregar & Yahfizham, 2025; Tanjung & Yahfizham, 2024). From a theoretical perspective, the structured and interactive features of Microsoft Mathematics 4.0 are expected to enhance both computational thinking and learning motivation in the context of learning functions. Therefore, this study aims to test the hypothesis that the use of Microsoft Mathematics 4.0 significantly improves prospective mathematics teachers' computational thinking skills and learning motivation when learning the concept of functions.

## **METHOD**

### **Research Design**

This study employed a quantitative approach with a quasi-experimental one-group pretest–posttest design. This design was used to measure changes in students' CT abilities and learning motivation before and after the implementation of Microsoft Mathematics 4.0-assisted learning. Through this approach, the study aimed to examine whether the learning intervention produced measurable improvements in both variables. This design enabled the measurement of improvement resulting from the learning intervention without the use of a control group (Stratton, 2019).

### **Participants**

This study was conducted among first-semester students enrolled in the Mathematics Education study program at Universitas Sembilanbelas November Kolaka who were taking Calculus I. In this study, the lecturer served as the primary facilitator of the learning process. The researcher acted as the developer of the learning tools, observer of the learning activities, and data analyst. All instructional tools and materials were collaboratively discussed and reviewed with the lecturer to ensure a shared understanding of the procedures and to minimize potential bias.

The participants consisted of 17 students with varying ability levels. Participants were selected using a purposive sampling technique because first-semester students were studying the topic of functions, which was the primary focus of this research. All participants volunteered and were informed in advance about the research objectives and procedures. Informed consent was obtained prior to participation, and all collected data were treated confidentially in accordance with ethical principles in educational research.

### **Instruments and Data Collection**

Data collection in this study employed three primary instruments: a CT ability test, a learning motivation questionnaire, and a student activity observation sheet. The CT ability test was developed based on four core CT indicators: problem decomposition, pattern recognition, abstraction, and algorithm design. The test was administered in two stages: a pre-test before the learning intervention and a post-test after the implementation of Microsoft Mathematics 4.0-assisted learning. The test results were used to evaluate improvements in students' CT abilities after the intervention.

Furthermore, a learning motivation questionnaire was adapted from the constructs developed by Pintrich et al. (1993) and Gopalan et al. (2017). The questionnaire covered three dimensions: intrinsic motivation, extrinsic motivation, and self-efficacy. It was administered before and after the intervention to measure changes in students' motivation toward learning mathematics. Meanwhile, the observation sheet was used to record students' participation, interaction, and engagement during the Microsoft Mathematics 4.0-assisted learning process. These observational data served as complementary information to support the interpretation of the quantitative findings.

Data collection in this study employed three primary instruments: a CT ability test, a learning motivation questionnaire, and a student activity observation sheet. The CT ability test was used to collect quantitative data on students' computational thinking skills before and after the implementation of Microsoft Mathematics 4.0 and to answer the first research question regarding its effect on students' CT skills.

The learning motivation questionnaire was used to collect data on students' learning motivation and to answer the second research question regarding the effect of Microsoft Mathematics 4.0 on learning motivation. The observation sheet was used to collect supporting data on students' participation, interaction, and engagement during the learning process, providing additional context for interpreting the quantitative findings.

All research instruments underwent content validation by three experts: a mathematics education specialist, a learning technology expert, and an educational evaluation expert. The validation process assessed the relevance of each instrument item to the intended indicators, the clarity of the language used, and the alignment of the items with the research objectives. Based

on the experts' suggestions, the instruments were revised until they met adequate content validity criteria and were deemed suitable for data collection.

The research implementation procedure consisted of three stages: preparation, implementation, and evaluation. The preparation stage included conducting a literature review, developing and validating the research instruments, and designing the Microsoft Mathematics 4.0-assisted learning activities in collaboration with the lecturer. During the implementation stage, students participated in five learning sessions on the topic of functions that integrated Microsoft Mathematics 4.0. Prior to the learning sessions, students completed a CT pre-test and a learning motivation questionnaire. After completing all learning sessions, students took the CT post-test and completed the motivation questionnaire again to identify changes in their CT abilities and motivation levels. Finally, in the evaluation stage, all data collected from the tests, questionnaires, and observations were verified to ensure completeness and consistency before proceeding to the analysis stage.

### **Data Analysis**

Data analysis in this study was conducted quantitatively and descriptively to illustrate improvements in students' CT abilities and learning motivation following the use of Microsoft Mathematics 4.0. The analysis was performed using SPSS software and consisted of two main stages: descriptive statistical analysis and inferential statistical analysis. In the descriptive stage, data obtained from the CT pre-test and post-test, as well as the learning motivation questionnaire, were analyzed to determine the mean scores, percentage improvement, standard deviation, and score distribution. This stage provided an overview of changes in students' CT abilities and learning motivation before and after the intervention. Subsequently, a data normality test using the Shapiro–Wilk test was conducted to determine the appropriate statistical procedure for hypothesis testing.

To examine the significance of the difference between pre-test and post-test scores, a paired-samples t-test was employed. Comparing pre-test and post-test scores was essential to establish students' initial competency levels and to determine whether the observed improvements were statistically significant. This analysis also helped distinguish the effect of the instructional intervention from possible improvements due to natural learning progression or repeated exposure to the test. A paired-samples t-test allowed the researcher to determine whether the magnitude of change exceeded what would be expected from random variation. Through this analysis, the study evaluated whether the use of Microsoft Mathematics 4.0 in learning functions significantly improved students' CT abilities and learning motivation.

A p-value of less than 0.05 ( $p < 0.05$ ) was considered indicative of a statistically significant difference. In addition, effect size was calculated to measure the magnitude of the intervention's impact on students' CT abilities and learning motivation. The quantitative findings were further supported by field observations to provide contextual insights into changes in students' learning behaviors. Finally, triangulation among test results, questionnaire responses, and observation data was conducted to strengthen the validity and reliability of the interpretation of the research findings.

## **RESULT AND DISCUSSION**

### **Result**

#### **Descriptive Findings and Normality Test**

A descriptive analysis was conducted to examine changes in students' computational thinking (CT) and learning motivation after the implementation of Microsoft Mathematics 4.0-assisted learning in the topic of functions. This analysis aimed to provide an initial overview of whether the use of Microsoft Mathematics 4.0 influenced students' CT abilities and learning motivation. The results of the descriptive analysis are presented in

Table 1.

Table 1 indicates a clear improvement in both variables examined in this study. The average learning motivation score increased from 44.82 (SD = 1.912) in the pre-test to 56.71 (SD = 4.210) in the post-test, representing an increase of 11.89%. Meanwhile, students' CT scores improved from 53.92% (SD = 12.189) to 80.39% (SD = 15.29), with an increase of 26.47%. These descriptive findings suggest that learning supported by Microsoft Mathematics 4.0

was associated with improved computational thinking skills and higher learning motivation among students.

Furthermore, before conducting inferential statistical analysis, a normality test was performed using the Shapiro–Wilk test. This test is used to ensure that the data meets the assumptions required for parametric testing. The results of the normality test are presented in Table 2.

Table 1. Descriptive Test Results

	N	Minimum	Maximum	Mean	Std. Deviation
Motiv. Pretest	17	41	47	44.82	1.912
Motiv. Posttest	17	50	66	56.71	4.210
CT Pretest	17	33.33	75.00	53.9224	12.18965
CT Posttest	17	50.00	100.00	80.3924	15.29278
Valid N (listwise)	17				

Table 2. Data Normality Test Results

	Statistic (W)	df	Sig. (p)
Motiv. Pretest	.901	17	.071
Motiv. Posttest	.941	17	.329
CT Pretest	.908	17	.091
CT Posttest	.920	17	.146

As shown in Table 2, the data for both variables were normally distributed. For learning motivation, the Shapiro–Wilk test produced values of  $W = 0.901$  ( $p = 0.071$ ) for the pre-test and  $W = 0.941$  ( $p = 0.329$ ) for the post-test. For computational thinking, the values were  $W = 0.908$  ( $p = 0.091$ ) for the pre-test and  $W = 0.920$  ( $p = 0.146$ ) for the post-test. All p-values were greater than 0.05, indicating that the data met the normality assumption. Therefore, a paired-samples t-

test could be appropriately applied to examine the effect of Microsoft Mathematics 4.0 on students' CT and learning motivation.

**Inferential Analysis of Paired-Sample t-test Results**

To determine whether the observed improvements were statistically significant, a paired-samples t-test was conducted. The descriptive statistics for the paired variables are presented in Table 3.

Table 3. Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Motiv. Pretest	44.82	17	1.912	.464
Motiv. Posttest	56.71	17	4.210	1.021
CT Pretest	53.9224	17	12.18965	2.95643
CT Posttest	80.3924	17	15.29278	3.70904

The results in Table 3 show an increase in the mean scores for both variables after the implementation of Microsoft Mathematics 4.0. The mean

learning motivation score increased from 44.82 in the pre-test to 56.71 in the post-test. Similarly, the mean CT score increased from 53.92% to 80.39%. These descriptive

differences suggest that students demonstrated higher motivation and stronger computational thinking after learning functions using Microsoft Mathematics 4.0. To confirm whether these improvements were statistically significant, the paired-samples t-test results are presented in Table 4.

The paired-samples t-test results show statistically significant differences between the pre-test and post-test scores for both variables. For learning motivation, the result  $t(16) = -13.404$ ,  $p < 0.001$  indicates a significant increase after the implementation of Microsoft Mathematics 4.0. This finding suggests that the use of Microsoft Mathematics 4.0 contributed to strengthening students' motivation in learning mathematical functions.

For computational thinking, the result  $t(16) = -5.334$ ,  $p < 0.001$  also indicates a statistically significant improvement. The 95% confidence interval of the difference ranged from  $-36.99$  to  $-15.95$ , reflecting an average improvement of approximately 26–27 points in CT scores. These findings demonstrate that learning functions with Microsoft Mathematics 4.0 significantly improved students' computational thinking skills.

Overall, the inferential results indicate that the use of Microsoft Mathematics 4.0 had a significant positive effect on both computational thinking and learning motivation. These findings support the study's hypothesis that the integration of Microsoft Mathematics 4.0 into function learning significantly enhances students' computational thinking skills and learning motivation.

In addition to the quantitative findings, classroom observations conducted

during the five instructional sessions provided further support for these results. At the beginning of the lessons, most students appeared passive and tended to follow the lecturer's instructions with limited initiative. However, after Microsoft Mathematics 4.0 was introduced, students showed noticeably higher engagement during learning activities.

Students demonstrated greater enthusiasm when they were able to visualize function graphs and manipulate parameters directly on the computer screen. This interactive experience encouraged students to explore mathematical relationships and discuss their observations with peers. Many students compared graphical outputs and interpreted how changes in parameters affected the shape of functions.

Observational data also indicated improvements in learning participation. Approximately 80% of the students actively participated in small-group discussions, and more than half of them asked conceptual questions during the learning sessions. These behaviors reflect increased learning motivation and deeper engagement in the learning process.

Furthermore, the observation sheets revealed improvements in learning engagement indicators such as sustained attention, active participation, and initiative in solving mathematical problems. Students with initially lower ability levels also showed greater confidence in attempting solution steps. The immediate visual feedback provided by Microsoft Mathematics 4.0 helped students identify errors and revise their solutions more effectively.

Table 4. Paired Samples t-Test Results

		Paired Differences		t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference				
		Lower	Upper			
Pair 1	Motiv. _Pretest – Motiv. _Posttest	-13.762	-10.003	-13.404	16	.000
Pair 2	CT Pretest - CT Posttest	-36.99077	-15.94923	-5.334	16	.000

## Discussion

The results of this study indicate that implementing Microsoft Mathematics 4.0 significantly enhanced students' computational thinking (CT) skills and learning motivation in learning the concept of functions. Quantitative analysis showed an average increase of approximately 26 points in CT ability and about 12 points in learning motivation. These results demonstrate that the integration of Microsoft Mathematics 4.0 in function learning positively influenced both cognitive outcomes and motivational aspects of learning. These findings are consistent with Dockendorff (2020) and Bilqis et al. (2025), who reported that interactive and visualization-based technologies improve students' motivation, participation, and understanding of abstract mathematical concepts. In this study, Microsoft Mathematics 4.0 functioned not only as a computational tool but also as a learning medium that facilitated computational thinking processes and strengthened students' engagement with mathematical concepts. The software's dynamic visualization and immediate feedback mechanisms help students understand conceptual relationships and solve problems systematically. These features also contribute to increased confidence in students' mathematical abilities (Fung & Poon, 2020; Kohen et al., 2019).

The improvement in students' CT abilities observed in this study can be explained by the learning processes facilitated by Microsoft Mathematics 4.0. The software allows students to visualize mathematical functions directly and observe changes in variables in real time. Through this process, students can identify patterns, analyze relationships, and construct algorithmic solution strategies when solving mathematical problems. These learning experiences reflect key components of computational thinking, including problem decomposition, pattern recognition, abstraction, and algorithm design. This mechanism is consistent with the findings of Miguens et al. (2024), who reported that technology-supported exploratory learning environments can effectively develop computational thinking skills. In the context

of this study, Microsoft Mathematics 4.0 created a learning environment that supported systematic reasoning and algorithmic thinking in learning functions.

These findings are also consistent with the study by Wang and Wang (2024), which reported that the integration of no-code digital tools can improve students' algorithmic thinking and learning motivation. Both studies emphasize that technology-supported learning environments can promote computational thinking development without requiring programming skills. In this study, Microsoft Mathematics 4.0 functioned as a no-code mathematical tool that supports algorithmic reasoning through structured computational procedures. As a result, students were able to focus more on conceptual understanding and systematic problem-solving strategies rather than technical programming processes.

Classroom learning activities during the implementation also reflected changes in students' learning engagement. Students showed greater interest when visualizing function graphs and manipulating parameters directly using Microsoft Mathematics 4.0. This interaction enabled students to observe how changes in variables influenced the graphical representation of functions. As students became more familiar with the software, they participated more actively in discussions about graphical interpretations and solution strategies. These learning behaviors indicate increased engagement with mathematical concepts during technology-supported instruction.

The improvement in students' learning motivation also highlights the role of affective factors in technology-enhanced learning environments. Learning activities using Microsoft Mathematics 4.0 created an engaging learning experience in which students could immediately observe the results of their mathematical exploration. Such experiences increase students' interest and encourage them to explore mathematical relationships more actively. These findings align with learning motivation theories emphasizing the importance of competence, autonomy, and social interaction in supporting intrinsic motivation (Higgins et

al., 2019; T. M. Siregar et al., 2024). Microsoft Mathematics 4.0 supports these motivational components by allowing students to independently manipulate functions, verify their solutions, and discuss their findings during learning activities.

Furthermore, these findings support the results of Abar et al. (2025), who reported that dynamic visualization and immediate feedback can enhance student engagement and self-directed learning. In Microsoft Mathematics 4.0, visual feedback allows students to review the correctness of their solution steps and identify possible errors. This feedback mechanism encourages students to revise their reasoning and refine their problem-solving strategies. Consequently, students can develop deeper conceptual understanding while strengthening computational thinking processes. As noted by Naganjaneyulu et al. (2020), visual mathematical software helps learners analyze complex problems by providing representations that support error detection and conceptual clarification. In this study, the availability of immediate feedback contributed to the observed improvements in both CT and learning motivation. These findings reinforce the theoretical view that learning experiences that allow for exploration, self-reflection, and cognitive autonomy contribute to deeper conceptual understanding (Baten et al., 2020; Jonsson et al., 2022).

Despite these positive findings, several variations in student responses were observed during the learning process. Students with stronger digital literacy tended to adapt more quickly to the software interface than those with limited prior experience using digital tools. This pattern is consistent with the findings of Wang and Wang (2024), who noted that technological literacy can influence the effectiveness of digital learning interventions. Therefore, providing initial orientation and instructional support is important to ensure that all students can effectively engage with technology-based learning environments. Previous studies have also emphasized the importance of scaffolding to support students' adaptation to digitally integrated learning environments (Abylkassymova et

al., 2025; Dubinina et al., 2022). In addition, the relatively short duration of the intervention may have limited the observation of long-term improvements in CT and learning motivation. Future research with longer implementation periods may provide deeper insights into the sustainability of these improvements.

Pedagogically, the findings of this study highlight the potential of Microsoft Mathematics 4.0 as an instructional tool for higher education mathematics learning. The integration of this software supports a shift from teacher-centered instruction toward a more student-centered learning environment. In such environments, students actively explore mathematical representations, test solution strategies, and construct conceptual understanding through interactive learning activities. Lecturers can utilize Microsoft Mathematics 4.0 not only as a computational aid but also as a pedagogical tool to promote computational thinking and strengthen students' motivation to learn mathematics. Furthermore, these findings suggest that higher education institutions may benefit from integrating interactive mathematical software into the curriculum. Such integration can support the development of essential 21st-century competencies, including computational reasoning, problem-solving skills, and technological literacy.

## CONCLUSION

This study examined the effect of Microsoft Mathematics 4.0 on prospective mathematics teachers' computational thinking and learning motivation in learning functions. The findings indicate that integrating Microsoft Mathematics 4.0 into mathematics instruction can support the development of computational thinking while simultaneously strengthening students' motivation to learn. The interactive features of the software, including dynamic visualization and immediate feedback, provide learning experiences that facilitate conceptual understanding and systematic problem solving.

However, this study has several limitations. The relatively small sample size and the absence of a control group limit the

generalizability of the findings. Future studies are recommended to employ larger samples and comparative experimental designs to further investigate the effectiveness of Microsoft Mathematics 4.0 in different mathematical contexts and educational settings.

#### ACKNOWLEDGMENT

The authors gratefully acknowledge Universitas Sembilanbelas November Kolaka for supporting this study through the internally funded research scheme for lecturers and students. The authors also thank the Institute for Quality Assurance and Learning Development (LPMPP) for its coordination and support during the implementation of this research.

#### AUTHOR CONTRIBUTIONS

Meiliati, R. : Conceptualization, methodology design, formal analysis, writing original draft, supervision, and project administration.

Marillah, D. : Data collection in classroom settings and support for the implementation process.

Fitri : Data entry and organization for analysis, writing, review & editing, and visualization.

Salido, A. : Software management, technical support, and validation.

Aswin : Investigation, classroom implementation, and data curation

Husain, D. S. : Validation and assistance in observation activities.

#### REFERENCES

- Abar, C. A. A. P., Santos, José Manuel Dos Santos Dos Breda, A. M. R. D., & Lavicza, Z. (2025). Automatic feedback in mathematics education: A pathway to robotics and computational thinking. *Acta Scientiae*, 27(2), 1–27. <https://doi.org/10.17648/acta.scientiae.8240>
- Abylkassymova, A. E., Duisebayeva, A. B., Tuyakov, Y. A., Ardabayeva, A. K., & Kossanov, B. M. (2025). Enhancing the preparation of future mathematics teachers in a digital learning environment. *International Journal of*

*Information and Education Technology*, 15(6), 1193–1200. <https://doi.org/10.18178/ijiet.2025.15.6.2322>

- Angraini, L. M., & Abdurrahman, A. (2024). Computational thinking readiness level of first-year students of mathematics education. *International Journal of Mathematics and Mathematics Education (IJMME)*, 2(3), 207–221. <https://doi.org/10.56855/ijmme.v2i3.1099>
- Baten, E., Vansteenkiste, M., De Muynck, G. J., De Poortere, E., & Desoete, A. (2020). How can the blow of math difficulty on elementary school children's motivational, cognitive, and affective experiences be dampened? The critical role of autonomy-supportive instructions. *Journal of Educational Psychology*, 112(8), 1490–1505. <https://doi.org/10.1037/edu0000444>
- Bilqis, A. A. S., Astuti, W., & Hardi, H. (2025). The role of interactive technology in enhancing student engagement in mathematics. *Jurnal Pendidikan Matematika*, 16(2), 209–215. <http://ojs.uho.ac.id/index.php/jpm>
- Chan, S.-W., Looi, C.-K., Ho, W. K., & Kim, M. S. (2023). Tools and approaches for integrating computational thinking and mathematics: A scoping review of current empirical studies. *Journal of Educational Computing Research*, 60(8), 2036–2080. <https://doi.org/10.1177/07356331221098793>
- Dockendorff, M. (2020). How can digital technology enhance mathematics teaching and learning? In *Examining Multiple Intelligences and Digital Technologies for Enhanced Learning Opportunities* (pp. 216–243). IGI Global Scientific Publishing. <https://doi.org/10.4018/978-1-7998-0249-5.ch011>
- Dubinina, G., Konnova, L., & Stepanyan, I. (2022). Technologies for teaching mathematics in a multilingual digital environment. *Education Sciences*, 12, Article 590.

- <https://doi.org/10.3390/educsci12090590>
- Fung, C. H., & Poon, K. K. (2020). Can dynamic activities boost mathematics understanding and metacognition? A case study on the limit of rational functions. *International Journal of Mathematical Education in Science and Technology*, 52(8), 1225–1239. <https://doi.org/10.1080/0020739X.2020.1749905>
- Gopalan, V., Bakar, J. A. A., Zulkifli, A. N., Alwi, A., & Mat, R. C. (2017). A review of the motivation theories in learning. *AIP Conference Proceedings*, 1891(1), 020043. <https://doi.org/10.1063/1.5005376>
- Higgins, K., Huscroft-D'Angelo, J., & Crawford, L. (2019). Effects of technology in mathematics on achievement, motivation, and attitude: A meta-analysis. *Journal of Educational Computing Research*, 57(2), 283–319. <https://doi.org/10.1177/0735633117748416>
- Hosseini-Mohand, H., & Hosseini-Mohand, H. (2023). Influence of motivation on the perception of mathematics by secondary school students. *Frontiers in Psychology*, 13(January), 1–16. <https://doi.org/10.3389/fpsyg.2022.1111600>
- Irawan, E., Rosjanuardi, R., & Prabawanto, S. (2024). Research trends of computational thinking in mathematics learning: A bibliometric analysis from 2009 to 2023. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(3). <https://doi.org/10.29333/ejmste/14343>
- Jamna, N. D., Hamid, H., & Bakar, M. T. (2022). Analisis kemampuan berpikir komputasi matematis siswa SMP pada materi persamaan kuadrat. *Jurnal Pendidikan Guru Matematika*, 2(3). <https://doi.org/10.33387/jpgm.v2i3.5149>
- Jonsson, B., Mossegård, J., Lithner, J., & Karlsson Wirebring, L. (2022). Creative mathematical reasoning: Does need for cognition matter? *Frontiers in Psychology*, 12, Article 797807. <https://doi.org/10.3389/fpsyg.2021.797807>
- Kohen, Z., Amram, M., Dagan, M., & Miranda, T. (2019). Self-efficacy and problem-solving skills in mathematics: The effect of instruction-based dynamic versus static visualization. *Interactive Learning Environments*, 30(4), 759–778. <https://doi.org/10.1080/10494820.2019.1683588>
- Latifah, T., & Afriansyah, E. A. (2021). Kesulitan dalam kemampuan pemecahan masalah matematis siswa pada materi statistika. *Journal of Authentic Research on Mathematics Education (JARME)*, 3(2), 134–150.
- Martín-Lucas, J., & Dujo, Á. G. del. (2022). Knowledge-building in an environment mediated by digital technology: A case study in higher education. *Education and Information Technologies*, 28, 3267–3287. <https://doi.org/10.1007/s10639-022-11304-0>
- Mendezabal, M. J. N., & Tindowen, D. J. C. (2018). Improving students' attitude, conceptual understanding and procedural skills in differential calculus through Microsoft Mathematics. *Journal of Technology and Science Education*, 8(4), 385–397. <https://doi.org/10.3926/jotse.356>
- Miguens, A. L. B., Piedade, J. M. N., Santos, R. J. B. dos, & Oliva, T. L. (2024). Meaningful learning in mathematics: A study on motivation for learning and development of computational thinking using educational robotics. *Educational Media International*, 61, 4–15. <https://doi.org/10.1080/09523987.2024.2357472>
- Murtianto, Y. H., Sutrisno, Nizaruddin, & Muhtarom. (2019). Effect of learning using mathematica software toward mathematical abstraction ability, motivation, and independence of students in analytic geometry. *Infinity Journal*, 8(2), 219–228. <https://doi.org/10.22460/infinity.v8i2.p219-228>

- Naganjaneyulu, V., Ali, S. M., Ali, M. I., Jabeen, M., & Naseeruddin, S. (2020). Microsoft mathematics as a teaching and learning tool for mathematics. *International Journal of Management and Humanities*, 5(4), 55–59. <https://doi.org/10.35940/ijmh.b1140.125420>
- Nurlaelah, E., Usdiyana, D., & Fadilah, N. (2024). The relationship between computational thinking ability and logical mathematical intelligence. *Mosharafa: Jurnal Pendidikan Matematika*, 13(1), 87–96. <https://doi.org/10.31980/mosharafa.v13i1.1978>
- Pérez, A. (2018). A framework for computational thinking dispositions in mathematics education. *Journal for Research in Mathematics Education JRME*, 49(4), 424–461. <https://doi.org/10.5951/jresematheduc.49.4.0424>
- Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the motivated strategies for learning questionnaire (Mslq). *Educational and Psychological Measurement*, 53(3), 801–813. <https://doi.org/10.1177/0013164493053003024>
- Salsabilah, S. A., & Rahaju, E. B. (2022). Miskonsepsi siswa SMP pada materi grafik fungsi kuadrat. *MATHEdunesa*, 11(3), 924–937. <https://doi.org/10.26740/mathedunesa.v11n3.p924-937>
- Saputri, A. N., Warsitarumanti, S., Maharani, D., Herman, T., & Hasanah, A. (2024). Analisis faktor-faktor kesulitan siswa dalam belajar materi persamaan kuadrat. *PHI: Jurnal Pendidikan Matematika*, 8(1), 37. <https://doi.org/10.33087/phi.v8i1.332>
- Sarah, L. L. (2021). Automatic trash bin arduino project (ATAP): Enhancing computational thinking skills through STEM learning. *SEAQIS Journal of Science Education*, 1(1), 27–35. <https://doi.org/10.58249/sjse.v1i1.22>
- Siregar, F. S. N., & Yahfizham, Y. (2025). Microsoft mathematics sebagai media untuk pengembangan pembelajaran matematika siswa. *Pentagon: Jurnal Matematika Dan Ilmu Pengetahuan Alam*, 3(2), 100–108. <https://doi.org/10.62383/pentagon.v3i2.539>
- Siregar, T. M., Andini, A., Panjaitan, Aprini Handayani Endy, N. S., & Siregar, Paradiba Apriliani Anggraini, S. (2024). Analisis faktor yang mempengaruhi rendahnya motivasi belajar siswa pada mata pelajaran matematika. *AR RUMMAN - Journal of Education and Learning Evaluation*, 1(2), 710–715. <https://doi.org/10.31932/j-pimat.v2i2.860>
- Stratton, S. J. (2019). Quasi-experimental design (pre-test and post-test studies) in prehospita and disaster research. *Prehospital and Disaster Medicine*, 34(6), 573–574. <https://doi.org/10.1017/S1049023X19005053>
- Tanjung, K., & Yahfizham, Y. (2024). Pemanfaatan media pembelajaran matematika berbantuan aplikasi Microsoft Mathematics (Systematic Literature Review). *Konstanta : Jurnal Matematika Dan Ilmu Pengetahuan Alam*, 2(2), 84–90. <https://doi.org/10.59581/konstanta.v2i2.3155>
- Wang, H. H., & Wang, C. H. A. (2024). Teaching design students machine learning to enhance motivation for learning computational thinking skills. *Acta Psychologica*, 251(December), 104619. <https://doi.org/10.1016/j.actpsy.2024.104619>
- Wu, T., Sarwono, E., & Huang, Y.-M. (2025). Incorporating computational thinking into virtual laboratories to enhance learning motivation, engagement, and higher-order thinking skills. *J. Comput. Assist. Learn.*, 41(2), Article e70017. <https://doi.org/10.1111/jcal.70017>
- Zhou, X., & Tsai, C.-W. (2023). The effects of socially shared regulation of learning on the computational thinking, motivation, and engagement

in collaborative learning by teaching.  
*Education and Information  
Technologies*, 28(7), 8135–8152.  
<https://doi.org/10.1007/s10639-022-11527-1>