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SMARTCALC GUIDE: ADVANCING MATHEMATICAL FLUENCY THROUGH DIGITAL CALCULATOR INTEGRATION

YUSRINA ANDU*, NURUL AITYQAH YAACOB, SITI NOOR DINA AHMAD, SITI ZAHARAH MOHD RUSLAN & ZURAIDA JAAFAR

Faculty of Computer and Mathematical Sciences, UiTM Cawangan Negeri Sembilan, Kampus Kuala Pilah, *Corresponding author: yusrinaandu@uitm.edu.my

ABSTRACT

Scientific calculators have become a compulsory partner for students in studying mathematical concepts. These devices enable students to visualize, compute, and explore basic and multiple equations as well as formulas in a user-friendly manner. However, many students often find it challenging to utilize the full potential of these calculators. Hence, the SMARTCALC GUIDE is introduced to them to improve their mathematical fluency in using scientific calculators. The research was conducted among 125 students from different academic programs as well as mathematics courses at UiTM Kampus Kuala Pilah, assessing improvements in scientific calculator efficiency as well as competence by taking a pre-test and post-test. Out of 125 participants, 80% students have agreed that SMARTCALC GUIDE improved their scientific calculator knowledge compared to before. Descriptive statistics revealed a major increase in the mean scores from the pre-test ($M = 2.23$, $SD = 2.05$) to the post-test ($M = 6.52$, $SD = 2.38$), indicating marked improvement. About 76.8% students agreed that this GUIDE has increase their confidence level in using scientific calculator. A majority (86.4%) of the participants agreed that using a scientific calculator significantly helped them solve mathematical problems more quickly. These findings show that SMARTCALC helped students not only understand the concepts of mathematics more efficiently but also boosted their confidence in applying these tools in other future courses. Thus, by enhancing students' proficiency with scientific calculators, the SMARTCALC GUIDE has significantly improved their mathematical fluency, deepened their understanding, and strengthened their problem-solving abilities.

Keywords: Scientific Calculator, Mathematics Fluency, Problem Solving

INTRODUCTION

Technology integration in mathematics education has revealed increasing potential to support students' achievement, confidence, and problem-solving capabilities. Scientific and graphing calculators are cognitive aids that improve comprehension of abstract mathematical concepts and lessen computing load when used properly. Recent studies highlight that calculator-based instruction can significantly improve learning outcomes, especially when aligned with guided teaching strategies (Angco et al., 2023; Kandemir & Demirbağ-Keskin, 2019). Moreover, calculators can act as substances for improving students' problem-solving accuracy, speed, and attitudes toward mathematics.

Beyond technological tools, psychological factors such as learning motivation, self-confidence, and self-regulated learning strategies also play crucial roles in students' academic success. El-Adl and Alkharusi (2020) found that students who employed self-regulated learning strategies and had higher intrinsic motivation demonstrated stronger achievement in mathematics. Similarly, Wahyuni et al. (2024) emphasized the influence of math anxiety and self-confidence on problem-solving skills, underscoring the need to support affective as well as cognitive domains in mathematics education. The intersection of digital tools and motivational factors is further reinforced by studies on e-learning environments. Yaniawati et al. (2020) revealed that the integration of e-learning within resource-based learning significantly improved students' creative thinking abilities and self-confidence in mathematics. These findings suggest that both technical assistance and emotional readiness might enhance students' mathematical experiences, especially in problem-solving scenarios.

Indeed, the invention of scientific calculators have helped many students, including those in UiTM Cawangan Negeri Sembilan (UiTMCNS) Kampus Kuala Pilah, to solve mathematical problems in various courses. However, through the observations carried out during classes, it has been revealed that most of them only use the basic operations. Furthermore, they are also not familiar with most of the advanced functions, which can be useful to assist them in solving mathematical problems. Although their purchased scientific calculators come with an operation guide booklet, nonetheless, it only comes with basic functions without much explanation. This shows that it is essential to have proper guidance on scientific calculators to reduce the confusion, frequent errors, and low participation of students during problem-solving activities. Thus, SMARTCALC GUIDE was introduced.

The main advantage of SMARTCALC GUIDE is that it has step by step instructions on how to insert the numbers or equations correctly. Moreover, games are also included for students to practice while observing their own competency and understanding of problem solving using their scientific calculators. Therefore, in this study, we will explore how our SMARTCALC GUIDE can improve the students' speed and accuracy in using scientific calculators to solve mathematical problems. Additionally, the impact of SMARTCALC GUIDE on the students' confidence and competence will also be evaluated. It is expected that our GUIDE will have positive effect on both objectives.

METHODOLOGY

This study consists of three phases: (i) the construction and development of the SMARTCALC GUIDE, (ii) data collection for the SMARTCALC GUIDE evaluation, and (iii) data analysis of the SMARTCALC GUIDE. The content of the developed material is based on topics covered in several mathematics courses where the use of scientific calculators is most required for diploma students. These topics include arithmetic operations, number systems, algebraic expressions, linear and quadratic functions, systems of equations, logarithms, indices, and trigonometric functions.

To evaluate the material, a workshop using the SMARTCALC GUIDE as instructional material was conducted. A total of 125 students enrolled in various academic programs and mathematics courses at UiTMCNS Kampus Kuala Pilah participated in this study. The study adopted a quasi-experimental pre-test and post-test single-group design to assess the effectiveness of our guide.

The workshop began with an overview of the layout of scientific calculators, along with information about the different models and brands commonly found in Malaysia. Students were guided through the keypad with clear explanations of the functions and modes of each button. To ensure students' efficiency and competence in using scientific calculators, hands-on practice with guided examples was incorporated. This approach allowed for the correction of common mistakes and misconceptions, while providing guidelines for effective calculator use.

Pre- and post-assessments were administered to evaluate the effectiveness of the SMARTCALC GUIDE. The pre-test was given before the workshop to measure the students' initial competency in using scientific calculators, and the post-test was conducted immediately afterward to assess any improvements in their skills. The assessments consisted of ten mathematics questions related to their syllabus, focusing on areas where scientific calculators are most required.

Additionally, a survey was conducted to gather the participants' feedback. The questionnaire was designed to determine the students' perceptions of the SMARTCALC GUIDE, using a five-point Likert scale to measure their agreement or disagreement. The data obtained were quantitatively analyzed using SPSS software. Participants' demographics were summarized using frequency and percentage. A descriptive analysis, including mean and standard deviation (SD), was employed to assess the students' perceptions and the differences in assessment scores. To evaluate the differences in the mean scores between the pre-test and post-test, a paired sample t-test was conducted.

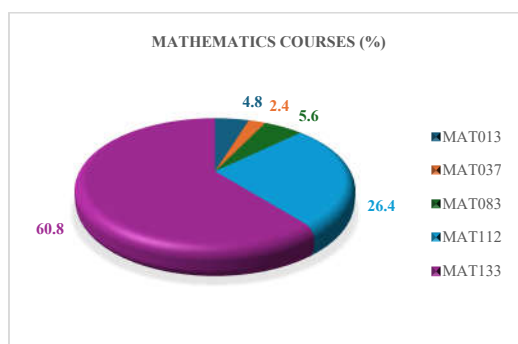
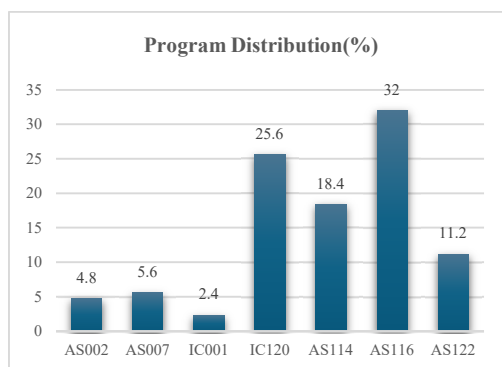
RESULT AND DISCUSSION

A total of 125 students participated in this study at UiTMCNS Kampus Kuala Pilah. The students were drawn from both pre-diploma and diploma programs across various fields of study and enrolled in different mathematics courses as part of their curriculum.

Figures and tables provided in this study further illustrate these distributions. Table 1 summarize the frequency of students who participated in this study by academic level and programme. The bar chart (Figure 1) and pie chart (Figure 2) highlight the proportional representation of students in each programme and mathematics courses.

Table 1.: a) Frequency and Percentage Graphs of Students' Programmes and Course Background (n=125)

Level	Program	Students	Total
Pre-diploma	AS002	6	16 (12.8%)
	AS007	7	
	IC001	3	
	IC120	32	
Diploma	AS114	23	109 (87.2%)
	AS116	40	
	AS122	14	



Of the 125 students, 16 students (12.8%) were from pre-diploma programmes comprising AS002, AS007, and IC001, while the remaining 109 students (87.2%) were from diploma programmes comprising IC120, AS114, AS116, and AS122. In terms of mathematics course enrolment, students were distributed across five courses. A total of 6 students (4.8%) were enrolled in MAT013, 7 students (5.6%) in MAT083, 3 students (243%) in MAT037, 33 students (26.4%) in MAT112, and 76 students (60.8%) in MAT133. MAT133 recorded the highest enrolment, accounting for over half of the total number of students, while MAT037 had the lowest enrolment.

In this study, students' feedback was also collected, and the outcome of the SMARTCALC GUIDE survey is presented in Table 2.

Table 2.: Descriptive Frequency Statistics of Students’ Feedback on SMARTCALC GUIDE

5-point rating scales	Frequency	Percent (%)
After attending the workshop, my understanding of how to use a scientific calculator has improved.		
Strongly Disagree	0	0
Disagree	1	0.8
Neutral	24	19.2
Agree	51	40.8
Strongly Agree	49	39.2
After attending this workshop, I feel more confident in my answers when using the scientific calculator.		
Strongly Disagree	0	0
Disagree	1	0.8
Neutral	28	22.4
Agree	52	41.6
Strongly Agree	44	35.2
I believe that the scientific calculator helps me solve mathematical problems more quickly.		
Strongly Disagree	0	0
Disagree	3	2.4
Neutral	14	11.2
Agree	43	34.4
Strongly Agree	65	52.0

A total of 80% agreed that their understanding of scientific calculators had improved after attending the workshop on SMARTCALC GUIDE (Table 2). This shows that the explanation that was given during the workshop has increased their knowledge and understanding on the mathematical functions on their scientific calculator. In terms of confidence levels, most of them agreed at 76.8% that SMARTCALC GUIDE has enhanced their confidence in solving mathematical problems. This result is similar with findings of Raduan et al. (2021). Thus, by having proper guidance, especially on inserting the numbers or equations in the scientific calculator correctly, students are less likely to make mistakes in obtaining the final answer for their calculations.

Table 2 also shows that 86.4% students agreed that SMARTCALC GUIDE has sped up their mathematical calculations. By applying the correct equation and syntax in their scientific calculator, it has expedited the time taken to solve the mathematical problems given. Prior to this, most of the students will insert the values or solve a long equation one-by-one, which causes them to spend longer times in solving a question. However, through SMARTCALC GUIDE, the numbers or variables can be inserted as a single equation in their scientific calculator, subsequently decreasing the time needed to solve a mathematical problem. In manual calculation of simultaneous equations, such as finding the value of the variables, the common mistakes that students likely make is the writing of wrong symbols of negative and positive. This usually occurs either during expansion of brackets or moving the variable

from left to right. Thus, by mastering the techniques to enter the whole equation in their scientific calculator, these common mistakes can be reduced.

The pre-and-post effect of the SMARTCALC GUIDE on the students' speed, precision as well as confidence and competence were also carried out. It was found out that the output in the mean scores of pre-test and post-test is different. The values for the pre-test mean score is 2.23 and the post-test mean score is 6.52 indicates the mean score increases from 2.23 (pre) to 6.52 (post). However, there is slightly more variability in post-test scores, with a standard deviation of 2.381, but small value of standard error for both assessments indicates high reliability of the sample mean estimates. It can also be observed that there is significant difference in means between pre-test and post-test score ($p\text{-value} = 0.000 < 0.05$). Due to the means of the two tests and the direction of the t -value, we can conclude that there was a statistically significant improvement in performance after using SMARTCALC GUIDE from 2.23 ± 2.05 to 6.52 ± 2.38 (mean $\pm$ sd); an improvement of 4.288 ± 2.593 . This finding is similar to the findings of Sugla et al. (2024) where their post-test results show significant improvement. Cohen's d is for comparing the means between two groups. Here, we obtained Cohen's $d = -1.654$ which implies a very strong effect of the GUIDE. This suggests that the workshop had a significant and meaningful impact on student performance in solving problems by using scientific calculators.

CONCLUSION

The outcomes show that SMARTCALC GUIDE has successfully improved students' speed and accuracy in solving mathematical problems using scientific calculators. Furthermore, after being introduced to the SMARTCALC GUIDE, students' confidence and competence have increased. This is because, through SMARTCALC GUIDE, they are exposed to various features in their scientific calculators and will be able to use them more effectively and confidently for solving mathematical problems compared to before. In conclusion, fostering students' proficiency with scientific calculators has significantly enhanced their mathematical fluency, deepened their understanding, and strengthened their problem-solving capabilities. These skills are important not only for academic success at the university level but also for future professional development. The impact of scientific calculator literacy will further empower students to adapt confidently to increasingly complex mathematical and technological challenges in this modern era.

REFERENCES

- Angco, R. J., Aliser, A., Lacson, E., & Bonotan, A. (2023). The use of graphing calculators in teaching mathematics: a meta-synthesis. *Jurnal Pendidikan Progresif*, 13(2), 230-243.
- Kandemir, M. A., & Demirbag-Keskin, P. (2019). Effect of Graphing Calculator Program Supported Problem Solving Instruction on Mathematical Achievement and Attitude. *International Journal of Research in Education and Science*, 5(1), 203-223.
- El-Adl, A., & Alkharusi, H. (2020). Relationships between self-regulated learning strategies, learning motivation and mathematics achievement. *Cypriot Journal of Educational Sciences*, 15(1), 104-111. <https://doi.org/10.18844/cjes.v15i1.4461>

- Wahyuni, R., Juniati, D., & Wijayanti, P. (2024). How do math anxiety and self-confidence affect mathematical problem solving?. *TEM Journal*, 13(1). <https://doi.org/10.18421/tem131-58>
- Yaniawati, P., Kariadinata, R., Sari, N., Pramiasih, E., & Mariani, M. (2020). Integration of e-learning for mathematics on resource-based learning: Increasing mathematical creative thinking and self-confidence. *International Journal of Emerging Technologies in Learning (iJET)*, 15(6), 60-78. <https://doi.org/10.3991/ijet.v15i06.11915>
- Radzuan, F. S., Kamarudin, N., Khambari, M. N. M., & Arsad, N. M. (2021). Impact of Scientific Calculators in Mathematics among Low-Achieving Students in a Secondary School in Kajang, Selangor. *Pertanika Journal of Social Sciences & Humanities*, 29. <https://doi.org/10.47836/pjssh.29.s1.11>
- Suglo, E. K., Aligi, I., Derick, A. A., Akuteye, E. A., Akanbang, S., & Amamboda, R. (2024). The Impact of Introducing Scientific Calculators to Junior High School Graduates on Their Academic Performance in Mathematics. *East African Journal of Education Studies*, 7(4), 500-514. <https://doi.org/10.37284/eajes.7.4.2366>