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The Effects of Scientific Calculator Usage on Pre-service Teacher's Computational Skills

Amoah, K. J.[1], Dramani, B. A.[2]
Presbyterian Women's College of Education, P. O. Box 19, Aburi, E/R, Ghana.
Bagabaga College of Education, P.O. Box ER 35, Tamale, ER, Ghana.

Abstract:- This study was meant to measure the effects of the use of scientific calculators on pre-service teachers' computational skills. It specifically sought to find out the impact of scientific calculator usage on pre-service teachers' performance and errors in computational skills. Thirty student-teachers participated in the study. Researchers used interviews, pre-tests, interventions, and post-tests to investigate the impact of scientific calculator use on student-teachers' computational skills. The study revealed the errors student-teachers made in their computational skills which included errors in parenthesis, approximation, concept application and sequence of operations. As a result, we found that there was a difference between the results before and after the test in terms of the minimum, maximum, mean, and standard deviation and the latter was superior to the former (i.e., the pre-test mean and the standard deviation is 3.90, test after 2.05). The test means and SD are 6.40 and 2.67). The t-test results (29df, t=6.335, p=0.00) also showed that the mean difference was significant at p=0.00. Analysis was performed to determine whether mean differences were statistically significant. This means that scientific calculators had improved the computational skills and abilities of student-teachers, thereby improving their mathematics performance.

Keywords:- *Effects, Scientific Calculator, Usage, Pre-Service Teachers, Computational Skills.*

I. INTRODUCTION

Throughout the history of mathematics, aids for computations and problem-solving have been developed alongside the study and development of mathematics as a subject (Alam, 2022). Mathematical tables, counting boards, logarithm tables and slide rules have all proven useful computational aids to mathematics. Thirty years ago, it was supposed that mathematics was only needed by somebody planning to work in the "hard sciences", especially physics and chemistry or to become an engineer, a professional statistician or an accountant (Nishida, Ida, & Uchida, 2022). Today, numbers and shapes are used all over the world to calculate, represent, and explain things in arithmetic, geometry and algebra (Nishida, Ida, & Uchida, 2022). Quite recently, modern technology has caused many educational curricula to be restructured and this has seriously affected pre-service teachers learning of many subjects, especially mathematics (Lacek, 2023). This brought to bear the position statement by Dhondt, Kraan, & Bal, (2022). that

The nature of mathematics training has altered over the past several years as a result of greater technological use and shifting employment requirements. Pre-service teachers must be prepared to thrive in the technologically advanced culture of today. This calls for highly trained professionals with the aptitude to use their mathematics knowledge, which goes above and beyond the basic aptitude for addressing everyday issues. (Dhondt, Kraan, & Bal, 2022; Lacek, 2023).

Unquestionably, it has been crucial to change how important computing, thinking, and problem-solving are in schools and institutions. Understanding mathematics and the use of technology in mathematics instruction and learning have also been stressed. Pre-service teachers who understand mathematics and use technology remember what they learn and can use it in many contexts. Thus, a curriculum that can enhance the mathematical skills of pre-service teachers is required in tandem with the expanding effect of technological innovation. This includes moving away from a curriculum that emphasizes the memorization of obscure facts and procedures in favor of one that places a stronger emphasis on conceptual understanding, computational skills, problem-solving, and the use of technology in both teaching and learning (Oppong-Gyebi, Amoako Atta, Kwadwo, Belbase, Bonyah, & Peprah-Opoku, 2023).

According to Matthiessen (2023), it is conceivable to place less emphasis on algorithmic abilities as a result of the influence of technology forces on mathematics teaching and learning. This vacuum may then be filled by placing more focus on the development of mathematical ideas. Additionally, technology helps pre-service teachers save time and offers them access to innovative, potent new ways to dig deeper into ideas that were previously unattainable. (David, Pinho, Agostinho, Costa, Portella, Keesman, & Garcia, 2022; Matthiessen, 2023) The power of technology causes major changes in mathematics education.

According to Tunjera, (2023), technology has been identified as having discernible advantages such as facilitating improved collaboration among pre-service teachers, promoting communication, and encouraging the sharing of knowledge. The utilization of technology provides prompt and precise feedback to individuals in pre-service teaching programs, thereby fostering a positive motivational outlook. The integration of technology in education also facilitates the implementation of constructivist pedagogy, whereby trainee educators leverage technological tools to investigate and comprehend mathematical concepts. The presented methodology advocates for the cultivation of higher-order cognitive processes and advanced problem-solving tactics, which coincides with the recommendations disseminated by the National Council of Teachers of Mathematics (NCTM). Subsequently, educators-in-training leverage technology in order to focus on problem-solving procedures and mathematical computations associated with the identified problems, thereby establishing the indispensability of technology in the educational pedagogy of mathematics (Ali & Hernandez, 2023).

Based on the aforementioned arguments, educators have opted to incorporate technology in areas where there have been identified requirements, challenges, or potential improvements in productivity. In order to meet a requisite, it is essential to ascertain the nature of an issue and employ the computational abilities procured to tackle mathematical quandaries. In adherence to the Colleges of Education's academic framework, mathematics is a mandatory component of the integrated Curriculum in Ghana. Its emphasis rests on computation and problem-solving, and therefore, prospective teachers are encouraged to apportion significant attention to these elements in their preparation and delivery of mathematics courses. It is noteworthy to mention that pre-service educators presently enroll in a comprehensive introductory course during the initial year of their academic pursuit (Narh-Kert, Osei, & Oteng, 2022; Okyere, 2022). Nonetheless, a persistent challenge remains regarding the query of whether pre-service teachers are potentially facilitating or instructing their peers in problem-solving and the extent to which these pre-service teachers possess the requisite computational competencies for resolving mathematical problems.

The need of training pre-service teachers' computational and problem-solving abilities in a reciprocal manner has been constantly stressed by mathematics educators over the last two decades (Liu, Gu, & Xu, 2023). This perspective holds that procedural proficiency and strategic competence, or the capacity to solve problems, "are not independent; they represent different aspects of a complex whole" and "are interwoven and interdependent in the development of proficiency in the study of mathematics" courses. Most recently, it was advised that pre-service teachers develop procedural fluency while learning to construct and solve problems as well as master fundamental mathematical concepts (such as how to express fractions on a number line and recognize comparable fractions).

- *Statement of the problem*

David, et al, (2022). stated that recent times have seen a flow in the usage of calculators among students at all levels of the educational structure. However, the fullest potential of the scientific calculator concerning its proper integration into the teaching and learning of mathematics is still untapped. More disturbing is the fact that a very good number of the holders and users of these calculators cannot use them to the optimum. According to Zalmon & Wonu, (2017), the Chief Examiners' Report on core mathematics in the West Africa Examinations Council's Senior High School Examinations indicated that students' performance in school certificate mathematics examinations. The report indicated that students' weaknesses included poor skills in computations and their ability to solve easy problems in a rather difficult way". "It is clear that the ability to apply the required computational and problem-solving skills is lacking".

The report revealed that the weaknesses demonstrated by the candidates were indicative of poor proficiency in computation and problem-solving. Furthermore, it appeared that these individuals tended to approach simpler problems with convoluted methods. This observation suggests that a significant number of students are deficient in their ability to perform computations and effectively solve problems. As indicated in the report, the apprehension of a mathematical equation by a student involved the utilization of a calculator resulting in an input of 5. 1375 instead of the desired outcome of 48, obtained through the correct calculation of 54.5 - (260/40), equivalent to 54.5 - 65 In a separate illustration, learners utilized a calculator to compute the product of 5. 123 and 2301, followed by their division with 4.1101 multiplied by 3.99, devoid of any use of brackets. In lieu of performing the operation of multiplying (5.123 by 2301) and subsequently dividing by (4.1101 x 399), the calculation yielded the result of 4. 43569 The intended outcome was 7.19 The examples presented above demonstrate an apparent deficiency in the students' proficiency in utilizing the scientific calculator for problem-solving purposes. Consequently, this deficiency has resulted in a lack of fundamental computational competence and an inadequacy in the students' abilities to resolve problems. There have been suggestions advocating for the introduction of fundamental computational proficiencies and the capability to employ mathematical problem-solving principles and skills to students by their teachers. This study yielded a noteworthy finding with regard to the computational aptitude of students, based on an observation made during a test administered to pre-service teachers. Specifically, it was noted that a significant proportion of the test-takers struggled with utilizing calculators to perform intricate calculations, thus revealing a notable dearth of computational proficiency among this cohort. Therefore, it is imperative to investigate the impact of scientific calculators on the computational abilities of pre-service teachers.

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This observation, derived from a test administered to pre-service teachers, suggests a noteworthy deficiency in the computational capabilities of the students. Specifically, the majority of students struggled with operating calculators in the context of complex mathematical operations.

➢ *Purpose of the Study and research questions*

The study's purpose was to determine and establish the impact of the scientific calculator use on improving pre-service teachers' computational skills. To achieve this, the following research questions guided the study:

- What computational errors do Pre-service teachers make when using the scientific calculator?
- What is the effect of the scientific calculator on Pre-service teachers' achievement in mathematics?

In answering the second research question, a hypothesis was formulated for the study. The hypothesis was

- Students' will perform better in the post-test than in the pre-test.

II. LITERATURE REVIEW

According to Cowan (2022), the coordination of a number of cognitive processes, such as computational methods, conceptual knowledge, and working memory, results in the development of mathematical cognition in pupils. As a result, the relationships between various cognitive processes and the effects that a loss in one area has on the other regions and mathematical ability are probably best described in terms of impaired acquisition of mathematics skills and knowledge (Tinnell, 2022).

According to Lo & Andrews (2022), computational abilities are often measured by the precision and speed with which basic arithmetic problems are answered as well as by the approach taken in solving them: Students approach arithmetic issues in a variety of ways. The distribution of associative strengths between a problem and potential answers in memory determines the solution latency and accuracy, which in turn relies on whether the answer is promptly retrieved or solved using a longer, "backup" solution process (such as counting). In general, the chance of recovering an answer increases with a more distinct or "peaked" distribution of associative strengths is. Chouteau, Lemaire, Thevenot, Dewi, & Mazens, (2023). posits, that effective retrieval is dependent on the past successful usage of backup methods, and if a problem and an answer are only weakly related, children may need to do several retrieval attempts before they feel comfortable giving their response. The most effective method of retrieval is from long-term memory, and the development of multiplication abilities requires moving from employing ineffective backup options to main retrieval.

Consequently, according to Ozkale & Aprea (2023), contemporary trends in mathematics and technology are just starting to reflect this enlarged understanding of what it means to be mathematically literate. Every teacher has to be aware of the goals of successful mathematics curricula and the fact that mathematical literacy is no longer solely determined by computational prowess. The abilities deemed necessary for pursuing higher education opportunities include problem-solving, using mathematics in real-world contexts, being aware of the reasonableness of results, estimation and approximation, appropriate computational skills, geometry, measurement, reading, interpreting and creating tables, charts, and graphs, using mathematics to predict, computer literacy, and applying mathematics to everyday situations.

Mi, (2023), explains that Computational skills are defined as the ability to calculate basic addition, subtraction, multiplication, and division problems quickly and accurately using mental methods, paper-and-pencil, and other tools, such as a calculator. The computational skills/strategies include estimating, appropriate use of parenthesis, computational speed, correct use of a sequence of operations and approximation. All these skills are used in solving mathematical problems when using scientific calculators. Computations are complex physical activities which involve a number of processes such as problem representation and problem execution. The two main stages demand that pre-service teachers have computational skills to solve mathematical problems. Appropriate problem representation is the basis for understanding the problem, critical thinking, application, manipulating, classification, and making a plan to solve the problem. Problem execution is also based on the premise of application/implementation, critical thinking, decision-making, and evaluation. pre-service teachers who have difficulty representing mathematical problems will have difficulty executing the problem and solving them. Thus, Pre-service teachers either have not acquired problem representation strategies or do not know how to use them appropriately. Okyere, (2022). explained that calculators are effective aids when it comes to problem-solving, reinforcement of computational skills, pattern recognition, and number sense (Gizzi, 2022). They also help in teaching topics such as percentages and fractions, integers, perimeter, area, rates, taxes, and exponents.

Studies have also revealed that students struggle to solve problems, bringing about three types of errors in solving mathematics problems. These are factual, procedural, and computational errors (Kamberi, Latifi, Rexhepi, & Iseni, 2022; Seif, Cian, Zhou, Chen, & Jiang, 2023). Computational errors are errors that occur in the computational data, during a computation (Suzuki, Endo, Fujii, & Tokunaga, 2022). For example, the detection of a singular system during a factorization. For example, let $x=0.3333$ be an approximate number for the exact number 1/3 Obviously, if this is performed as an algebraic operation for the approximate number, the error will occur in the final result accordingly. There are three main sources of errors in numerical computation. These are rounding, data uncertainty, and truncation (Pokusiński, & Kamiński, 2023).

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In response to the fast development of technology globally and to also ensure that pre-service teachers' computational skills are improved, Ghana has developed and maintained a compulsory mathematics curriculum for all pre-service teachers in the first year of their course of study. According to Boye, & Agyei, (2023), the contents of the first-year curriculum course objectives indicate that pre-service teachers should demonstrate sound knowledge and understanding of the mathematics curriculum concepts and procedures on Numbers and Algebra; make relevant connections and discover relationships involving various concepts and use them to solve related problems; apply for numbers in daily lives and solve relevant number problems using ICT tools such as calculators and phones. In addition to that, it is expected that teachers learn how to integrate ICT into the Mathematics curriculum by using spreadsheets and calculators for calculations.

The mathematics curriculum is based on the premise that, all pre-service teachers can learn mathematics and that all need to learn mathematics and is therefore designed to meet expected standards of mathematics in many parts of the world (Oppong-Gyebi, Bonyah, & Clark, 2023). In response to the rationale, the mathematics curriculum pertaining to the instruction, acquisition, and implementation of Algebra was formulated with the objective of facilitating pre-service educators to proficiently engage with calculators and computers for resolving problems and undertaking empirical inquiries into practical scenarios. Furthermore, the curriculum aimed to enhance computational capabilities by instilling suitable techniques for carrying out mathematical operations, whilst also advocating the application of math in everyday life by facilitating an understanding of appropriate mathematical problem-solving strategies. The syllabus outlines general objectives with the aim of equipping pre-service teachers with the ability to employ effective strategies in performing numerical operations. It also seeks to develop their computational skills by utilizing appropriate techniques to carry out calculations, estimate values with precision, and work within contextual degrees of accuracy, while being able to respond verbally to queries related to mathematics. Additionally, the objectives seek to enhance their capacities to engage in discussions on mathematical concepts, perform mental computations, utilize calculators to foster greater comprehension of numerical computations, and effectively solve real-world problems.

Advocates of calculators claim that their usage allows aspiring teachers to focus more on understanding and solving complicated problems and spend less time on tedious mathematical computations, according to Bohara (2023). help pre-service teachers develop number sense, enable pre-service teachers to study mathematical concepts they could not attempt if they had to carry out the necessary calculations themselves, enable pre-service teachers who would typically be turned off from mathematics due to frustration or boredom, increase their mathematical understanding, and increase their confidence in their mathematical prowess. Studies carried out by a few people also demonstrate that considerate calculator use in mathematics classrooms enhances pre-service teachers' mathematical proficiency and attitudes (Davis, 2023). For instance, Irvine (2021) stated that the impact of using handheld calculators on pre-service teachers' attitudes and computational abilities is substantial in enhancing pre-service teachers' performance in mathematics.

According to Jumadi and Dwandaru (2023), using scientific calculators helps pupils develop their critical thinking skills. When math students use critical thinking, they reach well-informed conclusions about what to do and how to think. In other words, students do not just infer or apply rules without considering their significance; rather, they evaluate criteria and reasons for making informed judgments. The body of research demonstrates that there are several definitions of critical thinking. According to Ramdani, Susilo, Suhadi, and Sueb (2023), one of the key elements of success while using scientific calculators is critical thinking. To succeed in today's culture, according to Lombardi (2023) kids need to develop their ability to reason critically and think for themselves (Cooper, 2023). Understanding the objects and people around you is necessary for critical thinking. (Hwang, 2023). Maknun, (2023), defines critical thinking as the use of cognitive skills or strategies that increase the likelihood of a desired outcome. Critical thinking is the rational response to questions that cannot be answered definitively and all relevant information may not be available (Kloeg, 2023). By challenging and examining your own and other people's mental processes, being critical implies comprehending the objects and people around you (Hwang, 2023). Maknun (2023) describes critical thinking as the application of cognitive techniques or approaches that raise the probability of a desired result. The logical solution to problems that cannot be resolved conclusively or to which all pertinent information may not be available is critical thinking (Kloeg, 2023).

Davis (2023) stated that the influence of calculator use on pre-service teachers' learning has been a popular research topic in mathematics education and that numerous studies have consistently shown that thoughtful use of the scientific calculator in mathematics classes improves pre-service teachers' mathematical achievement and attitudes toward mathematics (Kosko, 2022). The usage of portable calculators, namely the comprehension of arithmetical ideas and problem-solving abilities of pre-service teachers, has been noted by Kosko (2022) as improving pre-service teachers' mathematics learning. The study's findings were followed by the assertion that, when used in accordance with a thoroughly thought-out strategy, calculators can enhance pre-service teachers' capacity for problem-solving and boost their emotional results without impairing their fundamental knowledge. In addition to imparting mathematical concepts, a calculator is a useful tool for exploration and discovery in problem-solving scenarios. In addition, it gives pre-service instructors quick feedback and directs them to concentrate on comprehending their work. In

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line with earlier studies (Davis, 2023; Kosko, 2022) the research's conclusions show that pre-service teachers who utilize calculators are more engaged in their education and attain higher levels of problem-solving proficiency. The following additional advantages using calculators for learning arithmetic may also exist: Concept development using calculators is possible. Exercises with calculators are possible.

From the above arguments, it must be pointed out that the essence of calculator technology in mathematics education was to solve mathematical problems. The scientific calculator has been developed to solve problems associated with human needs in more productive ways using computational skills. However pre-service teachers' inability to use the scientific calculator in solving mathematical problems was a result of pre-service teachers' inability to use their computational skills as my observation revealed that most of the pre-service teachers lacked the computational skills majority of them found it difficult to use the scientific calculator in performing complex computations and solving problems in the classroom. This observation made me conduct a pre-test to find out how many pre-service teachers had the scientific calculator and whether they possessed the needed computational skills to use the scientific calculators in solving mathematical problems.

A diagnostic test conducted to find out pre-service teachers' strengths and weaknesses in the use of the scientific calculator indicated that only a small percentage made good use of the scientific calculator. Of the few who had it and made good use of it in their way, it reflects positively on their results. Thus, the use of the scientific calculator can easily enhance pre-service teachers' ability to solve problems which will significantly enhance pre-service teachers' performance in mathematics. Some of the pre-service teachers who were interviewed were of the view that they used the calculator because it is user-friendly. Its usage saves time and reduces mental strain while others said that they had difficulties in operating the calculators since they had not been taught the functions of the various keys on the calculator making it difficult for them to use and hence affecting their performances in their examinations. There was, therefore, the need to find out the effect of scientific calculator usage on pre-service teachers' computational skills.

III. METHODOLOGY

A mixed-methods study design was employed by the researcher. According to Almalki (2016), mixed methods research is a type of study in which a researcher or team of researchers combines aspects of qualitative and quantitative research approaches (e.g., the use of qualitative and quantitative viewpoints, data collection, analysis, and inference techniques) for the general goal of gaining a broad and deep understanding as well as corroboration. To get a more complete view of the phenomenon, it is thought desirable to use a mixed-method design. In order to understand and characterize the situation, the research combined quantitative and qualitative techniques and provided a detailed examination of one or more events, locations, programs, social groupings, communities, people, or other bounded systems. The effectiveness of the scientific calculator in enhancing students' computing abilities and mathematical accomplishment was also investigated using observations, interviews, pre-tests, and post-tests.

➢ *Study population, Sampling and sampling technique*

The targeted population for the research was all preservice teachers in the Akuapem-North Municipality of the Eastern Region of Ghana. The responsibility of instructing the seven mathematics classes was given to math tutors. Non-probability sampling, in particular convenience and purposeful sampling, was employed in this investigation. Due to poor logistics, limited resources, and accessibility, convenience and purposeful sampling were used. Based on their availability and proximity to the researcher, one class was chosen. This kind of research typically uses non-random, small, convenient/purposeful sample (Clemmons, 2019). According to Etikan, Musa, and Alkassim (2016), a convenience sample is one in which a group of participants were chosen based on their availability. The researcher believes that the class that was selected was the best option for this study because it allowed the researcher to track students' development as they were being taught. As a result, the study's sample size was thirty (30) pre-service teachers, thirteen (13) of whom were men and seventeen (17) of whom were women. For the observations, interviews, pre-test, and post-test, they were assigned pseudonyms. The Casio fx-991MS scientific calculator, which made advantage of the existing technology, was utilized. This was selected since all pre-service instructors owned one and it has the necessary functionalities for the research.

➢ *Research Instruments*

The pre-test, post-test, interview, and observation were the instruments employed for data collection according to the nature of the study. In order to conduct the study, a semi-structured interview guide and a checklist for identifying computational mistakes were created. The benefit of a semi-structured interview is that the interviewer has control over how much information is gathered from the interviewee while also being allowed to explore any new avenues that present itself (Khan, 2023). The researcher encouraged the participants to express themselves freely throughout the interview sessions.

Item 1 in the interview guide had to do with how long students have been using the scientific calculator. Item 2 also had to do with pre-service teachers' rate of competence with the use of the scientific calculator. Item 3 was meant to find out the factors responsible for pre-service teachers' (low, average, above average, or high) performance in the use of the scientific calculator in studying mathematics. Item 4 in the interview guide was meant to find out how the use of the scientific calculator could improve pre-service teachers' computational skills in mathematics. Item 5 was also meant to find out whether the scientific calculator could improve pre-service teachers' computational skills in mathematics.

The Pre-test and the post-test questions were five in number. The checklist for determining computational errors, interview, pre-test and post-test questions were administered.

➢ *Administration of the Instruments and Intervention*

To find out how to improve pre-service teachers' computational skills and the use of scientific calculators, the researcher prepared a checklist for determining errors an interview guide, a pre-test and a post-test. The checklist for determining computational errors was used to observe the pre-service teachers' scripts as they were marked. The researcher afterwards conducted interviews with the pre-service teachers. Pre-service teachers were interviewed using five semi-structured interview questions. Reponses from the interview sessions were coded in the codebook and sorted using SPSS.

The pre-test was administered with the use of scientific calculators. Five (5) pre-test questions were written, typed and printed for the pre-service teachers. Pre-service teachers were given twenty-five minutes to answer the questions. The researcher and the other mathematics teachers invigilated the students after which the scripts were collected, marked and the scores recorded. The scores were grouped into three categories. The first category was for those who scored between 0 and 5 whiles those who scored between 5 and 15 were placed in the second category.

The intervention design was implemented after the pre-test was administered using a day-to-day activity. The following were the subtopics that were treated; Identification and uses of the first function keys; Identification and uses of the second function keys; using the scientific calculator to solve mathematical problems. Planned visits of six days of intervention were implemented after the pre-test. After the intervention, five (5) post-test questions were administered to the students to find out whether students' computational skills had improved using the scientific calculators. The researcher and other mathematics teachers invigilated the students after which the scripts were collected, marked and the scores recorded.

➢ *Rubrics for scoring student's pre-test and post-test*

The marks awarding system served the purpose of assigning the learners to various. Each correct answer to the five-item test was assigned 3 points. Hence, each student's score ranged from 0 – 15 marks. The percentage score was calculated for each student and question analysis of students' pre-test and post-test was done using SPSS paired t-test.

➢ *Data collection procedure*

Data was collected using both qualitative and quantitative methods such as the use of interviews, observation, pre-test and post-test. The interviews were conducted with pre-service teachers on the usage of scientific calculators and their effects. Using an interview guide, five interview questions were given. These included;

- the sort of errors that pre-service teachers committed when using the scientific calculators
- how pre-service teachers handled the scientific calculators
- how important it was for a pre-service teacher to use the scientific calculators
- whether pre-service teachers knew the use of the functions on the scientific calculators
- whether the scientific calculator can improve pre-service teachers' performance in mathematics

The responses of pre-service teachers were analysed under themes. The pre-service teachers were observed using a checklist as they used scientific calculators in answering the pre-test and post-test questions. The quantitative data was collected and analysed using SPSS paired t-test.

IV. RESULTS

The results of the analyses of the data. The data were organized and presented using tables, charts and descriptive statistics. The results were presented under the following themes:

- Pre-service teachers' computational errors in the use of the scientific calculators
- Impact of the scientific calculator usage on Pre-service teachers' performance

A. *Research Question 1*

➢ *Pre-service teachers' errors in the use of the scientific calculator*

The study was to examine how the use of the scientific calculator could improve the computational skills of Pre-service teachers. To accomplish this, Pre-service teachers were allowed to use their calculators in pre-test and post-test. When scoring the tests, data were obtained on errors the students made in doing calculations. Four common errors were identified: the sequence of operations, approximation, application of concepts and the appropriate use of parenthesis. students' errors in the use of scientific calculators.

- *Errors in the use of parenthesis*

Most of the students ignored the parenthesis instead of using the parenthesis which affected their answers.

- *Errors in the use of approximation*

Some of the students could not approximate their answers. They ignored the approximation which affected their answers. Instead of approximating their answers, some of the students left their answers the same way they got them.

- *Errors in the use of a sequence of operations*

Most of the students did not follow the sequence of operations which affected their answers. most of the students did not follow the sequence of operations which affected their answers.

- *Errors in the application of the concept*

Most of the students applied the wrong concept which affected their answers. Instead of finding the inverse of the trigonometric function, students just found the value of the trigonometry function. most of the pre-service teachers ignored the parenthesis instead of using the parenthesis which affected their answers. In addition to that, students should have found the value of the inverse of the trigonometric function, but rather they found the value of the trigonometry function.

The number of pre-service teachers who used the wrong computational skills for each of the five items in the Pre-test and Post-test is presented in Tables 1 and 2.

Table 1: Number of pre-service teachers who used the wrong computational skills for each item in the Pre-test and Post-test

Test Items	Parenthesis		Approximation		Operational Sequence		Concept Application		Total	
	N	%	N	%	N	%	N	%	N Total	% Total
Pre-test Item 1	15	50	8	27	5	17	2	7	30	26
Post-test Item 1	1	3	0	0	2	7	0	0	3	3
Pre-test Item 2	8	27	4	13	7	23	0	0	19	17
Post-test Item 2	2	7	0	0	0	0	0	0	2	2
Pre-test Item 3	7	23	0	0	8	27	1	3	16	14
Post-test Item 3	2	7	1	3	2	7	0	0	5	4
Pre-test Item 4	2	7	0	0	4	13	3	10	9	8
Post-test Item 4	2	7	0	0	3	10	2	7	7	6
Pre-test Item 5	12	40	0	0	4	13	0	0	16	14
Post-test Item 5	2	7	1	3	5	17	0	0	8	7
Total	53	46	14	12	40	35	8	7	115	100

From Table 1, pre-service teachers' most common errors committed were on parenthesis and Operational sequence. Only a few errors were committed in approximation and concept application by the pre-service teachers. The majority of the pre-service teachers had difficulty in the pre-test but did better in the post-test.

Table 2. Number of pre-service teachers who used the wrong computational skills for each item in the Pre-test and Post-test

Test Items	Pre-test		Post-test	
	N	%	N	%
Item 1	30	33	3	12
Item 2	19	21	2	8
Item 3	16	18	5	20
Item 4	9	10	7	28
Item 5	16	18	8	32
Total	90	100	25	100

From Table 2, further analysis indicates that pre-service teachers' total errors in both the pre-test and post-test were 115. Out of this number of errors, pre-service teachers committed more errors in the pre-test than in the post-test. In the pre-test, the total errors were ninety (90) with parenthesis and operational sequence having the highest number whilst approximation and concept application were at the minimum. Table 2 again indicates in the pre-test that pre-service teachers' most common errors were on items 1, 2, 3 and 5 with errors on item 4 being at the minimum.

In the post-test, the total errors were twenty-five (25) with parenthesis and operational sequence having the highest number whilst approximation and concept application were again at the minimum. Table 2 again indicates in the post-test that students' most common errors were on items 3, 4 and 5. From the errors made in the pre-test and post-test in Table 2, pre-service teachers' difficulties were reduced immensely after they were taken through the intervention. Pre-service teachers however attributed the number of errors to their poor competence with the use of the scientific calculator in solving mathematical problems.

B. Research Question 2

➢ *Impact of the scientific calculator usage on Pre-service teacher's Mathematics Performance*

The study was to find out the impact of the scientific calculator on preservice teachers' performance in mathematics. In order to accomplish this, the pre-service teachers were allowed to use their calculators in two tests (i.e. pre-test and the post-test) as described in the previous chapter. The results showing the descriptive statistics of students' overall performance on the tests are presented in Tables 3 and 4. Table 3 indicates that there was a difference in pre-test and post-test scores concerning the minimum, maximum, mean and standard deviation with the latter better than the former (i.e. with pre-test mean and SD 3.90 and 2.05 and post-test mean and SD 6.40 and 2.67).

Table 3. Descriptive statistics on pre-service teachers' pre-test and post-test scores

	N	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
Pre-service teacher's pre-test	30	3.9	2.057	0	9
Pre-service teacher's post-test	30	6.4	2.673	1	11

To determine if the mean differences were statistically significant, further analysis was done. The results of the t-test showed that the difference in means was significant at p=0.00 (29df, t = 6.335). As a result, the alternative hypothesis is accepted and the null hypothesis—that there is no discernible difference between pre-service teachers' pre-test and post-test—is rejected. Additionally, it may be claimed that there was a statistically significant difference between the post-test and pre-test because the student's post-test result (M = 6.40, SD = 2.673.) was greater than their pre-test result (M = 3.90, SD = 2.057). It can therefore be claimed that the post-test and pre-test showed a statistically significant difference.

According to the study of the data in Table 4, the general performance of pre-service instructors was higher in the post-test than it was in the pre-test.

Table 4: Overall pre-service teachers' performance in the pre-tests and post-test

Marks	**Pre-test results**		**Post-test results**	
	N	%	N	%
0 - 5	25	83	10	33
6 - 15	5	17	20	67

Pre-service teachers performed poorly on the pre-test, with the majority scoring below a 5. The post-test results also showed that pre-service teachers performed admirably because the majority of them scored higher than 6. In comparison, pre-service instructors performed much better on the post-test than did students on the pre-test.

C. Discussion on the Impact of pre-service teachers' Performance in the Pre-test and Post-test

To find out why pre-service teachers committed so many computational errors in the pre-test, an interview was conducted with some of the students. The interview responses from the interview revealed that most of the pre-service teachers first used the scientific calculator when they were in SHS 1 while a small percentage explained that they were introduced to its use when they were in JHS 3. The majority of the pre-service teachers rated their competence with the use of the scientific calculator in solving mathematical problems as a very low rate while few of them admitted their performances as average.

Pre-service teachers attributed the factors responsible for their poor performance in the use of the scientific calculator to the fact that the pre-service teachers were either not taught or were just introduced to the use of the scientific calculator as such their performance.

As to whether the scientific calculator could improve pre-service teachers' computational skills, the number of pre-service teachers who responded that the scientific calculator could improve their computational skills was far greater than the number of students who responded that the scientific calculator could not improve their computational skills and those who gave no response to the question. However, most of the pre-service teachers testified that the most beneficial and appropriate tool for studying mathematics in the classroom and for writing examinations was the scientific calculator. In addition to that, the pre-service teachers also stated that their computational skills could improve drastically when they are taught how to use scientific calculators in solving mathematical problems.

For instance, Pre-service teacher P said "*I think if mathematics tools such as the scientific calculator are used effectively and efficiently it will develop our computational skills and help us to solve more mathematical problems.*

Pre-service teacher Q was also of the view that *"computational skills help us in using the calculator to check the correct answer which reduces the computational time".*

Pre-service teacher R also explained that "*if our teachers will make some time and teach us how the scientific calculators can be used to the maximum, then we can use it in*

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our examinations and not have problems in using this effective tool".

Pre-service teacher *S also stated that if the scientific calculators can constantly be used, it will bring maximum benefit to (us) students which will improve our performance in Mathematics*".

D. Discussion of Findings

According to the study, operational sequencing, approximation, and concept application were the pre-service instructors' most frequent mistakes in the pre-test, followed by parenthesis. However, after going through the intervention, writing the post-test, and having their scripts marked, the pre-service teachers' problems significantly decreased. This demonstrated that a larger percentage of pre-service teachers had computational skills that had improved in the post-test than they had in the pre-test.

After the post-test was graded, pre-service teachers' performance significantly improved, according to the examination of the scientific calculator's effects on their computing abilities. The general performance of pre-service instructors suggested that their pre-test performance was subpar. The performance of the pre-service teachers was quite strong, according to the post-test findings. Comparatively, pre-service instructors performed much worse on the pre-test than students did on the post-test, which resulted in a significant improvement on the pre-test.

Analysis from the descriptive statistics also showed a substantial performance difference between pre-service teachers' pre-test results (M=3.90, SD=2.057) and their post-test results (M=6.40, SD=2.673), favouring the post-test results. This outcome validates the study's conclusions. Calculators are useful tools for problem-solving, practising computational skills, seeing patterns, and developing number sense, according to Davis (2023).

The finding from this study supports prior research by Mereku (2023). As well as the acquisition of broad factual and procedural information, the TIMSS-2003 found that the learners who took part in it placed a major priority on the application of knowledge. It can be argued that the subpar academic performance shown by trainee teachers in Ghana is primarily caused by a lack of alignment between the modern globalized trends in school mathematics and the emphasis on mathematics didactics in Ghanaian instructional policies. (Poku, 2019; Sie & Agyei, 2023).

V. CONCLUSION

The researchers concluded by noting that exponents, rates, taxes, and other mathematical concepts like percentages and fractions, integers, perimeter, and the area may all be taught using scientific calculators. Students' comprehension of mathematical concepts and their computing abilities were shown to have improved in particular. Comparatively to their colleagues who did not use calculators, pre-service instructors who did have better attitudes toward mathematics and much higher self-concepts in the subject. Calculators were included in mathematics education without affecting the pre-service teachers' capacity for doing computations using paper and pencil. The researchers concluded by noting that exponents, rates, taxes, and other mathematical concepts like percentages and fractions, integers, perimeter, and the area may all be taught using scientific calculators. Students' comprehension of mathematical concepts and their computing abilities were shown to have improved in particular. Comparatively to their colleagues who did not use calculators, pre-service instructors who did have better attitudes toward mathematics and much higher self-concepts in the subject. Calculators were included in mathematics education without affecting the pre-service teachers' capacity for doing computations using paper and pencil.

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