



Mathematical Problem Solving Skills as Correlates of Pre-Service NCE Mathematics Teachers' Performance in South-East, Nigeria

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Abstract

The trend of poor performance of Pre-service NCE Mathematics teachers could be as a result of their level of mathematical problem-solving skills. The purpose of the study was to ascertain mathematical problem-solving skills as correlates of Pre-service NCE Mathematics Teachers' Performance in South-East, Nigeria. Three research questions guided the study while three hypotheses were tested at 0.05 level of significance. Correlation research design was used for the study. The population of the study was 197 pre-service NCE Mathematics teachers in South-East, Nigeria. All the population of 197 was studied as sample because, it is small and manageable. Mathematics Problem-Solving Skill Scale (MPSSS) was used an instrument for data collection. MPSSS was validated by three experts, two in the Departments of Science Education and Educational Foundations from Nnamdi Azikiwe University, Awka and the other in the Department of Mathematics Federal College of Education Technical, Asaba, Delta State. The reliability of MPSSS was tested using Cronbach Alpha method and coefficient value of 0.82 respectively was obtained which was considered high enough to confirm the instrument as reliable. Data was analyzed using Pearson product moment correlation coefficients. The findings revealed that a high positive and significant relationship existed between mathematical problem-solving skills scores and academic performance scores of pre-service NCE mathematics teachers. It was recommended that pre-service NCE mathematics teachers should sustain their acquisition of mathematical problem-solving skills across gender. This is with a view to improving their academic performance in Mathematics.

Key words: Problem-solving skills, Pre-service Mathematics Teachers, Performance

Introduction

Mathematics: a dread enemy, yet an indispensable friend kenneled as an essential precursor to success in modern society. Its usefulness in science and technological activities as well as commerce, economics, education and even humanities is almost at par with the importance of education as a whole. In Nigeria, as in most countries, mathematics occupies a crucial place in the basic school, senior school and tertiary school which include College of Education as well curricula. Mathematics is a compulsory subject for every learner at these levels; especially those in

science based disciplines. Thus, mathematics is a gate-keeper and critical concept for further studies in the country, Nigeria (Okigbo & Ayegbusi, 2024).

According to Olatoye, 2019, mathematics is the science of space, time, capacity, amount, shapes, numbers and association with each other. Contributing to the benefit of mathematics, Charu (2018) opined that mathematics is the foundation of any meaningful scientific endeavor and any nation that needs development in education, science and technology should equip her youths with strong mathematical

knowledge. Mathematics Education programme is run at colleges of education to enable pre-service teachers to develop skills, learn the teaching methods and discharge confidence in the teaching and learning of mathematics. Furthermore, the programme offers pre-service teachers of mathematics the opportunity to be trained as teachers through direct interaction with the learning materials, like mathematical board, games and the school environment.

Pre-service Nigeria Certificate in Education (NCE) Mathematics teachers are students trained in Colleges of Education with the aim of producing trained NCE teachers to become professional Mathematics teachers. They are students enrolled in an initial teacher training school programme, studying to become professional practicing Mathematics teachers. They complete supervised field-based teaching experiences with the support and mentorship of College department and cooperating teachers. They are expected to work in basic education sector one to nine (Basic 1-9) on graduation, where they teach all school subjects most of the time. During this period, the Pre-service NCE Mathematics teachers engage in problem solving in Mathematics in their various schools of teaching practice, as problem solving is an important component of mathematics education. This is because, problem solving has a way of testing one's ability of converting words to numbers or numbers to words. This is otherwise known as mathematical modeling.

According to Jagals and Van der Walt, 2016, mathematics problem-solving skill refers to the use of cognitive skills and high-level of understanding to solve invisible, non-routine problems in a meaningful way. Mathematical problem-solving skills are related to the student's ability to understand verbal sentences in problems, convert them into mathematical models, make calculation plans from mathematical models, and use numeracy skills to solve non-routine problems (Azizah, 2014). However, many skills such as identification, problem definition, equation have to be learnt for one to acquire and be able to use problem solving skills generally. Problem-solving is one of the skills that students must develop to meet the digital era in addition to critical thinking skills, creativity, innovation, communication and collaboration in mathematics. This approach will serve the purpose of gaining cognitive ability of pre-service NCE mathematics teachers in mathematical problems through analysis, problem-solving steps and the use of some procedures to achieve expected results.

Possessing a great skill to solve mathematical problems will provide pre-service NCE mathematics teachers with improved learning experience (Okigbo & Ayegbusi, 2024).

It is the focus of the school's mathematics curriculum which in the learning process is expected to gain the experience to transfer and apply learned knowledge and skills to solve problems in mathematics. Regarding to that problem, skilled people solve problems to survive and to face the various issues in their life. Mathematics problem solving has long been seen as an important aspect of mathematics, the teaching of mathematics and the learning of mathematics. Problem solving has suffused mathematics curricula around the world with calls for the teaching of problem solving skills (Permata, Kusmayadi and Fitriana, 2018). Problem-solving skills can be enhanced upon through the adoption of the following strategies: analogy, guess-check revised, problem reformulation, solution drawing, systematic experimentation, way back and use of graphs of functions (Novotná, et al., 2012). The acquisition of problem-solving skills among pre-service NCE mathematics teachers given that mathematics as a course requires learners to think critically, systematically and reflectively and requires vigilant, detailed and earnest effort has become expedient (Hutauruk et al., 2019). The process of teaching and learning mathematics by the pre-service NCE mathematics teachers will be meaningless and fruitless if they lack the skills required to solve the problems that help in their academics performance.

According to Marcela and Lucia, 2017, academic performance is an indication of the level of personal and educational goals a student has achieved at school. It is the amount of knowledge gotten from learning. Academic performance depends on a number of factors like students' attitudes, interests, personality characteristics and social class in addition to learning. In a narrow point of view, academic performance is the outcome of education as it indicates the extent to which the student, teacher, curricular and indeed the educational institution has achieved the predetermined educational goals in mathematics learning (Soheila, 2020). It is pertinent to say that the academic performance of pre-service National Certificate in Education (NCE) Mathematics teachers is vital given the role of mathematics in national development.

In spite of the vital role of Mathematics in national development, the performance of pre-service

NCE mathematics in Mathematics course in colleges of education has been consistently unsatisfactory in South-East, Nigeria. For instance, as observed by the researcher in Federal College of Education, Umunze and AlvanIkoku College of Education, the performance of candidates in their second year MAT 212 (Problem solving) examination as released by the course lecturers from 2023 to 2025 revealed that 52.94%, 54.77% and 46.00% of the candidates that sat for the examination in Mathematics did not have credit passes in the course. The afore-mentioned statistics is further confirmed by the researchers' observation in Colleges of Education in South-East, Nigeria that Pre-service NCE Mathematics teachers find it difficult to solve word problems presented in a paragraph unlike when it is presented in a direct equation. Corroborating with this observation, Swanson, Orosco and Lussier (2014) stated that it is easier for students to solve problems presented in numbers or a certain equation than those in word format in mathematics. Additionally, Gabina, Assan-Donkoh, Puotier and Wiafe (2020) observed that students' errors in algebra have been associated with poor performance in Mathematics. The trend of poor performance in Mathematics has continued despite concerted efforts by government, Mathematics lecturers and other relevant stakeholders in improving students' academic performance in Mathematics in Nigeria. However, the academic performance of pre-service NCE mathematics teachers could differ along gender dimensions.

Gender personify the biological or social quality of being male or female. Gender differences in students' performance in mathematics have become key global issues of concern among researchers and educators. This may not be separated from the inconsistencies in findings of some researchers regarding gender and students' performance in mathematics. For instance, in the study conducted by Bala and Shaafiu (2016), it was found that there was no significant relationship between male and female students' academic achievement and their problem solving ability. On the other hand, Adewumi and Akinodi (2016) in their study found that performance of students taught using problem-solving strategy is not in any manner affected by their gender while Allahnana, et al. (2018) found that male students excel in mathematics performance more than their female counterparts in their study. Apparently, mathematics problem-solving skills is associated to pre-service Mathematics teachers' academic performance in

Mathematics. Based on the foregoing, study set out to investigate on the mathematical problem solving skills as correlates of Pre-service NCE Mathematics Teachers' performance in South-East, Nigeria. However, the trend of poor performance of Pre-service NCE Mathematics teachers could be as a result of the level of mathematical problem solving skills of the NCE pre-service teachers. The problem is "what is the relationship between Mathematical problem solving skills and performance of pre-service NCE mathematics teachers? Consequently, there is need to empirically investigate the relationship that exists between the pre-service NCE mathematics teachers mathematical problem solving skills and their academic performance in South-East, Nigeria.

Purpose of the Study

The purpose of this study was to determine mathematical problem solving skills as correlates of Pre-service NCE Mathematics Teachers' Performance in South-East, Nigeria. Specifically, the study aimed at determining:

1. The nature of relationship existing between mathematical problem-solving skills and academic performance of pre-service NCE mathematics teachers in South-East, Nigeria.
2. The nature of relationship existing between mathematical problem-solving skills and academic performance of male pre-service NCE mathematics teachers in South-East, Nigeria.
3. The nature of relationship existing between mathematical problem-solving skills and academic performance of female pre-service NCE mathematics teachers in South-East, Nigeria.

Research Questions

The study was guided by the following research questions

1. What is the nature of relationship existing between mathematical problem solving skills scores and academic performance scores of pre-service NCE mathematics teachers in South-East, Nigeria?
2. What is the nature of relationship existing between mathematical problem solving skills scores and academic performance scores of male pre-service NCE mathematics teachers in South-East, Nigeria?

3. What is the nature of relationship existing between mathematical problem solving skills scores and academic performance scores of female pre-service NCE mathematics teachers in South-East, Nigeria?

Research Hypotheses

The following research hypotheses were tested at 0.05 level of significance:

1. There is no significant relationship existing between mathematical problem solving skills scores and academic performance scores of pre-service NCE mathematics teachers in South-East, Nigeria.
2. There is no significant relationship existing between mathematical problem solving skills scores and academic performance scores of male pre-service NCE mathematics teachers in South-East, Nigeria.
3. There is no significant relationship existing between mathematical problem solving skills scores and academic performance scores of female pre-service NCE mathematics teachers in South-East, Nigeria.

Methods

Correlation research design was adopted for the study. Correlation research design seeks to establish the existing relationship between two or more variables. It focuses on the determination of the extent, direction and magnitude of relationship between two or more variables Nworgu (2015). The appropriateness of correlation research design to the current study stemmed from the fact that the researcher sought to determine the relationship between one independent and one dependent variable. Problem-solving skills being the independent variables while academic performance in mathematics is the dependent variable. The study was carried out in South-east geopolitical zone of Nigeria. South East is one of the six geo-political zones in Nigeria. It is constituted by six states *visa viz*: Abia, Anambra, Ebonyi, Enugu and Imo States. The population of the study consisted of 197 NCE 2 and 3 (90 males and 107 females) students for the 2024/25 session in both State and Federal Colleges of Education in South-East, Nigeria in the 8 Colleges of Education (3 Federal and 5 State) namely Federal College of Education (Tech) Umunze (Male = 5; F = 7), Nwafor Orizu College of Education Nsugbe (Male = 19; Female = 14), AlvanIkoku Federal College of Education Owerri

(Male = 31, Female = 43), Federal College of Education, Eha-Amufu (Male = 7, Female = 9), Ebonyi State College of Education (Male = 7, Female = 3), Enugu State College of Education (Tech), Enugu (Male = 8, Female = 18), College of Education Arochukwu, Abia State (Male = 5, Female = 5), Imo State College of Education, Ihitte-Uboma (Male = 8, Female = 8). There was no sampling, this is because, the population is of manageable size for the study since it covers the whole of the South-East. Instruments that was employed for data collection was one set of questionnaire. The questionnaire was captioned 'Mathematics Problem-Solving Skill Scale (MPSSS)'. MPSSS was adapted by the researcher from Problem-solving performance and skills instrument by Pentang *et al.* (2021). It contains 49 items which was reduced to 40 after validation and which has respondents responded by opting for one of four response categories *viz*: strongly agree, agree, disagree and strongly disagree. For the academic performance of the pre-service teachers, it is an already existing data that were drawn from documents containing NCE 2 and NCE 3 of the pre-service teachers in Mathematics examinations. Specifically, the 2024/25 academic session results were taken into cognizance. Drafts of the MPSSS was given alongside the purpose of the study, research questions and hypotheses to three experts; one in the Department of Science Education, one in the Department of Educational Foundations (Measurement and Evaluation) from Nnamdi Azikiwe University, Awka and the other in the Department of Mathematics Federal College of Education Technical, Asaba, Delta state. These experts validated the instruments to ensure that relevant items were included in the final draft of the MPSSS. Reliability of MPSSS was tested using Cronbach alpha method. This was carried out via by administering the MPSSS to a group of 30 NCE 2 and NCE 3 students of College of Education in Delta State with similar characteristics which is outside the area of the current study. The choice of Cronbach statistics was informed by the fact that the items in the MPSST were internally consistent. The alpha coefficient values obtained for MPSSS was .82 respectively. This value was considered adequate and reliable as it fell in line with the stipulation of Nworgu (2015) that an instrument is deemed reliable and excellent when its reliability co-efficient is above .80 for quantitative research. Data were collected by the researcher alongside eight research assistants who were the course lecturers in the Colleges of Education

under consideration. The justification for the use of their course lecturers was for ease of administration. The course lecturers ensured the administration of the MPSSS before the commencement of semester examination in the course. Conscious efforts were made by the researcher towards ensuring that same code was used by each student for MPSSS. On-the-spot delivery approach was used by the researcher to ensure that 197 copies of MPSSS were administered with utmost precision and efficiency through the help

of the research assistants and retrieval facilitated immediately. The research questions were answered using Pearson product moment correlation coefficients. The hypotheses were tested with t-test of correlation at 0.05 alpha levels. In taking decisions with respect to the hypotheses, a null hypothesis was rejected if the probability value (p-value) was less than or equal to significant value of 0.05; if otherwise ($p > 0.05$), the null hypothesis was accepted.

Results

Research Question 1: What is the nature of relationship existing between mathematical problem solving skills scores and academic performance scores of pre-service NCE mathematics teachers in South-East, Nigeria?

Table 1: Pearson r on Relationship between Mathematical Problem Solving Skills and Academic Performance of Pre-Service NCE Mathematics Teachers.

Source of Variation	N	df	R	Remark
Mathematical Problem-Solving Skills	197	195	0.814	High Positive Relationship
Academic Performance				

Data in Table 1 show that there is a high positive relationship existing between mathematical problem solving skills scores and academic performance scores of pre-service NCE mathematics

teachers in South-East, Nigeria. This is evident by the size of Pearson's Correlation Coefficient r , which is 0.814.

Hypothesis One: There is no significant relationship existing between mathematical problem solving skills scores and academic performance scores of pre-service NCE mathematics teachers in South-East, Nigeria.

Table 2: Test of Significance of Pearson Correlation between Mathematical Problem Solving Skills scores and Academic Performance scores of Pre-Service NCE Mathematics Teachers.

Source of Variation	N	df	t-cal.	p-value	Remark
Mathematical Problem-Solving Skills	197	195	2.31	$p < .001$	Sig
Academic Performance					

Table 2 shows that there is a significant relationship between mathematical problem solving skills scores and academic performance scores of pre-

service NCE mathematics teachers in South-East, Nigeria. The t-cal. (2.31) has P -value < 0.05 . The null hypothesis one was therefore rejected.

Research Question 2: What is the nature of relationship existing between mathematical problem solving skills scores and academic performance scores of male pre-service NCE mathematics teachers in South-East, Nigeria?

Table 3: Pearson r on Relationship between Mathematical Problem Solving Skills and Academic Performance of Male Pre-Service NCE Mathematics Teachers.

Source of Variation	N	df	R	Remark
Mathematical Problem-Solving Skills	90	88	0.806	High Positive Relationship
Academic Performance				

Data in Table 3 show that there is a high positive relationship existing between mathematical problem solving skills scores and academic performance scores of male pre-service NCE

mathematics teachers in South-East, Nigeria. This is evident by the size of Pearson's Correlation Coefficient r , which is 0.806.

Hypothesis Two: There is no significant relationship existing between mathematical problem solving skills scores and academic performance scores of male pre-service NCE mathematics teachers in South-East, Nigeria.

Table 4: Test of Significance of Pearson Correlation between Mathematical Problem Solving Skills and Academic Performance of Male Pre-Service NCE Mathematics Teachers.

Source of Variation	N	df	t-cal.	p-value	Remark
Mathematical Problem-Solving Skills	90	88	2.01	0.03	Sig
Academic Performance					

Table 4 shows that there is a significant relationship between mathematical problem-solving skills scores and academic performance scores of male

pre-service NCE mathematics teachers in South-East, Nigeria. The t-cal. (2.01) has P -value <0.05 . The null hypothesis two was therefore rejected.

Research Question 3: What is the nature of relationship existing between mathematical problem solving skills scores and academic performance scores of female pre-service NCE mathematics teachers in South-East, Nigeria?

Table 5: Pearson r on Relationship between Mathematical Problem Solving Skills and Academic Performance of Female Pre-Service NCE Mathematics Teachers.

Source of Variation	N	df	r	Remark
Mathematical Problem-Solving Skills	107	105	0.798	High Positive Relationship
Academic Performance				

Data in Table 5 show that there is a moderate positive relationship existing between mathematical problem solving skills scores and academic performance scores of female pre-service NCE

mathematics teachers in South-East, Nigeria. This is evident by the size of Pearson's Correlation Coefficient r , which is 0.798.

Hypothesis Three: There is no significant relationship existing between mathematical problem solving skills scores and academic performance scores of female pre-service NCE mathematics teachers in South-East, Nigeria.

Table 6: Test of Significance of Pearson Correlation between Mathematical Problem Solving Skills Scores and Academic Performance Scores of Female Pre-Service NCE Mathematics Teachers.

Source of Variation	N	df	t-cal.	p-value	Remark
Mathematical Problem-Solving Skills	107	105	2.35	$P<.001$	Sig
Academic Performance					

Table 6 shows that there is a significant relationship between mathematical problem solving skills scores and academic performance scores of female pre-service NCE mathematics teachers in South-East, Nigeria. The t-cal (2.35) has P -value <0.05 . The null hypothesis three was therefore rejected.

Discussion

The findings of the study revealed that a high positive and significant relationship existed between mathematical problem-solving skills scores and academic performance scores of pre-service NCE mathematics teachers in South-East, Nigeria. This may be as a result of the fact that mathematical problem-solving skills aids in the understanding and

retention of many concepts in Mathematics. Undoubtedly, any pre-service teacher who has acquired mathematical problem-solving skills is bound to be performing well in many areas in Mathematics. Apparently, problem-solving approach has a way of enriching pre-service prospective elementary mathematics teachers' knowledge of Mathematics and equipping them for instructional delivery. Thus, performance in the subject can best be enhanced with the acquisition of mathematical problem-solving skills and its application to solving mathematics problems.

Conclusion

Based on the findings of the study, it was concluded that a high positive relationship existed between mathematical problem-solving skills scores and academic performance scores of pre-service NCE mathematics teachers. Finally, the study concluded that pre-service NCE mathematics teachers' mathematical problem-solving skills significantly associated with their academic achievement in Mathematics.

Recommendation

In view of the discussion and conclusion of the study, it was recommended that: Pre-service NCE mathematics teachers should sustain their acquisition of mathematical problem-solving skills across gender. This is with a view to improving their academic performance in Mathematics.

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