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Analysis of Topics Perceived Difficult by Pre-service Mathematics Teachers and Lecturers in Colleges of Education in Niger State, Nigeria

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Abstract

This study was conducted to investigate the topics perceived as difficult by pre-service mathematics teachers and Mathematics lecturers in Colleges of Education in Niger State, Nigeria. One Hundred and seven (107) 300 level Pre-service Mathematics Teachers and Seventeen (17) Lecturers were purposively selected from two (2) Colleges of Education in Niger State, Nigeria. A twenty-three items questionnaire named Mathematics Topic Analysis Questionnaire (MTAQ) with two sections was administered to respondents (Pre-service Mathematics Teachers and Mathematics Lecturers). The questionnaire was validated by experts, and its internal consistency was assessed using Cronbach's Alpha, which yielded a reliability coefficient of 0.87. Data analysis was done using Mean and Standard deviation and independent sample t-test. A criterion means of 2.5 was set as the basis for judgment. A mean score of 2.5 and above indicated an easy topic, while less than 2.5 indicated a difficult topic. Findings revealed that Pre-service Mathematics teachers perceived 9 topics as difficult to comprehend while 3 topics were perceived as difficult to teach by Mathematics lecturers. The study also showed that Pre-service Mathematics teachers' gender has no significant influence on their perception of difficult topics in mathematics. It was therefore recommended that students should be encouraged and motivated to learn mathematics, curriculum developers should develop instructions that would improve students' knowledge by laying more emphasis on the perceived difficulty areas in mathematics and further studies should be conducted to find out the factors responsible for the perceived difficulty and also if there is a relationship between perception and students' achievement.

Keywords: Analysis, lecturers, mathematics education, perceived difficulty, Pre-service teachers, topics

1. Introduction

The role Mathematics education plays in the advancement of any society cannot be overemphasised as it equips individuals with the essential skills and

knowledge for effective problem-solving and critical thinking. Amerstorfer and Freiin von Münster-Kistner (2021), Du Plessis (2020), Schut, van Tartwijk, Driessen, van der Vleuten and Heeneman (2020) emphasize in their

various studies the critical role that mathematics plays, leading to its inclusion among the courses studied in higher education. However, there is a growing concern over the quality of mathematics education in these institutions, with many students and lecturers identifying certain topics as particularly challenging (Andras, 2022; Gillaspay & Vasilica, 2021; Pelsner, 2023).

In a bit to ameliorate the challenges identified, The Federal Government of Nigeria has taken steps to improve the teaching and learning of mathematics by reviewing the curriculum, training teachers, providing resources, promoting STEM education, and collaborating with international partners (Ogar & Opoh, 2015). All these efforts are aimed at making mathematics more accessible and less challenging for students; however, the problem persists. It is on this note that Adegun and Adegun (2013), and Bichi, Ibrahim and Ibrahim (2018) emphasized that the integration of theory and practical aspects of science and mathematics education is essential for any development across all fields of study.

Given the above, studies Bringula, Reguyal, Tan and Ulfa (2021), Musengimana Kampire and Ntawiha (2021), Mehta, Miletich and Detyana, (2021) have shown that the perceived difficulty of mathematics topics is influenced by factors such as teaching methods, curriculum content, and individual differences among learners. For instance, Adeyemi (2016) Awofala, Akinoso, Adeniyi, Jega, Fatade, and Arigbabu (2024), and Bryant (2023) found that pre-service mathematics teachers often struggle with calculus and geometry due to a lack of understanding of the underlying concepts. Similarly, Okoro (2018) reported that lecturers in Colleges of Education identified abstract algebra as a

challenging topic to teach due to its abstract nature.

Studies on Students' and Teachers' Views of Difficult Areas in Mathematics, such as those conducted by Mutodi and Ngirande (2014), Farooq and Shah (2008), and Adegun and Adegun (2013), have shown that both teachers and students perceive similar topics (Abstract algebra) as difficult across educational levels. For example, Adegun and Adegun (2013) found that secondary school teachers and students in Ogbomosho South, Oyo, Nigeria, shared the same views on difficult areas in teaching and learning mathematics.

In another related development Hassan (2019) in his studies on Pre-service Mathematics Teachers stressed that Pre-service Mathematics Teacher needs to be grounded in the singular fact that at the secondary school level, where they (pre-service mathematics teachers) are expected to practice and impart the knowledge and skills acquired during training, topics, which are often perceived as difficult, constitute a significant portion of the mathematics curriculum. These topics serve as a foundation for understanding advanced branches of mathematics and constitute a substantial section of the mathematics curriculum for all students in Nigerian secondary schools.

Regarding gender, the study by Farooq and Shah (2008) reported that "almost all literature on this topic points to the commonly held perception that doing mathematics is consistent with a male self-image and inconsistent with a female self-image." This self-image is often influenced by peer pressure. Males tend to be more inclined toward mathematics than females, viewing it as a male-dominated field. At the secondary school level, many girls do not

actively participate in mathematics classes due to their poor perceptions of the subject, which are negatively influenced by sex-role stereotypes.

In a related study by Farooq and Shah (2008) that assessed students' attitudes toward mathematics, high school students of both genders were used as the study population. A sample of 685 students (379 males and 306 females) from 10th grade was conveniently selected from 10 private and public sector schools in Pakistan. A questionnaire ($\alpha = 0.7452$) was used to examine the attitudes of male and female students toward mathematics at the secondary school level. Descriptive statistics and a t-test with a significance level of $P < 0.05$ were used for data analysis. The findings showed that male and female 10th-grade students from secondary schools in Lahore had similar attitudes toward mathematics, indicating that gender differences have no impact on students' attitudes toward mathematics in Pakistan.

To address these challenges and enhance strategies for promoting understanding and participation in mathematics-related fields, it is essential to analyze difficult topics perceived by pre-service mathematics teachers and lecturers in Colleges of Education in Niger State, Nigeria. Understanding how pre-service mathematics teachers perceive mathematics will provide valuable insights into how mathematics should be presented in the classroom and ultimately improve mathematics education in Nigeria.

2. Objectives of the study

The main objective of this study is to analyze topics Perceived Difficult by Pre-service Mathematics Teachers and Mathematics Lecturers in Colleges of Education in Niger

State, Nigeria. In particular, the stated objectives are to:

1. Analyse and identify topics Perceived Difficult to learn by Pre-service Mathematics Teachers in colleges of Education in Niger State.
2. Analyse and identify topics Perceived Difficult to teach by Mathematics Lecturers in colleges of Education in Niger State.
3. To find out whether gender differences existed in the Pre-service Mathematics Teachers' perception of difficult topics in mathematics at Colleges of Education.

3. Research Questions:

1. What topics in colleges of Education in Niger State do Pre-service Mathematics Teachers Perceived Difficult to learn?
2. What topics in colleges of Education in Niger State do Mathematics Lecturers Perceived Difficult to teach?
3. Is there any gender difference in Pre-service Mathematics Teachers' perception of difficult topics in mathematics at Colleges of Education?

4. Research Hypothesis

The following hypothesis was formulated and tested for the study

H₀: There is no significant gender difference in Pre-service Mathematics Teachers' perception of difficult topics in mathematics at Colleges of Education.

5. Research Methodology

The study utilized a descriptive cross-sectional survey research design, which is suitable for describing the findings of a

studied population (Mutudi, Nehemia & Iyamu, 2020). The targeted population consisted of One Hundred and seven (107) 300 level Pre-service Mathematics Teachers and Seventeen (17) Mathematics Lecturers from the two (2) Colleges of Education in Niger State: Niger State College of Education Minna and Federal College of Education Kontagora. Purposive sampling was used to select the sample. A twenty-three items questionnaire named Mathematics Topic Analysis Questionnaire (MTAQ) with two sections was administered to gather information from respondents (Pre-service Mathematics Teachers and Mathematics Lecturers). The questionnaire was validated by experts, and its internal consistency was

assessed using Cronbach's Alpha, which yielded a reliability coefficient of 0.87. Data analysis was done using Mean and Standard deviation and independent sample t-test. A criterion means of 2.5 was used as a basis for judgement, a mean score of 2.5 and above indicated an easy topic, while less than 2.5 indicated a difficult topic.

6. Data Analysis and Results

6.1 Research Question 1: What topics in colleges of Education in Niger State do Pre-service Mathematics Teachers Perceived Difficult to learn?

Table 1 Mean and Standard Deviation rating of Mathematics Topics as perceived by Pre-service Mathematics Teachers

S/N	Topic	N	Mean	Std Dev	Decision
1	Algebra	107	2.82	.878	E
2	Trigonometry	107	2.79	1.34	E
3	History of Mathematics	107	2.82	2.22	E
4	Basic Statistics	107	2.76	.89	E
5	Differential Calculus	107	1.49	.59	D
6	Problem-Solving	107	2.79	1.29	E
7	Vector Analysis	107	1.91	.89	D
8	Probability Theory	107	2.10	.95	D
9	Integral Calculus	107	1.91	.87	D
10	Coordinate Geometry	107	2.75	3.79	E
11	Maths. Methodology	107	2.96	2.18	E
12	Maths. Lab. Practical	107	2.69	.98	E
13	Application of Computer to Math	107	3.20	2.04	E
14	Dynamics	107	2.21	2.10	D
15	Number Theory	107	3.04	1.21	E
16	Real Analysis I	107	2.00	.85	D
17	JSS Contents Teaching	107	3.51	.57	E
18	Research Methodology	107	2.83	.82	E
19	Statics	107	2.03	1.01	D
20	Linear Algebra	107	2.76	.88	E
21	Real Analysis II	107	1.55	.76	D
22	Abstract Algebra	107	2.04	.49	D

23	Differential Equations	107	2.83	.76	E
Grand Mean			2.21		

Decision means 2.50

KEY: D stands for difficult while E stands for Easy

Table 1 presents the mean and standard deviations of Mathematics topics rated as easy and difficult by Pre-service Mathematics teachers in colleges of Education in Niger State. The results show that out of the 23 major topics in Mathematics, 9 were perceived as difficult to learn/comprehend. These difficult topics include Differential Calculus, Vector Analysis, Probability theory, Integral Calculus, Real Analysis I, Statics, Real Analysis II, and Abstract Algebra. Conversely, the remaining 14 topics in the Mathematics Department were perceived as easy to learn

by the pre-service Mathematics Teachers. Additionally, the overall grand mean score for the 23 topics is 2.21, which is less than the decision mean score of 2.50. This suggests that the major topics in the Mathematics Department were perceived as difficult to learn by Pre-service Mathematics Teachers in colleges of Education in Niger State, Nigeria.

Research Question 2: What topics in colleges of Education in Niger State do Mathematics Lecturers Perceived Difficult to teach by Mathematics Lecturers?

Table 2: Mean and Standard Deviation rating of Mathematics Topics as perceived by Lecturers

S/N	Topic	N	Mean	Std. Dev	Decision
1	Algebra	17	2.70	.94	E
2	Trigonometry	17	2.85	.93	E
3	History of Mathematics	17	2.88	1.07	E
4	Basic Statistics	17	3.01	.92	E
5	Differential Calculus	17	3.24	.62	E
6	Problem-Solving	17	3.14	1.30	E
7	Vector Analysis	17	2.92	.68	E
8	Probability Theory	17	3.09	.73	E
9	Integral Calculus	17	3.05	2.96	E
10	Coordinate Geometry	17	2.56	1.19	E
11	Maths. Methodology	17	2.96	.69	E
12	Maths. Lab. Practical	17	3.07	.95	E
13	Application of Computer to Math	17	3.28	.71	E
14	Dynamics	17	3.20	.77	E
15	Number Theory	17	2.53	.82	E
16	Real Analysis I	17	2.13	1.12	D
17	JSS Contents Teaching	17	3.00	.09	E
18	Research Methodology	17	3.02	.91	E
19	Statics	17	2.76	.73	E
20	Linear Algebra	17	3.08	.80	E
21	Real Analysis II	17	1.97	1.05	D

22	Abstract Algebra	17	2.27	.66	D
23	Differential Equations	17	2.71	.99	E
Grand Mean			2.84		

Decision means 2.50

KEY: D stands for difficult while E stands for Easy

Table 2 displays the mean and standard deviations of Mathematics topics rated as easy and difficult to teach by Mathematics Lecturers in colleges of Education in Niger State. The results show that out of the 23 major topics in Mathematics, 3 were perceived as difficult to teach. These difficult topics are Real Analysis I, Real Analysis II, and Abstract Algebra. Conversely, the remaining 20 topics in the Mathematics Department were perceived as easy to teach by

Table 3 Gender difference in Pre-service Mathematics Teachers' perceptions of difficult topics in Mathematics

Sex	N	Mean	Std. Dev.	df	t-cal	sig. (2-tailed)
Male	78	54.86	6.370	105	.555	0.580
Female	31	55.61	6.489			

Table 3 shows an independent sample t-test of Pre-service Mathematics Teachers' gender difference and their perception of mathematics topics. It revealed that there is no statistically significant difference in the Pre-service Mathematics Teachers' perception of difficult topics in mathematics between males ($M=54.86$, $SD = 6.370$) and females ($M= 55.61$, $SD = 6.489$), $t(105) = .555$, $p > 0.05$. This suggests that gender had no significant effect on mathematics topics. Hence, the null hypothesis is retained.

7. Discussion of Findings

The results indicate that out of the 23 major topics in Mathematics, 9 were perceived as difficult to learn and comprehend. These challenging topics include Differential Calculus, Vector Analysis, Probability Theory,

Mathematics Lecturers. Furthermore, the overall grand mean score for the 23 topics is 2.84, which exceeds the decision mean score of 2.50. This suggests that the major topics in the Mathematics Department were perceived as easy to teach by Mathematics Lecturers in colleges of Education in Niger State, Nigeria.

Ho1: There is no significant Gender difference in pre-service mathematics teachers' perception of difficult topics in Mathematics

Integral Calculus, Real Analysis I, Statics, Real Analysis II, and Abstract Algebra. Conversely, the remaining 14 topics were perceived as easier to learn by pre-service Mathematics teachers.

The overall grand mean score for these 23 topics is 2.21, which is below the decision mean score of 2.50. This suggests that the major topics in the Mathematics Department are generally perceived as difficult to learn by pre-service Mathematics teachers in colleges of education in Niger State, Nigeria.

This finding aligns with previous research by Bichi, Ibrahim, and Ibrahim (2018), which assessed students' perceptions of difficult mathematics topics in selected senior secondary schools in Kano State, Nigeria. They found that students perceived 65% of the topics as difficult to comprehend. The

study also showed a significant influence of students' gender on their perception of difficult topics in mathematics. It recommended encouraging and motivating students to learn mathematics, developing curricula that emphasize difficult areas, and conducting further studies to identify factors responsible for these perceptions and their relationship to student achievement.

Similarly, Adegun and Adegun (2013) found that secondary school teachers and students in Ogbomosho South, Oyo, Nigeria, shared similar views on difficult areas in teaching and learning mathematics. Mehta, Miletich, and Detya (2021) emphasized that the perceived difficulty of mathematics topics is influenced by factors such as teaching methods, curriculum content, and individual differences among learners. Adeyemi (2016) and others also found that pre-service mathematics teachers often struggle with calculus and geometry due to a lack of understanding of the underlying concepts. Okoro (2018) reported that lecturers in colleges of education identified abstract algebra as a challenging topic to teach due to its abstract nature.

The finding on Gender difference in Pre-service Mathematics Teachers' perception of difficult topics in Mathematic revealed no statistically significant difference in the Pre-service Mathematics Teachers' perception of difficult topics in mathematics between males ($M=54.86$, $SD = 6.370$) and females ($M=55.61$, $SD = 6.489$), $t(105) = .555$, $p > 0.05$. This suggests that gender had no significant effect on mathematics topics. Hence, the null hypothesis is retained. This finding contradicts with previous finding of Farooq and Shah (2008) which indicated a statistically significant difference in the perceived levels of difficulty of mathematics topics between male and female students. It can, therefore, be concluded that students'

perceptions of difficult topics in mathematics were influenced by gender. The finding of this study was however consistent with the findings of a similar study by Farooq and Shah (2008) that assessed students' attitudes toward mathematics of high school students in which both genders were used as the study population. The findings showed that male and female 10th-grade students from secondary schools in Lahore had similar attitudes toward mathematics, indicating that gender differences have an impact on students' attitudes toward mathematics.

Overall, these findings highlight the need to address challenges and enhance strategies for promoting understanding and participation in mathematics-related fields. It is essential to analyze the difficult topics perceived by pre-service mathematics teachers and lecturers in colleges of education in Niger State, Nigeria.

8. Conclusion

The research reveals that major topics in the Mathematics Department were perceived as difficult to learn by Pre-service Mathematics Teachers in colleges of Education in Niger State, Nigeria and gender had no significant effect on mathematics topics. The findings therefore collectively emphasize the need to address the challenges and enhance strategies for promoting understanding and participation in mathematics-related fields, it is essential to analyze difficult topics perceived by pre-service mathematics teachers and lecturers in Colleges of Education in Niger State, Nigeria.

9. Recommendations

The following recommendation was made based on the findings and conclusion of this study.

1. Teachers and other stakeholders should endeavour to encourage and

- motivate students to learn mathematics.
2. Curriculum developers should develop instructions that would improve students' knowledge by laying more emphasis on the perceived difficulty areas in mathematics.
 3. Authors of textbooks should shift emphasis from teachers' activities to students' activities that will promote learning by doing.
 4. Further studies should be conducted on perceived levels of difficulty of mathematics topics especially on the factors responsible for the difficulty levels and if there is a relationship between perception and students' achievement.

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