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Development and Validation of Diagnostic Test in Trigonometry and Probability for Senior Secondary School Mathematics in South East, Nigeria

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ABSTRACT

The study investigated the Development and Validation of a Diagnostic Test in Trigonometry and Probability for Senior Secondary School Mathematics in South East, Nigeria. The study utilized a descriptive research design to gather comprehensive data on students' understanding of trigonometry and probability. Six research questions and two null hypotheses guided the study. The research was conducted in Anambra, Enugu, and Ebonyi States. The population for the study included senior secondary school class three entrants in the three states, totaling 73,029 students. A sample of 3,651 SS3 students representing 5% of each education zone in the states was selected using a proportionate stratified random sampling technique. The Diagnostic Test for Trigonometry and Probability (DTTP) was used, consisting of two sections: one for bio-data and the other with 100 test items focusing on trigonometry and probability. The responses were multiple-choice with scoring based on correct and incorrect answers, resulting in a final DTTP. The DTTP underwent content analysis, review of objectives, development of a test blueprint, item writing, and face/content validation by experts. Trial testing was conducted, and reliability indices were computed using KR-20, indicating initial reliability at 0.76 before final administration. Six research assistants aided in data collection to ensure near-complete data sets, and the instrument was administered under optimal conditions to enhance testees' performance. Other statistical analyses including such as SPSS factor analysis, and t-tests were used to address research questions and hypotheses, with a significance level of 0.05 guiding the decision-making process for hypothesis testing. The findings of the study indicated that total of 80 items in the DTTP were identified as factorially pure; male students outperformed in Trigonometry slightly more than in Probability. On the other hand, female students achieved nearly equal average scores in both Trigonometry and Probability. Furthermore, the study revealed that urban students surpassed their rural counterparts in terms of academic achievement. Due to the validation, reliability, and classification capabilities of the Readiness Test (DTTP) in identifying students' strengths and weaknesses, teachers are recommended to adopt DTTP for mathematics instruction and evaluation. Given the innovative nature of the Diagnostic Test in Trigonometry and Probability (DTTP) for mathematics education, teachers are urged to integrate it into their teaching and evaluation methods.

Keywords: Development, Validation, Trigonometry, Probability, Mathematics, Diagnostic Test.

INTRODUCTION

Mathematics is considered indispensable due to its substantial use in various human activities, encompassing school subjects such as Basic Technology, Biology, Chemistry, Physics, and Agricultural science. Its paramount importance is evident in how the subject is prioritized in educational settings. As Ashcraft (2014) aptly pointed out, the learning of Mathematics serves as fundamental preparation for adult life. Mathematics also plays a crucial role in analyzing and communicating information and ideas to tackle a wide array of practical tasks and real-life problems (Burns, 2015). Furthermore, employers in sectors like Engineering Construction, Pharmaceutical, Financial, and Retail industries have consistently emphasized the ongoing need for individuals with proficient Mathematical skills (Ozigbo, 2016). This underscores the necessity for every child to receive comprehensive Mathematics education within classrooms across all levels of the education system. Despite the significance of Mathematics, there is ample evidence from various sources worldwide indicating the generally poor achievement of Secondary School students in Mathematics (Ifamuyiwa, 2015; Idigo, 2016; Iketaku, 2019). For instance, on the international stage, reports from the National Research Council in the late 1990s suggested a deteriorating trend in students' study of Mathematics globally, particularly concerning the enrollment and performance of minority groups in Mathematics/Science courses (Celiber Associate, 2013; Ashcraft & Faust, 2016). Considering these critical aspects and the vital utility of Mathematics, the Federal Government of Nigeria (FGN, 2014) mandated it as a core and compulsory subject at primary and secondary levels of education system in Nigeria, as outlined in the National Policy on Education, which remains the guiding principle for all educational objectives in the country.

Despite its immense importance, Mathematics stands out as the most dreaded subject among learners compared to all other subjects offered in schools (Ashcraft & Faust, 2016). An analysis conducted on students' performance in the Senior School Certificate Examination results in Mathematics reveals a widespread trend of poor performance in Mathematics and Science subjects among students in Enugu State Post Primary Schools. The analysis further revealed that in Mathematics, out of every 100 students who took the examination at centres across Anambra, Enugu and Ebonyi States, a minority achieved a Credit; a moderate number obtained a Pass, while the majority did not pass. This implies that only a small percentage of the students out of every 100 were deemed qualified to pursue Mathematics or any other Science-related course in higher education institutions in Nigeria (Ozigbo, 2016).

Moreover, there is substantial evidence indicating the pervasive poor performance of Secondary School students in Mathematics globally. For instance, reports from the WAEC Chief Examiners (2013-2023) attested to students' inadequate performance in Mathematics. It is disheartening that the overall performance of students in mathematics has been consistently below par (Okoye, 2020; Inekwe & Zakariyyaa, 2022). This escalating situation cannot be left unchecked. Some have attributed it to the inadequate teaching of the subject by teachers. Specifically, criticism has been directed towards the instructional methods employed in teaching mathematics in schools, and the perceived lack of relevance of mathematical content to students' real-life experiences, as highlighted by Ezeife (2002).

The West African Examination Council (WAEC) Chief Examiners (2021 and 2022) consistently reported that students harbor an aversion towards mathematics, indicating that students may not be putting in sufficient effort or taking the subject seriously. For instance, students' inability to transition to a thinking mode suitable for specific problems, such as switching between numeric, graphic, or symbolic forms of representing mathematical ideas, hindered them from solving a wide range of mathematical problems (Burns, 2015). Other researchers such as Okonkwo (2014), Okwu and Kurume (2014), and Idigo (2016) have attributed the root cause of students' poor achievement to errors. These errors include process errors committed by students while solving mathematical problems. According to Idigo (2016), teachers' inability to identify these process errors among students has contributed to the persistent poor performance of students in both internal and external examinations over the years.

Therefore, to address the poor performance of students in mathematics, it is imperative to identify these errors or weaknesses related to process skills among students for further learning of Trigonometry and Probability at the SS3 level. Consequently, it becomes essential to investigate the specific areas of weakness among students as indicated by the process errors they commit. The Diagnostic Test of

Trigonometry and Probability (DTTP) aimed to reveal the frequency of these process errors, enabling an assessment of the extent to which SS3 students possess the requisite knowledge of the SS3 mathematics curriculum contents in the Diagnostic test for senior secondary school mathematics work. This scenario necessitated the development of a DTTP to determine whether SS3 students possess the foundational learning experiences needed to cope with mathematics coursework. Okonkwo (2014) previously developed and validated a Diagnostic test for SS3 students. Additionally, Obienyem (2018) identified Diagnostic Test levels of SS3 entrants. Both studies focused on SS3 students intending to pursue mathematics programmes. Given the scarcity of instruments for determining the Diagnostic Test of students intending to pursue mathematics programmes at the SS3 level and addressing mathematics deficiencies among Nigerian secondary school students, as well as the need to enhance the teaching and learning of the subject, this study was motivated to develop and validate a diagnostic test for senior secondary school students.

Statement of the Problem

For several years, students have consistently performed poorly in Trigonometry and Probability, two fundamental topics in Mathematics. Observations made by Mathematics teachers suggest that students lack interest in Mathematics and struggle with the abstract nature of certain topics, such as Trigonometry and Probability. The underlying issue appears to be the lack of a much-needed Diagnostic test in Trigonometry and Probability, which is crucial for effective teaching and learning of Mathematics. The absence of a Diagnostic test in Trigonometry and Probability contributes to several detrimental situations or challenges:

- Negative attitude of students towards Trigonometry and Probability
- Lack of interest in Trigonometry and Probability
- Fear of Trigonometry and Probability among students
- Poor performance in Trigonometry and Probability

Therefore, this study was designed to address the aforementioned problems. Consequently, the study investigated the Development and Validation of a Diagnostic test in Trigonometry and Probability for Senior Secondary School Mathematics.

Significance of the Study

This study holds significant importance for several reasons:

Educational Assessment: It aims to create a reliable diagnostic tool to assess students' understanding of trigonometry and probability, which are crucial components of the mathematics curriculum. This can help identify specific areas where students struggle, allowing for targeted interventions.

Curriculum Improvement: By analyzing students' performance, educators can gain insights into common misconceptions and errors in these subjects. This feedback can inform curriculum development and teaching strategies, ultimately enhancing the quality of mathematics education.

Regional Focus: The study addresses educational challenges specific to the South East region of Nigeria, providing localized data that can contribute to improving educational outcomes in that area.

Research Contribution: It contributes to the body of research on educational assessments in mathematics, particularly in developing countries where such studies may be limited. The findings can serve as a reference for future research and policy-making in education.

Overall, this study is a step towards improving mathematical literacy among secondary school students in Nigeria by providing a structured approach to diagnosing and addressing learning gaps in key mathematical concepts.

Research Questions

The study was guided by the following questions:

1. What items were developed for the Diagnostic Test in Trigonometry and Probability (DTTP)?
2. What are the factorially pure (loaded) items in DTTP?
3. What are the mean achievement scores and standard deviations of students in DTTP concerning gender?

4. What are the mean achievement scores and standard deviations of students in the two subtests of DTTP concerning gender?
5. What are the mean achievement scores and standard deviation of students in DTTP based on location?
6. What are the mean achievement scores and standard deviations of students in the two subtests of DTTP based on location?

Research Hypotheses

Two null hypotheses were tested at the 0.05 level of significance:

Ho1: There is no significant difference between the mean scores of male and female students in Diagnostic Test for Trigonometry and Probability (DTTP).

Ho2: There is no significant difference between the mean scores of urban and rural students in DTTP.

METHODOLOGY

The study utilized a descriptive research design to gather comprehensive data on students' understanding of trigonometry and probability. The descriptive design was selected to provide a detailed insight into the educational landscape regarding trigonometry and probability among secondary school students in South East Nigeria. The research was conducted in Anambra, Enugu, and Ebonyi States. The population for the study included senior secondary school class three entrants in the three states, totaling 73,029 students. A sample of 3,651 SS3 students representing 5% of each education zone in the states was selected using a proportionate stratified random sampling technique. The Diagnostic Test for Trigonometry and Probability (DTTP) was used, consisting of two sections: one for bio-data and the other with 100 test items focusing on trigonometry and probability. The responses were multiple-choice with scoring based on correct and incorrect answers, resulting in a final DTTP with 70 test items. The DTTP underwent content analysis, review of objectives, development of a test blueprint, item writing, and face/content validation by experts. Trial testing was conducted, and reliability indices were computed using KR-20, indicating initial reliability before final administration. Six research assistants aided in data collection to ensure near-complete data sets, and the instrument was administered under optimal conditions to enhance testees' performance. Statistical analyses including KR-20 for reliability, SPSS factor analysis, and t-tests were used to address research questions and hypotheses, with a significance level of 0.05 guiding the decision-making process for hypothesis testing.

RESULTS

The results of the study are presented according to the research questions and hypotheses. They are presented in tables.

Research Question 1: *What items were developed for the Diagnostic Test in Trigonometry and Probability (DTTP)?*

Table 1: Test Blueprint for DTTP

S/N	Content Area	Cognitive Domains						
		K 20%	C 20%	A 30%	An 10%	S 5%	E 5%	Total 100%
1	Trigonometry (50%)	7	7	28	4	2	2	50
2	Probability (50%)	7	7	28	4	2	2	50
	Total (100%)	14	14	56	8	4	4	100

The findings for research question one are as follows: The researcher initially formulated 124 items for DTTP. These 124 items underwent face validation and content validation by three experts, with 100 items successfully passing face validation. However, certain items were revised based on the feedback from the validators.

Research Question 2: *What are the factorially pure (loaded) items in DTTP?*

Table 2: Factorial loadings of DTTP items in a Rotated Component

Pp	**Factors**				
	1	**2**	**3**	**4**	**5**
1.	0.116	0.444	0.211	-0.118	0.201
2.	0.396	0.211	0.141	-0.116	0.092
3.	0.516	0.116	0.99	-0.211	-0.186
4.	0.112	0.086	0.05	0.011	0.206
5.	0.067	-0.129	0.396	0.118	-0.192
6.	0.348	0.049	0.156	0.0611	-0.241
7.	0.521	0.111	0.106	-0.112	0.222
8.	0.114	0.361	0.118	-0.211	0.188
9.	0.192	0.218	0.018	0.222	0.169
10.	0.400	0.200	-0.112	0.066	0.123
11.	0.116	0.401	0.112	0.211	-0.116
12.	0.364	0.148	0.061	-0.200	-0.149
13.	0.390	-0.116	0.112	-0.098	0.127
14.	0.112	0.089	0.061	0.377	0.148
15.	0.416	0.201	0.106	-0.109	-0.113
16.	0.096	0.391	0.111	-0.121	-0.109
17.	0.340	0.116	-0.211	0.001	0.111
18.	0.456	0.155	0.210	-0.112	0.110
19.	-0.100	0.116	0.411	0.168	-0.116
20.	-0.111	-0.008	-0.121	0.116	0.349
21.	0.206	0.118	-0.112	0.501	0.106
22.	0.376	0.112	-0.189	-0.116	-0.069
23.	0.112	0.516	0.081	0.19	0.111
24.	0.416	0.035	0.116	0.671	0.088
25.	0.111	0.206	0.409	0.109	-0.128
26.	0.011	0.129	-0.068	0.112	0.355
27.	0.196	0.148	0.627	0.356	0.056
28.	0.411	0.206	-0.198	0.120	-0.109
Pp	**Factors**				
	1	**2**	**3**	**4**	**5**
29.	0.112	0.218	0.300	0.096	0.184

30.	-0.112	0.381	0.182	0.191	-0.098
31.	0.109	0.500	-0.116	-0.113	0.008
32.	0.391	0.192	0.186	0.131	0.119
33.	0.461	0.163	-0.109	0.002	-0.110
34.	0.134	-0.112	0.116	0.182	0.381
35.	0.009	-0.084	0.381	0.066	0.172
36.	0.116	0.512	-0.111	0.008	0.196
37.	0.128	0.086	0.216	0.169	0.018
38.	0.360	0.216	-0.119	0.098	0.113
39.	0.400	0.139	-0.116	-0.211	0.119
40.	0.218	0.300	0.216	0.069	0.008
41.	0.142	0.113	0.148	0.216	0.019
42.	0.019	0.200	0.208	0.198	0.216
43.	0.448	0.117	0.042	0.066	0.081
44.	0.048	0.217	0.142	0.066	0.018
45.	-0.112	-0.216	0.108	0.210	0.209
46.	0.161	0.381	0.211	0.081	-0.009
47.	0.390	0.090	-0.112	-0.116	0.088
48.	0.008	0.356	-0.009	0.111	-0.186
49.	0.112	0.019	0.048	0.078	-0.112
50.	0.012	0.139	0.364	0.148	0.116
51.	0.444	0.046	-0.200	0.112	0.009
52.	-0.116	-0.218	0.261	0.112	-0.214
53.	0.094	-0.186	-0.112	0.402	0.116
54.	0.066	-0.222	0.116	-0.019	-0.211
55.	0.516	0.034	0.121	0.086	0.001
56.	0.116	0.340	-0.111	0.146	0.200
57.	0.181	0.406	0.121	0.089	0.119
58.	0.391	-0.116	0.148	0.081	0.119
59.	0.056	0.358	0.128	0.091	0.199
60.	0.113	-0.086	0.372	0.117	0.079
61.	0.048	0.349	0.116	0.192	0.139
62.	-0.168	-0.233	0.148	0.266	0.110
63.	-0.271	-0.299	0.689	0.061	-0.146

64.	0.373	0.112	0.066	0.061	-0.011
65.	0.006	0.359	-0.116	-0.121	0.148
Pp	**Factors**				
	1	**2**	**3**	**4**	**5**
66.	0.486	-0.126	0.113	-0.108	0.129
67.	0.001	0.418	0.121	0.166	-0.081
68.	0.366	0.112	0.201	-0.108	0.009
69.	0.006	-0.121	0.419	0.190	0.186
70.	-0.112	0.206	0.391	-0.116	0.121
71.	0.381	0.182	0.121	0.006	0.019
72.	0.212	-0.144	-0.122	0.088	0.021
73.	0.096	-0.206	0.214	-0.146	0.216
74.	0.114	-0.186	0.200	0.089	0.162
75.	0.184	0.210	-0144	0.029	0.281
76.	0.046	0.089	-0.128	0.112	0.361
77.	0.008	0.189	0.116	0.412	0.121
78.	-0.116	-0.189	0.500	0.211	0.081
79.	0.356	0.156	0.121	0.089	0.113
80.	0.362	0.006	-0.113	0.193	0.118
81.	0.182	0.118	0.216	0.411	0.081
82.	-0.166	-0.189	0.112	0.601	0.201
83.	0.121	0.199	0.081	0.121	0.348
84.	-0.081	-0.128	0.506	0.116	0.127
85.	0.066	0.516	0.121	0.089	0.067
86.	0.111	0.372	0.068	0.121	-0.119
87.	0.488	-0.111	0.096	-0.162	-0.249
88.	-0.296	0.172	0.006	0.129	0.618
89.	0.119	-0.200	-0.184	0.276	0.199
90.	-0.199	0.181	0.216	0.398	0.0116
91.	0.189	0.109	0.500	0.200	-0.116
92.	0.066	0.409	-0.111	0.018	-0.129
93.	0.379	0.006	0.118	-0.122	0.064
94	-0.146	-0.112	0.396	0.100	0.006
95.	0.124	-0.069	0.114	0.419	0.116

96.	0.518	0.009	0.190	0.200	0.108
97.	-0.116	0.516	0.129	-0.008	0.118
98	0.127	0.366	-0.119	0.087	-0.148
99.	-0.200	-0.116	0.206	-0.148	0.091
100.	-0.146	0.029	0.099	-0.220	0.111

The researcher computed the factorially loaded pure items of DTTP using the Statistical Package for Social Sciences (SPSS) factorial analysis technique. The extraction method employed was principal component analysis. The rotation method applied in this analysis was Varimax with Kaiser Normalization, which converged after 12 iterations. The factorial loadings of all DTTP items using 5 factors (components) are presented in Table 2.
Rotated method: Varimax with Kaiser Normalization. Rotation converged after 12 iterations.

Table 3: Items that exhibit factorial purity in a single factor

Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
2,3,67, 10, 12	1, 8, 11, 16, 23, 30	5, 19, 25, 35	14,21,27,53	20, 26, 34, 76, 83
13,15,17, 18, 22	31, 46, 48, 56	50, 60	77, 81, 82, 90	88
24, 28, 32, 33, 38	57, 59, 61, 65, 67, 85	69, 70, 78	94, 95	
39,43, 47, 51, 55	86, 92, 97, 98	84,91,94		
58,64, 66, 68,				
71,79, 80, 87				
,93, 96				
31 items	**21 items**	**12 items**	**10 items**	**6 items**

Table 3 illustrates that 31 items exhibited factorial loading in factor 1, while 21 items demonstrated factorial loading in factor 2. Factor 3 showed factorial loading in 12 items, and 10 items displayed factorial loading in factor 4. Additionally, 6 items exhibited factorial loading in factor 5. All the aforementioned items showcased factorial loadings of 0.35 or higher, thereby meeting the criteria for inclusion in DTTP. Consequently, the researcher incorporated all 80 factorially pure items into DTTP. These 80 items were subsequently administered to the study sample to address research questions 4 to 7 and hypotheses 1 to 4.

Extraction method = Principal Component Analysis

Five factors were identified, as illustrated in Table 4. These factors, denoted as factors 1, 2, 3, 4, and 5, were meticulously scrutinized for their factorial purity and loading. A factor loading of at least 0.35 is deemed necessary for an item to be considered factorially pure and valid. Hence, only items exhibiting a factor loading of 0.35 or higher on a single factor were deemed suitable for inclusion in the final iteration of DTTP. Consequently, an item was excluded from consideration. Table 4 provides a comprehensive depiction of the items loaded within each of the five factors.

Research Question 3: *What are the mean achievement scores and standard deviations of students in DTTP concerning gender?*

The results for research question 3 is shown in Table 4

Table 4: Mean Scores and Standard deviations of male and female students in DTTP

Gender	**N**	**Mean**	**SD**
Male	26.74	36.8	9.84
Female	22.13	34.7	7.68

Table 4 indicates that male students achieved a marginally higher average score compared to their female counterparts.

Research Question 4: *What are the mean achievement scores and standard deviation of students in DTTP based on location?*

The results for this research question are exhibited in table 5.

Table 5: Means and standard Deviation due to location

Location	**N**	**Mean**	**SD**
Urban	27.19	37.81	10.28
Rural	34.27	34.96	11.98

The results in Table 5 show that urban students achieved slightly higher (37.81) than their rural counterparts who scored 34.96.

Testing of Research Hypotheses

Hypothesis 1

There is no significant difference between the mean scores of male and female students in Diagnostic Test for Trigonometry and Probability (DTTP).

The results for hypothesis are shown in Table 6

Table 6: T-test results due to gender

Gender	**Mean**	**SD**	**N**	**Df**	**t-cal**	**t-crit**	**Decision**
Male	36.80	9.04	1, 782	3,650	4.53	1.96	S
Female	34.70	7.68	1, 868				

Table 6 illustrates that the computed t-value of 4.53 indicates a significant disparity in the mean scores between male and female students in DTTP, favoring male students.

Hypothesis 2

There is no significant difference between the mean scores of urban and rural students in DTTP.

Table 7: t-test results for hypothesis 2.

Gender	**Mean**	**SD**	**N**	**Df**	**t-cal**	**t-crit**	**Dec**
Urban	37.81	10.28	1,924	3,650	5.90	1.96	S
Rural	34.96	11.98	1,726				

Table 7 illustrates that the calculated t-value of 5.90 demonstrates significance at the 0.05 level for this particular study. Therefore, it can be concluded that the location variable holds significance in the context of this study.

Summary of Findings

The following are the summary of the findings;

1. 100 items passed the face validation out of the initial 124 items. Following the item analysis, 81 items were deemed suitable out of the 100. The coefficient alpha (KR-20) for the overall test was calculated to be 0.76. Moreover, the KR-20 values for the two subtests, namely Trigonometry and Probability, were found to be 0.78 and 0.71, respectively. A total of 80 items in the DTTP were identified as factorially pure.
2. In terms of performance, male students exhibited a higher mean score of 36.8 compared to female students who scored an average of 34.7. Specifically, male students outperformed in

Trigonometry slightly more than in Probability. On the other hand, female students achieved nearly equal average scores in both Trigonometry and Probability. Notably, urban students surpassed their rural counterparts in terms of academic achievement.

3. Further analysis revealed a significant disparity in the mean scores between male and female students in favour of the males. The test results also indicated a significant difference favoring gender in the DTTP type test. However, no significant interaction effect was observed between the type of test and gender. Similarly, a significant gap in mean scores was observed between urban and rural students, favoring the former in terms of school location.

DISCUSSION OF FINDINGS

Item Validation and Reliability:

The rigorous validation process resulted in a reliable assessment tool, with a KR-20 index of 0.76 for DTTP. This supports the notion that well-validated assessments are crucial for accurately measuring student understanding in mathematics, aligning with established educational measurement principles.

Gender Differences

The study found that male students outperformed female students in overall achievement scores as well as in specific subtests (trigonometry and probability). This finding is consistent with other studies indicating a persistent gender gap in mathematics achievement, where males often score higher than females, particularly in higher-level mathematics contexts. There is a need for curriculum adjustments that address gender disparities. Tailoring instructional strategies to engage female students more effectively could help bridge the achievement gap.

Impact of School Location:

Urban students scored higher than their rural counterparts, reflecting broader trends observed in educational research. Urban areas typically have better resources, teaching quality, and access to educational support, which can enhance student performance. This underscores the importance of addressing educational inequalities between urban and rural settings. The urban-rural performance gap calls for strategic resource allocation to ensure that rural schools receive support comparable to their urban counterparts. This might include professional development for teachers or enhanced access to learning materials. The study outcomes are in line with those of Isinenyi (2015), Akukwe (2014), and Odo (2012), all reporting that students from rural areas made more errors than their urban counterparts. the significant mean difference due to school location could be attributed to urban schools being better equipped with resources such as libraries, qualified teachers, and funds to enhance teaching and learning quality compared to rural schools. Moreover, school equipment provided by the government to public schools is often vandalized and stolen in rural schools, exacerbating the educational lag among rural students. These explanations are hypothetical and warrant further investigation.

Factorial Analysis:

The identification of 80 factorially pure items suggests a robust construct validity for the DTTP. Such clarity in assessment design is essential for ensuring that tests measure what they intend to, thereby providing meaningful data for educators and policymakers.

Statistical Significance of Findings:

The significant differences found in achievement based on gender and location highlight critical areas for intervention. The t-value of 4.53 indicates a notable disparity favoring male students, while the f-calculated values further confirm that gender significantly influences performance outcomes.

CONCLUSION

The conclusions drawn in this study are solely based on the investigated issues. The data analysis results enumerated below revealed that: Males were more prepared than their female counterparts for senior secondary school mathematics learning, with a mean error difference of 8 favoring males. Gender was a significant factor in the diagnostic test of male and female SS3 entrants for senior secondary school mathematics learning as measured by DTTP (scores). This factor was deemed significant at $p < 0.05$.School location was a significant factor influencing the Diagnostic Test in Probability and

Trigonometry of SS3 entrants as measured by DTTP (scores). This location factor was found significant at P <0.05.The interaction effects of gender and type of junior secondary school attended (public or private) were found to significantly influence the Diagnostic Test in Probability and Trigonometry of SS3 students intending to pursue new mathematics programs at the SS3 level, with students from public schools appearing more prepared than those from private secondary schools for senior secondary school mathematics learning. The interaction effects of location and type of senior secondary school attended were found to be significant factors influencing the Probability and Trigonometry of beginning SS3 students. The interaction effects were significant at p <0.05, with urban students being more prepared than their rural counterparts for senior secondary school mathematics programs. Hence, a DTTP of an acceptable degree of validity

RECOMMENDATIONS

Based on the study findings, the following recommendations are proposed:

1. Due to the validation, reliability, and classification capabilities of the Readiness Test (DTTP) in identifying students' strengths and weaknesses, teachers are encouraged to adopt this tool for mathematics instruction and evaluation.
2. Given the innovative nature of the Diagnostic Test in Trigonometry and Probability (DTTP) for mathematics education, teachers are urged to integrate it into their teaching and evaluation methods.
3. Examination bodies are advised to introduce diagnostic tests in trigonometry and probability as part of mathematics evaluations, following the successful utilization of DTTP in assessing SS3 students entering senior secondary class one.
4. The study supports the integration of DTTP into the senior secondary school mathematics curriculum to enhance student performance in Trigonometry and Probability by distinguishing between high-performing and low-performing students.
5. Authors of mathematics textbooks and other test developers can utilize the DTTP as a reference for creating future assessments.

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