# Investigation of Knowledge and Performance of Students in Geometrical Construction and Loci among Secondary School Students in Zamfara, Nigeria

**Suleiman Bashir PhD[1], Umar Sodangi PhD[2]**

[1]absuleimank[at]gmail.com
[2]sodangiumar78[at]gmail.com
[1, 2]Department of Science Education, Federal University Gusau

**Abstract:** *The purpose of this study was to examine the secondary schools students' knowledge and performance in construction and loci. The research questions and hypotheses were formulated to guide the study. Quasi-experimental (pre-test, post-test, Non-equivalent control group design) was used for the study. The population of the study was Senior Secondary Two (SSII) students in Zamfara State admitted in 2016/17 session. The distribution of the population was male and female students from different background, culture and locations. Stratified Random Sampling Technique was adopted in selecting the sample size. The instrument used for the study was the Achievement Test on Construction and Loci (ATOCAL). Two lesson plans and marking guide was developed for the study. The test items, lesson plan and marling guide were validated by experts in mathematics education and measurement and evaluation from reputable university. The reliability of the instrument was determined by using Cronbach alpha value of 0.83 and 0.78. Sample of 240 students were drawn from the three senatorial districts of Zamfara state. Mean and standard deviation were used to answer research questions and t-test for testing the hypotheses. Finding from the study revealed that students' performance in construction and loci test in all the three senatorial districts is very poor. The performance range from zero (0) to four (4) out of 50 marks and that gender has no effect on their performance. Among the recommendation made by researchers is re-training of mathematics teachers in the teachings of construction and loci using varieties of instructional strategies.*

**Keywords:** Knowledge, Geometrical, Construction and Loci, and Student

## 1. Introduction

Mathematics plays a significant role in the commercial, scientific, technological and even entrepreneurial aspects for an adequate and significant development of any nation (Suleiman and Abdullahi, 2015). Thus the quest for national development along with scientific, technological growth and self-reliance are matched with corresponding progress in mathematics.

Despite the importance and relevance of mathematic to both academic disciplined and the body of knowledge that everybody needs in society couple with the effort of the government in making the subject a compulsory subject at the primary and secondary schools, students' achievement and performance in mathematics at the secondary school level in Nigeria is not encouraging. In line with this are (Suleiman 2010, Adebola and Ajilogba 2013) reports that secondary school students in Nigeria achieved poorly in mathematics most especially in public examination like West African Examinations Council (WAEC) and National Examination Council (NECO) as evidence in the results.

Reports from researches shows that many secondary school students fear, dislike answering geometry questions both in public internal and external examinations. Umar (2008) observed that out of 2, 738 students that sat for pre-WAEC (MOCK) examination in mathematics in kebbi state only 562 attempted questions in geometry which is 20.5%. West Africa Examination Council Chief Examiners (2012, 2013, 2014 and 2015) annual reports

also revealed that questions in geometrical construction and loci are some of the areas many students fear most and that those attempted these questions presented a poor attempt.

**Table 1:** Result of Senior Secondary School Mathematics Examination by WAEC (2000-2011)

| Years | Percentage Pass with Credit and above | Percentage Pass with Pass and below |
|---|---|---|
| 2000 | 32.81 | 67.19 |
| 2001 | 36.55 | 63.45 |
| 2002 | 34.50 | 65.50 |
| 2003 | 36.91 | 63.09 |
| 2004 | 34.52 | 65.42 |
| 2005 | 35.55 | 64.45 |
| 2006 | 39.92 | 60, 08 |
| 2007 | 15.56 | 84, 44 |
| 2008 | 23, 00 | 77.00 |
| 2009 | 31.00 | 69.00 |
| 2010 | 24.94 | 75.06 |
| 2011 | 38.98 | 61.02 |

Source: Onwuka (2015), Abacus, vol. 40, No 1.

One of the major factors that led to such performance and attitude is lack of understanding of the concepts and sub-concepts in geometry (Johnson, Wilder and Mason 2005). Sam-Kayode and Salman (2005) in their study declared that misconceptions and alternative conception held by students do affect their performance in geometry as well as in mathematics in general. Also teacher's background knowledge of senior secondary geometry part of mathematics course content affect students knowledge and performance in geometrical construction and loci. Sambo

(2005) stated that students taught by teachers with good background knowledge of geometry performed better.

From the outlined, it is clear that there is problem in teaching and learning of geometry in our schools. It is against this background that the researchers made a survey and identified some senior secondary schools in the state and investigated students' performance in geometrical constructions and loci.

## 2. Statement of the Problem

From research reports and experience of the researchers, many scholars doubt the competency of the students in knowledge of the geometry part of senior secondary school mathematics content. The study therefore made a survey and identified some geometrical constructions and administered test to senior secondary school students to determine their knowledge and performance in geometrical constructions and loci.

## 3. Purpose of the Study

The main focus of this study was the investigate Zamfara state senior secondary school (SS11) students' background knowledge of the geometrical constructions and loci. Specifically this study.

- Determined the level of students' performance in geometrical constructions and loci.
- Determined the difference in gender performance in gender performance in geometrical constructions and loci.

### Research Questions

Based on the purpose of the study, the following research questions were answered.

- What is the level of students' performance in geometrical constructions and loci?
- Does difference exist in male and female students' performance in geometrical constructions and loci?

### Research Hypothesis

- There is no significance in male and female students' performance in geometrical constructions and loci.

## 4. Methodology

The study adopted quasi-experimental design using non-equivalent group design or pre-test and post-test non-randomized was use in this study. Intact classes were randomly assigned to the two treatments group by balloting. The groups were given the same pre-test before the experiment and post-test after the experiment. One group was taught geometry concepts using Geogebra teaching strategy and the other taught using Conventional teaching strategy. This study was conducted in Zamfara state, Nigeria. The state is selected for the study because it has recorded persistent failure in mathematics (West

Africa Examination Council Analysis, 2016). Construction and Loci aspects of the geometry are one of the area that West Africa Examination Council (WAEC) usually prepare questions in both the mathematics objective and essay papers. According to Chief Examiner's report (2016) most of the candidates had problems in construction and loci questions.

Three Senatorial districts of Zamfara state namely, Zamfara central, Zamfara North west and Zamfara North East zones were used for the study. This is for the purpose of adequate coverage of the whole state.

The population for the study of senior secondary one student (SS1) of 2016/17 academic session from schools in Zamfara state was used. SS1students were chosen because the geometrical constructions and loci are well elaborated in the senior secondary education curriculum (SS1). The students at this level form the foundation class for the senior secondary school education. Therefore this level of students was most appropriate for the study, so as they lay a solid mathematical foundation for students at secondary education level.

The samples of the study comprised of three sampled co-educational public secondary schools in the state. One school from each of the three Senatorial districts. Two intact classes of SS1 were purposively selected from each school and they were randomly assigned as experimental and control group. These three Senior Secondary Schools selected have being presenting students for senior school certificate examination in mathematics for the past five years. Forty (40) students were selected from each intact class as the final subject for the study using the pre-test performance. Therefore, the sample size for the study is 240 students out of which? Are male and female students.

The instrument for data collection is Achievement Test on Construction and Loci (ATOCAL).Test items were developed by the researchers and it is aimed at measuring students' achievement in construction and loci. The instrument was validated by two test and measurement experts and two mathematics educators from the University. For reliability, the instrument was pilot-tested using senior school (SS11) of Federal College of Education Technical staff School Gusau and the result obtained was used to establish reliability and internal consistency of the items in the ATOCAL. The Cronbach alpha value of 0.83 and 0.79 were obtained. Lesson plans for Geogebra teaching strategy and conventional teaching strategy were prepared for the research. These lesson plans serves as teachers' guide for effective lesson delivery.

The researchers with the help of research assistants visited the selected schools and administered the test to ensure non-interference of any factor. The administration was for one (1) hour and the scoring was over 50 marks. The responses were scored and analysed using scores, mean and standard deviation to answer research questions and t-test analysis was used to test the hypotheses formulated for the study at $P<0.05$ level of significance.

## 5. Result

To provide answers to the research questions and the corresponding null hypothesis formulated, the mean, standard deviation, bar chart and t-test statistic were employed.

RQ 1: What is the level of students' performance in geometrical constructions and loci?

**Table 2:** Mean and Standard Deviation on Students' score in geometrical constructions and loci

| Gender | N | Mean | SD |
|--------|-----|--------|--------|
| Male | 187 | 0.5294 | 0.9785 |
| Female | 53 | 0.3491 | 0.8061 |
| Total | 240 | 0.4896 | 0.9445 |

Table 2 shows the mean score of the students in geometrical construction and loci as 0.4996 and the standard deviation of 0.9445. From the mean score, it shows that students' performance in construction and loci is very low. The mean score of 0.9445 out of 50 marks indicates that the students are very poor on constructions and loci.

RQ 2: Do difference in male and female students' performance in geometrical constructions and loci?

Referring to Table 2, male students mean score is 0.5294 while female students mean score is 0.3491. The means score difference is 0.1803. Though the mean scores for both male and female students are very low, but is the mean score difference between male and female score significant.

RQ 3: There is no significant difference in male and female students performance in geometrical construction and loci.

**Table 3:** T-test analysis on male and female students' performance in geometrical construction and loci.

| Gender | N | Mean | T | Df | P-value | Decision |
|--------|-----|--------|-------|-----|---------|----------|
| Male | 187 | 0.5294 | 1.228 | 238 | 0.221 | * NS |
| Female | 53 | 0.3491 | | | | |

P≤0.05, * NS = No Significant

An independent sample t-test was conducted as shown in Table 3 and the null hypothesis was retained because P-vale of 0.221 was greater than the stated significant level of 0.05. Therefore, there was no significant difference in the mean scores for male and female students in geometrical construction and loci test. These results suggest that male and female students performance in geometrical constructions and loci is very poor.

## 6. Discussion of the Findings

From the results of the findings, it was revealed that students' performance in geometrical construction and loci is very poor. This in line in the Umar 2008 and West African Examination Council Chief Examiners report of 2012, 2013, 2014 and 2015 that students fear and do not attempt or even perform poorly in geometrical construction and loci questions. Some of the factors discovered to be responsible for the poor performance are lack of construction instruments and misconception by the students.

## 7. Conclusion

Based on the results of the finding the study concludes that students at secondary school do not perform well in geometrical construction and loci and that the poor performance may be caused by lack of construction instruments and the misconception of the questions.

## 8. Recommendations

The researchers suggest the following recommendations:

1. Secondary school students should be taught construction using appropriate instruments.
2. All students should have personal appropriate instructional instrument.
3. Mathematics teachers should try to identify student's misconceptions in constructions and proffer remediation on them.
4. Further research studies should be conducted on how to motivate and improve student's interest and performance in geometrical constructions and loci.

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