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Gender Difference and Problem-Solving Abilities in Mathematics among Senior Secondary School Students

Jessey Ilama Obunge
Department of Science Education Rivers State University, Port-Harcourt, Nigeria
obungeji@gmail.com

Abstract
The study examined gender difference and Problem-Solving abilities in mathematics among senior secondary school students in Port-Harcourt local government area Rivers State, Nigeria. Design of the study was ex-post facto. The population of the study involved all senior secondary school III students in Port-Harcourt local government area. 373 senior secondary school III students achieved through intact class method participated in the study. Six secondary schools (two co-educational, two exclusively boys and two, exclusively girls) in Port Harcourt were purposively selected for the study. The instrument for data collection was a mathematics problem-solving test collated by the researcher from mathematics textbooks and administered to the students to ascertain and compare the problem-solving abilities of male and female students in mathematics. A reliability coefficient of 0.82 was obtained using Pearson Product Moment Correlation formula. Students' scores of 50% and above are classified as good performance, while scores of 49%and below are classified as poor performance. Two research questions and one hypothesis guided the study. Simple mean was used to answer research questions 1 and 2. Students' t-test score was used to test the null hypothesis at 0.05 significant level. Results of the analyses revealed that the male students had higher mean scores in mathematics than the female students in the two groups classified as good and poor performance respectively. The t-test score showed that there is a significant difference between male and female problem-solving abilities in mathematics in favour of the male students. Based on the findings, recommendations were made.

Keywords: Gender, Problem-Solving, Abilities, Mathematics, Students.

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1. Introduction

From preliterate society to modern day civilization, humans have been contending with numerous challenges in life and in finding solutions to these challenges, have adopted various strategies, thus a great deal of human's life, is spent solving problems. Problem-solving is an essential aspect of human activity, thus the major part of human thinking is consciously aimed towards problem-solving (Alacaci & Dogruel, 2012). Generally, problem means a situation that is not welcome and harmful that needs to be addressed and overcome. However, one of the ways humans provide solution to problems in life is through the application of mathematical procedures. Wardhani (2008) states that one of the purposes of studying mathematics is to solve problems, thus it involves the ability to understand problems, prepares mathematical models, completing models as well as interpreting the models. According to the National Council of Teachers of Mathematics (2012) 'the main purpose of teaching mathematics, is to prepare students to solve problems regularly'. In mathematics, problem refers to a statement requiring a solution, usually by means of a mathematical operation or geometric construction. As noted by Pant and Luitel (2016), mathematics is a problem-solving game in which there are several procedural mathematical problems focusing on algorithmic process, seeking for correct answer in mathematics text. Those who consider it as a game enjoy the challenges of developing new mathematics and solving previously unsolved problems in the various branches of mathematics. According to (Elizabeth, Abdul & Nornazira, 2018), problem solving is said to be one of the root causes of poor academic performance in science related discipline. This occurs as a result of students' inability and unwillingness to acquire the basic knowledge involved in solving problems, rather preferred memorizing solutions given by teachers in line with outdated methods of teaching.

Problems solving span across all spheres of life. As noted by (Kaya, Izgiol & Kesan, 2014) problem solving ability is a basic skill needed by individuals and is virtually applied in all areas of human endeavor. Specifically, mathematics is regarded as a universal branch of science that is highly important in the society, as its requirement is seen as a prerequisite to the study of many science-oriented courses, notably, in engineering, science, business management, medicine, agriculture, computer sciences among others. Various techniques have been adopted in finding solutions to problems through mathematical operation. Twentieth centuries and beyond have witnessed increasing difficulties and complexities that required highly problem-solving skills at the workplace and every area of life as such, makes mathematical literacy one of the components required to develop the 21st century skills (Julie, Sanjaya & Anggoro, 2017). As noted by Jayanthi (2019), mathematics is the pillar of national development, as the level of expertise acquired in mathematics, to an extent determines the level of scientific and technological aspects of nations. Mathematics is applied in every occupation and activity in human lives. It is crucial in today's business management, as organizations use it to complete business operations efficiently in areas such as accounting, marketing, sales forecast, inventory management etc. Mathematical knowledge is also applied in Arts, as Pythagoras the most notable mathematician acknowledged, numerical reasoning in harmonizing music (Jayanthi, 2019).

Most notably, mathematics has contributed enormously to the areas of Science and Technology as it is viewed as the Knowledge of Science, Technology and Engineering (Jayanthi, 2019). It is one of the critical components, in addition to Science, Technology and Engineering which is known to be 'STEM' areas as acknowledged by developed nations as tool for prosperity. Mathematical concepts have been applied in Biotechnology, Advanced semiconductor device, Digital image technology, Nano technology, Artificial satellites etc. knowledge of mathematics has been used in Agriculture as well as medical sciences as it is used in manufacturing devices, DNA sequencing and Gene technology among others. According to engineering for kids (2016) innovation and science literacy depends on a solid knowledge based in the STEM areas. As a prerequisite in the field of business, science, engineering and construction, mathematics has played a key role in solving problems in the real world. Mathematics solves problem through logic, as the rule of logic allows philosophers make true and logical deduction about the world. Through general rules, mathematics proffers solutions to numerous problems simultaneously as well as the application of these rules to other problem (AMS, 2016).

Although women and men are equal, naturally the biological structure of male and female is clearly different. One way in which this difference manifests is through the problem-solving approach of male and female. Awofala (2007) indicated that physically demanding careers are mostly dominated by males as they are seen to be physically strong while females are seen not to have excelled in these areas. Nazariah & Abidin (2017) indicated that students adopt various strategies in finding solutions to problems, thus students who possess low and moderate initial skill adopt extended plan with outcomes that are most likely inaccurate, while students that possess higher ability often implement unexpected approach in studying. Most times, difference in problem solving abilities between boys and girls is not strongly observed during their childhood but as they develop to adolescent stage, the differences begin to manifest (Robinson & Lubienski, 2013).

These differences between male and female problem-solving ability have been attributed to different factors. Studies indicated that differences exist between males' and females' cognitive performance as a result of social and cultural factors. Gender differences are reported in students' problem-solving ability based on anxiety.

Women are found to have exhibited greater anxiety during mathematics test. This has overstretched their memory and eventually led to poor performance in test results (Boston College, 2014). In Nigeria, culture is said to have played a dominant role in gender-based inequalities in education, poor performance of students in mathematics have been attributed to several factors. Most notable among them include shortage of qualified professional mathematics teachers, overpopulated mathematics classrooms, negative attitude exhibited towards mathematics study, inadequate teaching facilities, undue emphasis laid on the coverage of mathematics course content at the detriment of students meaningful understanding the basic concepts of mathematics. (Ojimba, 2012). Although, some studies have indicated the superiority of males' problem-solving ability over females' in mathematics, not all men have been seen to have outperformed women mathematically (Abubakar & Adegboyega, 2012).

Could the poor performance in mathematics by students be gender related? Against the foregoing background, the main objective of the Study is to examine gender difference and problem-solving abilities in mathematics among senior secondary school students in Port Harcourt local government area, Rivers State, Nigeria.

The purpose of the study was to, assess how senior secondary school students solve problems in mathematics and compare male and female mean scores in mathematics problem solving among senior secondary school students.

2. Methodology

The null hypothesis: there is no significant difference between male and female mean scores in mathematics problem solving, among senior secondary school students was analyzed at 0.05 significant level, using t-test. In the analysis, when p-value > 0.05, the null hypothesis is accepted and when p-value < 0.05, the null hypothesis is rejected. In order to achieve the objective of the study, ex-post factor design was adopted, it was chosen because the variables of the study had already occurred and will not be influenced by the researcher. The target population of the study was all the 5,340 senior secondary school III students in the study area. Six senior secondary schools (two co-educational, two exclusively girls and two exclusively boys) were purposively selected. 373 students participated in this study, this number is slightly above the minimum number determined by Taro Yamane formula, $n = \left(\frac{N}{1+(N)e^2}\right)$ where n = sample size, N= population under study (5340), e= margin error (0.05). The researcher collated five questions on quadratic equation and administered to the senior secondary school III students personally with the assistance of some teachers in the schools involved in the study, to ascertain and compare students' problem-solving abilities in mathematics. Scores up to 50% and above are termed good performance and classified under high problem-solving ability and scores of 49% and below are termed poor performance and classified under low problem-solving ability. The reliability co-efficient was obtained to be 0.82 with the use of Pearson's Product Moment Co-relation formula. Simple mean was used to answer research questions 1 and 2. The null hypothesis was analyzed by t-test at 0.05 significant level.

3. Results and Discussion

Research question one (1) sought to investigate how senior secondary school students solve mathematics problems. Table 1 showed that only 41 students out of 373 representing about 11% of the sample size scored, 50% and above in the mathematics problem-solving test.

332 students representing about 89% scored, 49% and below. This showed a general low problem-solving ability of the students in mathematics. This result agrees with the findings of Ogunsanya (2015) who studied word problems in algebra: Nigerian junior secondary school students' experience, in Lagos state. His findings

showed that only about 10% of the whole students involved answered the questions correctly and so he also reported a general low problem-solving ability of the students.

Table 1. General performance of the students

Scores	N	%	Mean
Good (50% & above)	41	11	59.64
Poor (49% & below)	332	89	25.25
Total	373	100	

Research question two (2) sought to investigate if students' problem-solving abilities in Mathematics is gender related.

Table 2 showed that in the group classified under good performance there are 18 males representing 12% of the total male students and about 5% of the total students that participated in the study, while 23 were female representing 10% of the total female students and about 6% of the total number of students that participated in the study. The mean score of the males in this group is 63.7 with a standard deviation of 8.26 while the mean score of the females is 55.60 with a standard deviation of 7.09. Their mean difference is 8.07 in favour of the male students.

Furthermore, in the group classified under poor performance, 132 were male which represents about 88% of total males and about 35% of the total students that participated in the study, while 200 were female representing 90% of the females and about 54% of the total students that participated in the study. The mean score of the male is 30.83 with a standard deviation of 14.67 and female's mean score is 19.67 with a standard deviation of 11.50. Their mean difference is 11.16 also in favour of the male. This study agrees with (Mutai, 2011) who investigated gender differences in mathematics performance among secondary school students in Bureti Sub-County and Kericho County, Kenya. Results of the study revealed a high significant difference in mathematics achievement between the male and the female students, further reported that the boys performed better than the girls.

Table 2. Performance of students with respect to gender

Scores	**Gender**	N	**%**	MEAN	**SD**
Good (50%and above)	Male	18	5	63.67	8.26
	Female	23	6	55.60	7.09
Poor (49% and below)	Male	132	35	30.83	14.67
	Female	200	54	19.67	11.53
	Total	**373**	**100**		

Hypothesis Test

There is no significant difference between the mean test scores of male and female students in mathematics problem-solving.

The results on Table 3, indicated that p-value is less than 0.05 ($P<0.05$). This showed a significant difference between the mean scores of male students and the mean scores of female students in favour of the male students.

Based on the finding, the study concludes that the male students have higher problem-solving abilities than the female students in this study.

(M = 37.4, SD = 17.4), (F = 23. 5, SD = 15.7). Thus, the null hypothesis is rejected.

Table 3. Performance level of students with respect to Gender by t-test at 0.05 significant level.

Gender	N	Mean	Std. Deviation	df	t-cal	p-value	Decision
Female	223	23.47	15.71	371	7.11	0.0001*	Rejected
Male	150	37.38	17.42				

4. Conclusion

The following conclusions were made based on the findings of this study: there exists a significant difference between male and female problem-solving abilities in mathematics among senior secondary school students in Port Harcourt. Specifically, the study revealed differences on the mean test score of male and female students in mathematics. The mean scores of males are higher than the mean scores of females in mathematics. Consequent upon this, the study concludes that male students have higher problem-solving abilities in mathematics than female students in senior secondary schools in Port Harcourt, River's state Nigeria.

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