Comparative Analysis of South West Students' Performance in National Mathematics Olympiads Competitions in Nigeria

Jekayinfa, Olatunji James[1]   Ojo, Solomon Gboyega[2]

1.Mathematical Science Education Programme, National Mathematical Centre, Abuja

2.Head, Olympiads Unit (Directorate), National Mathematical Centre, Abuja

Abstract

The main purpose of this study was to carry out a comparative analysis of the performance of South West students in the mathematics Olympiads competition organized annually in Nigeria by National Mathematical Centre, Abuja. Secondary data of the results of students for 2015, 2016 and 2017 Olympiads examinations in the six states of South West, Nigeria was collected and analyzed. Frequency count, percentage, mean and standard deviation were used to answer the three raised research questions while t-test and ANOVA were used to test the two formulated hypotheses. Results of the study showed that South West students' performance for the three years was largely poor. The result also showed that male students performed better than their female counterparts. It was recommended among others that the National Mathematical Centre, Nigeria should make preparatory textbooks and other materials available and accessible to participating students to get them well prepared and perform better in the Olympiads.

Keywords: Olympiads, National Mathematical Centre, Abuja

1. Introduction

The original meaning of the word 'Olympiad' was the period of four years reckoned from one celebration of the Olympic Games to the next, by which the ancient Greeks computed time. In modern times, the word has become associated with the regular celebration of the Olympic games revived in 1896 (Zawaira & Hitchcock, 2009). During the course of the twentieth century, it came to refer also to other specialist competitions held on a regular basis which included International Mathematical Olympiad (IMO), International Biology Olympiad (IBO), International Physics Olympiad (IPhO), Pan African Mathematics Olympiads (PAMO), Pan African Mathematics Olympiads for Girls (PAMO-G) to mention a few. One major difference from the Olympic Games is the general rule for Mathematical Olympiads, that contestants be high school students, not yet registered at a tertiary educational institution, and under the age of 19 years of age. The reason behind this is that a primary objective of the World Federation of National Mathematics Competitions (WFNMC) is to stimulate interest in and enjoyment of the subject in high schools.

A Mathematical Olympiad, then, whether provincial, national or international is a form of regular competition in which young people pit their mathematical prowess and wits against each other in solving challenging and attractive problems of a mathematical sort (Zawaira & Hitchcock, 2009; Usman & Ojo, 2014). The word usually used to distinguish Olympiad-style problems from the standard or 'drill' exercises in most textbooks is 'non-routine'. Such a problem will provide an appreciable challenge – it will provoke you to think, to explore, to wonder… This means that, while not much more actual background mathematical knowledge is demanded, yet the solution requires something quite different from the routine application of memorized techniques – it requires creative insight, drawing connections not explicitly given, and seeing things in novel ways, thinking with both imaginative clarity and logical persistence. The young people participate in the Olympiad competitions with a view to measuring one's abilities in a given discipline against those of other people, among others.

Competition is essential and intrinsic to life (Kenderov, 2006). Every day, living things in nature and economic subjects in society compete for resources, for better living conditions, and for higher efficiency. The desire to compete in overcoming a challenge is deeply rooted in human nature and has been employed for centuries to help people sharpen their skills and improve their performance in various activities. Since mathematics occupies a central place in all disciplines related to science and technology, improving the students' participation in mathematics competition is one of the crucial strategies to empower the students.

The rating of students, schools, regions and countries in mathematics has often been based on results of competition and Olympiads (Meremikwu, Ekwueme, Enukoha, 2014). Examining trends in the participation and performance of South West students in mathematics Olympiad may not be the best approach to determine the magnitude of improvements in the participation and performance of students from this geo-political zone of the country in mathematics, but it gives an indication of the direction of change. Using achievement-based rewards for the purpose of improving students' motivation, participation and performance in mathematics is a key reason for national and international mathematics Olympiads although achievement-based rewards have merits and demerits (Cameron, David, Banko, & Gear, 2005).

Cognitive Evaluation Theory (CET) provides a framework for better understanding of the extent to which

Olympiads and other competitive mathematics competitions motivate students to learn mathematics. CET explains how rewards tied to achievement affects intrinsic motivation. The theory proposes that the critical process that mediates the effects of performance-based rewards on intrinsic motivation are perceived autonomy and perceived competence. Meremikwu et al. (2014) opined that when rewards are perceived to be controlling perception autonomy decreases, leading to lower intrinsic motivation. The proponents of CET, therefore, hypothesized that because reward always has a controlling aspect, achievement-based reward invariably decrease intrinsic motivation. A review of several studies that assessed the effect of rewards on autonomy and intrinsic motivation showed that rewards increase self-perception of autonomy and intrinsic motivation. This school of thought essentially validates the usefulness of mathematics competitions and Olympiads.

2. National Mathematical Centre, Abuja and National Olympiads Competition

Mathematical Sciences Olympiads Competition is one of the most prestigious events that brings students from all over the country together annually for the purpose of identifying and motivating high abilities and talented students in the field of mathematics. The National Mathematical Centre, Abuja is the international center of excellence in mathematical sciences saddled with the responsibility of conducting national mathematical sciences Olympiads competition in and around Nigeria. Ojo & Usman (2014) highlighted some of the mandates of the Centre to include:

i. Identify and encourage young talents in mathematical sciences;
ii. Prepare Nigeria for a leading role in mathematical sciences;
iii. Stimulate enthusiasm for the physical sciences and
iv. Encourage and support activities leading to the improvement of teaching and learning of the mathematical sciences at all levels.

With a view to achieving these mandates, especially those highlighted in i and ii, the center organizes annual Olympiads Competition in seven (7) subject areas namely: Senior Mathematics, Biology Physics, Chemistry, Senior Informatics, Junior Mathematics, Junior Science and Junior Informatics. There are three stages of the competition which are the first round, second round and the final round. At the final stage of the completion, the winners in all the subjects areas would have emerged, and as such talented and gifted students in these areas would have been identified. Then, the business of encouraging them and preparing them for further feats in mathematical sciences begins in earnest at this stage. Winners of each of the subjects basically are expected to represent the country at the international arena where winners from other countries converge for the international stage of the competition. This stage is highly beneficial to the students' representatives of each country because of the opportunity of meeting and associating with best brains in the mathematical sciences. Scholarship opportunities for higher degree in the mathematical sciences are also mostly available for deserving students.

Students from across all the geo-political zones of Nigeria participate in the annual Mathematical Sciences Olympiads Competition organized by the National Mathematical Centre, Abuja. There are six geo-political zones in the country namely: North East, North West, North Central, South East, South West and South South. The South West geopolitical zone of Nigeria is a strategic zone in the country as far as education is concerned. In fact, the zone is regarded as an educationally advantaged zone for many reasons. The first university, popularly referred to as 'the Premier University' was established in Ibadan, in the South West. The Premier University served the entire nation as at then before other universities came into being after more than a decade. The coming of the missionaries who brought western education to Nigeria through Badagry, a town in the South West gave the zone the opportunity of having the first sets of schools established around the South West area. All these contributed to the foremost status of the South West in Education in Nigeria. The choice of South West for this paper is premised on the aforementioned to ascertain whether the performance of students from the zone in the National Mathematics Olympiads Competition would reflect the foremost education status of the zone.

2.1. Research Questions

Answers are provided for the following questions:

1. What is the general performance of South West students in the National Mathematics Olympiads?
2. To what extent is the performance of South West male students different from their female counterparts in the National Mathematics Olympiads Competition?
3. What difference exists in the performance of South West students in the National Mathematics Olympiads Competition based on their states?

2.2. Research Hypotheses

The following hypotheses are tested:

1. There is no significant difference in the mean scores of South West students in the National Mathematics Olympiads Competition based on gender

2.   There is no significant difference in the mean scores of South West students in the National Mathematics Olympiads Competition based on their states.

2.3.   Scope of the Study

The focus of this study was on National Mathematics Olympiads at the senior secondary level. The six states namely Lagos, Ogun, Oyo, Osun, Ondo and Ekiti States in the South West geopolitical zone of Nigeria were considered for the study. The study made use of results of students for three years spanning 2015, 2016 and 2017.

2.4.   Methodology

This study was a historical survey type. The population for the study was all senior secondary school students in the South West geo-political zone of the country. The target population was the senior school students from all the six states in the South West of Nigeria who sat for the National mathematics Olympiads Competitions. Secondary data of National Olympiads results of South West students was used.

Research questions 1, 2 and 3 were answered using descriptive statistics (frequency count, percentage, mean and standard deviation). Hypothesis 1 was tested using t-test and hypothesis 2 was tested using ANOVA.

3.   Results

3.1.   Demographic Description of Data

The data presented in Table 1 and 2 included demographic characteristics of the respondents' frequency counts and percentage. The variables used included gender and state.

Table 1:   Distribution of the Respondents by Gender

Gender	Frequency	Percentage (%)
Male	1576	58.3
Female	1128	41.7
Total	**2704**	**100.0**

Table 1 revealed that out of the 2704 participants in National Mathematics Olympiads in South-west that participated in the study, 1576 representing (58.3%) were males, while 1128 representing (41.7%) were females. This shows that there were more male parcipants in National Mathematics Olympiads in South-west than female parcipants in National Mathematics Olympiads in South-west in this study.

Table 2:   Distribution of the Respondents by State

State	Frequency	Percentage (%)
Ondo	338	12.5
Osun	505	18.7
Ekiti	270	10.0
Oyo	704	26.0
Ogun	543	20.1
Lagos	344	12.7
Total	**2704**	**100.0**

Table 2 revealed that out of the 2704 participants in National Mathematics Olympiads in South-west that participated in the study, 338 representing (12.5%) were from Ondo State, 505 representing (18.7%) were from Osun State, 270 representing (10.0%) were from Ekiti, 704 (26.0%) were from Oyo State, 543 (20.1%) were from Ogun State, while 334 representing (12.7%) were from Lagos State. This shows that majority of the participants in National Mathematics Olympiads in South-west were from Oyo State in this study.

3.2.   Answering of Research Questions

Research Question 1: *What is the general performance of South-west students in the National Mathematics Olympiad*?

Table 3:   Percentage Analysis of Level of General Performance of South-west Students in the National Mathematics Olympiad

Level of Performance	Frequency	Percentage (%)
High Level of Performance	24	0.9
Average Level of Performance	629	23.3
Low Level of Performance	2051	75.8
Total	**2704**	**100.0**

The result on Table 3 indicated that 24 representing (0.9%) of students that participated in National Mathematics Olympiads Competition had high level of performance, 629 representing (23.3%) of students that participated in National Mathematics Olympiads Competition had average level of performance, 2051 representing (75.8%) of students that participated in National Mathematics Olympiads Competition had low level of performance. This implies that students that participated in National Mathematics Olympiads

Competition had low level of performance.

3.3.   Hypotheses Testing
Two research hypotheses postulated for this study were tested using the independence t-test and the ANOVA statistics at 0.05 level of significance.

H_{O1}:   *There is no significant difference in the mean scores of South-west students in the National Mathematics Olympiads Competition based on gender.*

Table 4:   Mean, Standard Deviation and *t*-test Analysis difference in the mean scores of South-west students in the National Mathematics Olympiads Competition based on gender

Gender	No	Mean	Std.	df	Cal.t-Value	Sig. (2-tailed)	Decision
Male	1576	24.17	8.65	2702	2.67	0.01	H_{01} **Rejected**
Female	1128	23.29	8.28				

P<0.05

As shown on Table 4, male students had mean score of 24.17 with standard deviation 6.65, while female had mean score of 23.29 with standard deviation of 8.28, the calculated t-value was 2.67 while its calculated significance value is 0.01 of df 2702 at alpha level of 0.05. On this basis, null hypothesis one was therefore rejected. This means that there was a significant difference in the mean scores of South-west students in the National Mathematics Olympiads Competition based on gender. The reason was that the calculated significance value (0.01) was lower than 0.05 alpha level ($\rho > 0.05$). This is in favour of the male students with a mean score of 24.17 greater than the mean score of 23.29 female students in the National Mathematics Olympiads Competition.

H_{O2}:   *There is no significant difference in the mean scores of South West students in the National Mathematics Olympiads Competition based on their states.*

Table 5:   ANOVA Summary of Difference in the Mean Scores of South West Students in the National Mathematics Olympiads Competition based on their States

Source of Variance	Sum of Square	df	Mean of Square	F	Sig.	Decision
Between Groups	5588.285	5	1117.657			H_{02}
Within Groups	190145.305	2698	70.476	15.859	0.000	**Rejected**
Total	**195733.590**	**2703**				

$\rho > 0.05$

Table 5 shows an F-value 15.859 with calculated significant 0.000 at 0.05 alpha level. Since calculated significance 0.000 is lower than 0.05 alpha level, hypothesis two is thus rejected. This implies that there was a significant difference in the mean scores of South-west students in the National Mathematics Olympiads Competition based on their states.

Table 6:   Scheffe's post hoc Table for Students in the National Mathematics Olympiads Competition based on their States

		Subset for alpha = 0.05					
Qualification	N	1	2	3	4	5	6
Ekiti	270	20.08					
Lagos	344		22.56				
Ondo	338			23.94			
Ogun	543				24.10		
Osun	505					24.73	
Oyo	704						24.89

Table 6 shows the Scheffe's post hoc for difference in the mean scores of South-west students in the National Mathematics Olympiads Competition based on their states and it was revealed that the six states were significantly different. Students from Oyo State had the highest mean score of 24.89 in subset 6, followed by students from Osun State with a mean score of 24.73 in subset 5, students from Ogun State with a mean score of 24.10 in subset 4, students from Ondo State with a mean score of 23.94 in subset 3, students from Lagos State with a mean score of 22.56 in subset 2, while students from Ekiti State had the least with a mean score of 20.08 in subset 1.

4.   Discussion, Conclusion and Recommendations
4.1.   Discussion of the Findings
Finding revealed that students that participated in National Mathematics Olympiads Competition had low level of performance. This may be as a result of low level of motivation given to the students who excelled in the

competition over the years (Cameron, David and Gear, 2005).

Another finding revealed that there was a significant difference in the mean scores of South-west students in the National Mathematics Olympiads Competition based on gender. This finding agrees with the reason for instituting PAMO-G to cater for girls in Mathematics (Usman & Ojo, 2014).

Finding revealed that there was a significant difference in the mean scores of South-west students in the National Mathematics Olympiads Competition based on their states. This is in accordance with Meremikwu, Ekwueme & Enukoha (2014) who observed that rating of regions or countries in Mathematics has often been based on competition.

4.2.   Conclusion

This study has found out that students in the South West geo-political zone of the country did not perform satisfactorily well in the National Olympiads Competitions organized by National Mathematical Centre, Abuja. This may be as a result of the standard of the examination which is of international Olympiads standard, which is way ahead of the normal Nigerian secondary school standard. It may also be as a result of the lack of enough preparation of students for the special examination owing to the demands of their normal school academic activities. Moreover, the performance may be due to the unavailability or inaccessibility of text materials needed by the students to adequately prepare.

4.3.   Recommendations

Based on the discussion, the following recommendations are provided:
1. The students are expected to be well aware of the standard of the completion so as to be well informed and prepared for the competition;
2. National Mathematical Centre should endeavour to conduct the examinations at periods that would not interfere with the normal school calendar and
3. Textbooks and other relevant preparatory materials should be made available and accessible to participating schools or students.

REFERENCES

Cameron, J.; David, P. W.; Banko, K. M.;& Gear, A. (2005). Achievement-Based Rewards and Intrinsic Motivation: A Test of Cognitive Mediators. *Journal of Educational Psychology*,97(4), 641 – 655.

Kenderov, P. S. (2006). Competitions and mathematics education. Retrieved 21st April, from http//www.google.com

Meremikwu, A.N.; Ekwueme, C.O.; Enukoha, O. I. (2014). Gender Pattern in Participation and Performance at Mathematics Olympiads. *Advances in Social Sciences Research Journal*, 1(8), 1-5. DOI: 10.14738/assj.18.620

Usman, K.O.; Ojo, S.G.(2014). Mathematics Education: A tool for competitiveness and prestige. Abacus: *Journal of Mathematical Association of Nigeria*, 39(1), 97-105.

Zawaira, A,;& Hitchcock, G. (2009).A Primer for Mathematics Competitions. NY: Oxford University Press.