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EFFECTS OF DYNAMIC GEOMETRY INSTRUCTIONAL PROGRAMME ON STUDENTS' PERFORMANCE AND RETENTION IN GEOMETRY IN NASARAWA STATE, NIGERIA

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ABSTRACT
The study investigated the effects of dynamic geometry instructional programme on SS1 students' performance and retention in geometry in Nasarawa State. Six research questions guided the study. The design of the study was quasi-experimental, non-equivalent pre-test, post- test control group type. The population consisted of all the SS1 students in 13 local governments in Nasarawa State. The sample of the study comprised 210 SS1 students in six senior secondary schools using purposive sampling technique. Geometry Performance Test (GPT) with reliability coefficients of 0.84 was used for data collection. Mean and standard deviation were used to answer the research questions. The results showed that there is significant difference in mean performance scores and mean retention scores between the SS1 students taught geometry using dynamic geometry instructional programme and those taught using the conventional method. The results showed that there is no significant difference in the performance and retention of male and female students taught geometry with dynamic geometry instructional programme. Based on the findings of the study, it was recommended among others that awareness of the positive effects of dynamic geometry instructional programme on the performance and retention in geometry should be brought to the attention of school administrators.
Key words: Dynamic, Geometry, Performance, Retention, Van Hiele

INTRODUCTION
Learning outcomes in Mathematics education have become a phenomenon of interest to all. This accounts for why scholars have been working hard to unravel factors that militate against good academic performance (Aremu & Sokan, 2014). At the outset of an activity, students differ in learning as a function of their prior experiences, personal qualities and social support. The latter includes the extent that parents and teachers encourage learners to learn, facilitate their access to resources necessary for learning, and teach them strategies that enhance knowledge and skill acquisition and refinement (Ewumi, 2012). Niemi (2012) posits that performance is basically the competence a person has in the area of content. This competence is the result of many intellectual and non-intellectual variables. Performance is the ability to handle a given task successfully using appropriate knowledge, effort and

skills. It is the word preferred in the educational or psychometric fields, being sometimes characterized by the degree of inference required on the part of the student to give a response and by the type of reference to a cognitive process made explicit in the measurement tool. Educationally, performance means the mastering of major concepts and principles, important facts and prepositions, skills, strategic knowledge and integration of knowledge (Abifarin, 2012).

Retention, as defined by Ewumi (2012), is the ability to recall or recognize what has been learned or experienced and the capacity to remember. Retention in Mathematics necessitated the initial setup to assist students to ease their transition. Hence, the need to utilize Mathematics support provision such as introductory Mathematics courses offered before the semester begins, drop-in learning/help centres, help desks, pre-booked individual appointments, examination revision support, or peer-assisted support. Geometry is the study of the properties of shapes. According to Sherald and Hang (2010), the knowledge of geometry is important for students since it can be applied in other subjects. For instance, the knowledge of geometry is applied in other subjects such as physics, engineering drawing and technical drawing. There are basically two objectives of geometry learning, which are to develop logical thinking skill and to develop special intuitions that refer to how one views space and area in real world. Dynamic Geometry Instructional Programme (DGIP) provides a range of tools for constructing geometric objects from a range of 'primitive' objects such as points, segments, lines and circles. The DGIP packages form a relatively new type of generic software. They enable users to define objects such as points, straight objects (segments, lines, rays and vectors) and circles (or arcs). The tools available in the software include 'classical' constructions (midpoint, perpendicular and parallel) as well as transformation (reflect, route and translate). Once drawn, measurements can be taken from objects (length, angle and area).

Research Questions

The following research questions were raised to guide the study:

1. How will the mean performance scores of SS1 students exposed to dynamic geometry instructional programme differ from those taught geometry using conventional method?

2. What is the difference in the mean performance scores of male and female SS1 students taught geometry using dynamic geometry instructional programme?
3. How does the mean retention scores of SS1 students exposed to dynamic geometry instructional programme differ from those taught geometry using conventional method?
4. What is the difference in the mean retention scores of male and female SS1 students when taught geometry using dynamic geometry instructional programme?
5. What is the interaction effect of dynamic geometry instructional programme and gender on students' performance scores in geometry?
6. What is the interaction effect of dynamic geometry instructional programme and gender on students' retention scores in geometry?

Students, teachers, parents and the society at large may benefit from the findings of this study as dynamic geometry instructional programme may provide a generation of school leavers that may be problem-solvers and a Mathematics loving generation. This could transform the economic prowess of the society, since no society can achieve any meaningful growth without a mathematical base.

Theoretical Framework

The theories on which this study is anchored are: Piaget's cognitive development theory, Vygotsky's social development theory and van Hieles's learning theory. Jean Piaget cognitive development theory assumes that intellectual development is a direct continuation of inborn biological development. That is, the child is born biologically equipped to make a variety of motor responses, which provide them with the framework for the thought processes that follow. Lev Vygotsky social development theory assumes that social interaction is the framework for all learning and development. To Vygotsky, the development of the mind is the interweaving of biological development of the human body and the appropriation of the cultural, ideal and material heritage which exists in the present to coordinate people with each other and the physical world. Van Hiele learning theory assumes that students pass through five hierarchical levels of thinking, namely: recognition, analysis, ordering, deduction and rigor.

Research Design

The study employed quasi-experimental design of non-randomized pre-test post-test control group type. The design was chosen because it was not possible to have complete randomization of the subjects. Therefore, intact classes were randomly assigned to experimental and control groups using simple random sampling technique. Intact classes were used so as not to disrupt the already existing settings in the school. The population of this research included all the SS1 students in the 13 local government areas that made up of Nasarawa state. Geometry Performance Test (GPT) which is a forty-item 4-option objective geometry performance test constructed by the researcher based on Senior Secondary School 1 Mathematics syllabus in the areas of lines, angles and circles was used as instrument.

Method of Data Analysis

Data were analyzed with respect to the research questions formulated for the study. Mean (x) and standard deviation (sd) were used to answer the research questions.

Analysis and Interpretation

The data collected were analyzed and interpreted using mean and standard deviation.

Research Question 1

How will the mean performance scores of SS1 students exposed to dynamic geometry instructional programme differ from those taught geometry using the conventional method?

Table 1

Mean performance scores of SS1 students in geometry exposed to experimental and control groups.

		Pre-test		Post-test		
Method	N	x	sd	x	sd	Mean gain
DGIP	110	7.27	3.36	64.46	10.22	57.19
Conventional	100	5.04	1.09	57.38	5.54	22.34
Mean difference		2.23		7.08		34.85

Table 1 shows the difference in the mean performance scores in the experimental and control groups. At pre-test the mean scores of students in the experimental group was 7.27 while that of students in the control group

was 5.04. This shows a mean difference of 2.23 in favour of the experimental group. At post-test the mean scores of students in the experimental group was 64.46 while that of students in the control group was 57.38. This shows a mean difference of 7.08 in favour of the experimental group. The mean gain of students in the experimental group was 57.19 while that of students in the control group was 22.34. This shows a mean gain difference of 34.85 in favour of experimental group who were taught with dynamic geometry instructional programme. Posttest scores of the conventional group clustered about their mean scores owing to their standard deviation of 5.54 compared to that of the experimental group with standard deviation of 10.22. Thus, the conventional group's performance was more homogenous compared with their counterparts in the experimental group.

Research Question 2

What is the difference in the mean performance scores of male and female SS1 students taught geometry using the dynamic geometry instructional programme?

Table 2: Mean performance scores and standard deviation of male and female SS1 students taught geometry using the dynamic geometry instructional programme

		Pre-test		Post-test		
Method	N	x	sd	x	sd	Mean gain
Male	58	5.00	1.25	62.9	12.26	57.95
Female	52	9.67	3.24	66.06	7.53	56.39
Mean difference		4.67		3.11		1.56

Table 2 shows the differences in the mean performance scores of male and female SS1 students taught geometry using dynamic geometry instructional programme. At pre-test, the mean for male students was 5.00 with standard deviation of 1.25. On the other hand, the mean for female students was 9.67 with standard deviation of 3.24. The mean difference of 4.67 was in favour of female students. At the post-test, the mean for male students was 62.95 with standard deviation of 12.26. On the other hand, the mean for female students was 66.06 with standard deviation of 7.53. The mean difference of 3.11 was in favour of female students. The mean gain for male students was 57.95 while that of female students was 56.39. The mean gain difference of 1.56 is however in favour of the male students. Performance of female students was

more homogenous than that of male students. This is shown by a lower standard deviation of 7.53 by the female students compared with that of 12.26 by male students.

Research Question 3

How does the mean retention scores of SS1 students exposed to dynamic geometry instructional programme differ from those taught geometry using the conventional method?

Table 3: Mean retention scores and standard deviation of students taught using dynamic geometry instructional programme and conventional method.

		Pre-test		Post-test		
Method	N	x	sd	x	sd	Mean gain
DGIP	110	8.61	3.81	59.63	8.26	51.02
Conventional	100	5.62	2.45	29.79	12.18	24.17
Mean difference		2.99		29.84		26.85

Table 3 reveals the difference in the mean retention scores for the experimental and control groups. At the pre-test the mean retention scores for experimental group was 8.61 while that of control group was 5.62. The mean retention scores difference is 2.99 in favour of experimental group taught with dynamic geometry instructional programme. At the post-test the mean retention scores for experimental group was 59.63 while that of control group was 29.79. The mean retention scores difference is 29.84 in favour of those taught using the dynamic geometry instructional programme. The mean gain for experimental group was 51.02 while that of control group was 24.17. The mean gain difference of 26.85 was also in favour of the experimental group exposed to dynamic geometry instructional programme. Those exposed to dynamic geometry instructional programme with standard deviation of 8.26 performed more homogenously compared with those in the conventional group whose standard deviation is 12.18.

Research Question 4

What is the difference in the mean retention scores of male and female SS1 students when taught geometry using dynamic geometry instructional programme.

Table 4: Mean retention scores and standard deviation of male and female students in the experimental group.

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		Pre-test		Post-test		
Method	N	x	sd	x	sd	Mean gain
Male	57	5.18	2.16	59.63	10.87	54.45
Female	43	6.21	2.70	58.65	13.32	52.44
Mean difference		1.03		0.98		2.01

Table 4 shows the differences in the mean retention scores of male and female SS1 geometry students. At pre-test, the mean for male students was 5.18 with standard deviation of 2.16. On the other hand, the mean for female students was 6.21 with standard deviation of 2.70. The mean difference of 1.03 was in favour of the female students. At the post-test, the mean for male students was 59.63 with standard deviation of 10.87. On the other hand, the mean for female students was 58.65 with standard deviation of 13.32. The mean difference of 0.98 was in favour of the male students. The mean gain for male and female students was 54.45 and 52.44 respectively. The mean gain difference of 2.01 is in favour of the male students. Post-test retention scores of male students are more homogenous with standard deviation of 10.87, than that of female students with standard deviation of 13.32.

DISCUSSION OF FINDINGS

The result shows that dynamic geometry instructional programme enhances students' better performance in geometry. This finding agrees with Usiskin (2012) who found out that dynamic geometry instructional programme is a very good predictor of performance in the standard test and in the proof test. Brewton (2011) also found that there was a significant effect of treatment on students' performance in geometry. It was ascertained that six issues that needed urgent attention to the improvement of geometry teaching include: classroom interactions and atmosphere; anti-intellectualism and attribution style; Geometry as male domain; peers, teachers and society's cultural expectation; biased and inappropriate materials and assessment with dynamic geometry instructional programme. This finding is also similar to that of Azuka (2013) who discovered that using dynamic geometry instructional programme in learning creates the environment where the students can touch, feel, participate, discover, reason, deduce and interface ideas in the learning process. They may create their own conjectures and make a construction with technology to write a proof of argument. Teachers may need examples to encourage students to learn conjectures. The applications of dynamic geometry instructional programme will add excitement and motivation to the geometry learning environment; geometry

lessons will be enhanced by utilizing such software. Students can rotate figures, elongate lines, and add new constructions in order to make informed conjectures.

The finding revealed that dynamic geometry instructional programme is a programme that enhances students' better retention in geometry. This finding confirms Amoo (2012) who reported that students' intrinsic and extrinsic attitude positively affect their retention in geometry. The result further showed that students' perception of any task especially at the beginning affects the outcome of their existence more than anything else. It was concluded that retention of students in geometry largely depends on their attitude to the usage of dynamic geometry instructional programme. The finding of this study also agrees with Akinlolu (2011) who found that dynamic geometry instructional programme has significant effect on students' retention abilities. This finding corroborates Etukudo (2012) who found that there is no significant gender difference in the performance of students in the control group. This implies that students' performance in geometry is not dependent on gender. That is, both male and female students have good brains for using dynamic geometry instructional programme.

CONCLUSION

The findings of this study showed that inclusion of dynamic geometry instructional programme has a significant effect on SS1 students' performance and retention in geometry. This clearly indicates that the level of performance and retention of SS1 students is dependent on the strategy of instruction. The use of dynamic geometry instructional programme gave the students the opportunity to interact freely among themselves and clarified doubts whenever the need arose. This showed a higher performance and retention of students who were exposed to dynamic geometry instructional programme above those that used conventional method. The study also proved that dynamic geometry instructional programme was beneficial to both male and female students. There is significant interaction effect of methods and gender on mean performance scores and mean retention scores of SS1 students in geometry. The implication is that Mathematics teachers can adopt dynamic geometry instructional programme to students irrespective of their gender.

REFERENCES

Abifarin, E.A. (2012). Exploring the link between pre-service teachers' conception of proof and the use of dynamic geometry instructional programme. *School Science and Mathematics,* 102(5), 32-36.

Akinlolu, E. (2011). The use of dynamic geometry instructional programme in enhancing students' retention and performance in geometry. *Research Journal of Applied Sciences, Engineering and Technology,* 5(5), 49-57.

Amoo, I. (2012). Students' attitude to the usage of dynamic geometry instructional programme in Akure, Ondo State. *Eurasia Journal of Mathematics, Science and Technology Education,* 2(3), 66-78.

Aremu, S., & Sokan, K. (2014). Van Hiele levels and performance in writing geometry proofs. *Journal for Research in Mathematics Education,* 20(3), 56-61.

Azuka, P. (2013). Geometry learning using dynamic geometry instructional programme in Kubwa, Abuja. *Journal for Research in Mathematics Education,* 22(3), 113-118.

Brewton, T. (2011). Enhancing learning environments in geometry in Osun State. *Mathematics Teacher,* 8(3), 12-17.

Etukudo, D. (2012). Gender equality struggle among the students in government secondary school, Nyanya, Abuja. *Research Journal of Mathematics and Statistics,* 3(4), 65-73.

Ewumi, G. (2012). *Challenges of Mathematics in secondary schools*. Hong Kong: University Press.

Niemi, H. (2012). *Enhancing learning environments*. Georgia Southern University, U.S.A: Statesboro Press.

Sherard, A., & Hang A. (2010). The van Hiele levels using three-dimensional geometry and the spatial abilities of a group of pre-service secondary teachers in Southampton. England, *Mathematical Periscope,* 3(7), 122-128.

Usiskin, T. (2012). The ability of the dynamic geometry instructional programme to describe and predict the performance of students in secondary school geometry in Boston. *Boston College International Journal,* 5(3), 12-17.