EFFECTS OF CIRCLE THE SAGE INSTRUCTIONAL STRATEGY ON SENIOR SECONDARY SCHOOLS STUDENTS' NUMERICAL ABILITY IN PHYSICS IN EKITI STATE, NIGERIA.

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ABSTRACT

The study examined effect of circle the sage instructional strategy on students' numerical ability in Physics in senior secondary schools in Ikere local government of area of Ekiti state. A sample of sixty (60) students was selected for the study. A self-structured Physics Numerical Ability Test was used for data collection. A pre-test post-test quasi experimental research design was employed for the study. Two secondary schools in Ekiti state were chosen for the study. A test-retest method was employed to ascertain the reliability of the instrument, using Pearson Product Moment Correlation (PPMC). Three (3) hypotheses were formulated for the study. Data collected were analysed using ANCOVA. The findings of the study revealed that there was no significant effect of treatment on numerical ability of students in Physics, there was no significant effect of gender on numerical ability of students in Physics and there was no significant interaction effect of treatment and gender on numerical ability of students in Physics. Therefore, the study recommended that, though there was no effect of circle the sage strategiy on students' numerical ability but cicle the sage with other strategies should be used to teach Physics at all level and be incorporated into the teaching of Physics at the secondary school level

Keywords: *circle the sage, gender, numerical ability, performance, physics, instructional strategy.*

Introduction

International Union of Pure and Applied Physics (2009) described Physics as the study of matter, energy and their interactions. Physics can also be defined

as the study of energy and matter in space and time and how they are related to each other. Physics is generally regarded as the fulcrum of all technological advancement. This simply means that physics affects all areas of technology. It also establishes that behind every technology. In a nutshell, the discipline plays a vital role in the future progress of humankind. Physics education is an integral part of everyone's life. It produces required knowledge useful for future technological advances that will continue to drive the economic engines of the globe (Amunga, Musasia and Musera, 2011). It contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries (Kuhn and Brekl, 2012; Freeman, 2012). All school systems need to have provision for studying Physics education. Physics in senior secondary schools is usually offered by science students. Physics is learnt in senior secondary to prepare the students to be great engineers and scientists in future. Good academic performance(A1-C6) in Physics at this level opens door of opportunities of becoming dreamed engineers, scientists and technologists while poor performance(D7-F9) closes the dooor and presses students towards Physics non-related careers(Fasakin, 2011). The table below showed the performances of senior secondary schoools students in Physics in Nigeria.

Table 1: Performance of Students in Physics in West African Senior School Certificate Examination 2006-2019

Year	No of Candidates	Credit (1-6)%	Pass (7-8)%	Fail (9)%	Total Failure(7-9)%
2006	375824	58.05	23.15	16.52	39.67
2007	418593	43.19	33.48	21.13	54.61
2008	415113	48.26	21.95	28.13	50.08
2009	456636	47.83	30.41	17.16	47.57
2010	463775	51.27	26.40	18.27	44.67
2011	563161	63.94	24.30	11.76	36.06
2012	624658	68.74	22.06	9.20	31.26
2013	638857	46.62	27.62	22.92	50.54
2014	644391	60.21	24.83	12.58	37.41
2015	605248	40.02	25.36	34.62	59.98
2016	666901	76.27	16.05	5.52	21.57

2017	709481	53.10	27.43	17.40	44.83
2018	727733	78.40	13.95	4.85	18.80
2019	742394	76.95	14.69	5.73	20.42

Source: Research and Statistics Unit, West African Examination Council, Yaba, Lagos, Nigeria.

The above table showed inconsistencies and fluctuations in the performance of senior secondary schools students in physics in years 2006 to 2019 under review. Xraying the factors responsible for the performances of students, Abubakar and Adegboyega, (2012) established a positive correlation between students' performance and their numerical ability in physics in senior secondary schools. Othman (2006) descibed numerical ability as the ability to deal with numbers, and solve simple problems. In the field of science. the number and operations aims to assist the learners to comprehend the numbers; representation of number; the associations between numbers and numerical systems and decode the meanings of operations (National Council of Teachers of Mathematics, 2000). Students who have effective mastery of numerical aspects of Physics have more opportunity of performing well in physics. Numerical ability is significant in academic achievement of the students in Physics (Fredel, 2015). Also, Rova (2012) reported that there was significant difference between performance of Physics students taught numerical ability with various instructional strategies and those taught with lecture method.

Moreover, gender difference occured in numerical ability in favour of male students (Ameer and Singh, 2013) but Satish and Himanshu (2019) and Wachanga and Mwangi (2014) reported that there was no significant difference in the numerica ability of students based on gender.

There are various instructional strategies of improving students' numerical ability. Among them, we have circle the sage. Circle the Sage is one of cooperative learning structures developed by Dr. Spencer Kagan. According to the researches, it aids cooperative learning which are positive interdependence, individual accountability, equal participation and simultaneous interaction.

Circle the Sage is a cooperative learning where the teacher polls the class to see which learners have special knowledge to share on a topic. Those learners become the sages. They stand and spread out in the classroom. The teacher breaks the remaining learners evenly into teams and teams send members to

different sages, (with no more than two members of the same team going to the same sage). The sage explains what they know while the mates listen, ask questions, and take notes. All learners thereafter return to their teams. Hence, this study examined the effect of circle the sage strategy on students' numerical ability in Physics in senior secondary schools in Ise local government of area of Ekiti state.

Statement of the Problem

Despite the high position offered to Physics in Nigerian education system, it is disheartening that approaches and strategies for teaching and learning of this subject at secondary schools levels still remain traditional (Achor, Imoko and Uloko 2013). There has been so much agitation from educational stake holders about the poor performance of students in Physics and several factor have been identified as responsible for the poor numerical ability of students which are of classroom interaction which are part to the insufficient interaction between the teacher and the students. Despite the value and importance of mathematics in secondary school, the subject still seems to be difficult for students as evident in their low achievement in the subject especially at external examination, (WAEC, 2006-2019).

The question therefore is what is the cause of this fallen standard and poor academic achievement of students in Physics? Is the fault entirely that of the teacher or teaching methods? Thus, the study aimed at providing answer to the question:- What are effects of circle the sage strategy on students' numerical ability in Physics in senior secondary schools? Therefore, this study aimed at finding out effect of circle the sage strategy on students' numerical ability in Physics in senior secondary schools in Ekiti state, Nigeria.

Research Hypotheses

The following hypotheses were formulated for the study:

Ho1: There is no significant effect of treatment on students' numerical ability in Physics.

Ho2: There is no significant of effect of gender on students' numerical ability in Physics.

Ho3: There is no significant interaction effects of treatment and gender on students' numerical ability in Physics.

Research Design

A 2x1x1 pre-test post-test quasi experimental research design was used.

Sample of the Study

The sample for the study was made up of sixty (60) students. Simple random sampling technique was used to select sixty (60) students from two senior secondary schools in Ise local government area. The schools are randomly assigned to two treatment groups.

Instrument for Data Collection

The research instrument used in this study was twenty (20) objective questions used for the pre-test, post-test tagged Physics Numerical Ability Test (PNAT).

Method of Data Analysis

The analytical technique used to analyze the data collected was ANCOVA analysis carried out at 5% probability level of significance.

Test of Hypotheses

Hypothesis 1

There is no significant effect of treatment on numerical ability of students in Physics.

Table 2: ANCOVA analysis of effect of treatment on numerical ability of students in Physics.

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	224.870[a]	4	60.441	14.116	.257
Intercept	324.002	1	324.002	75.401	.012
Treatment	9.411	1	9.411	1.261	.119
Postttest	182.117	1	182.117	42.191	.267
Error	412.739	95	4.345		
Total	27129.000	100			

Corrected Total	657.710	99

[a]R squared= 0.311(Adjusted R square=0.316)

Table 2 indicates the effect of the treatment on students' numerical ability in physics. It was revealed that the significant value is F(1,99)=1.261,P(0.05), partial η^2= 0.119 is higher than significant value 0.05. This indicated that the group does not differ significantly on the effect of the treatment. Hence the null hypothesis was not rejected. This revealed that there was no significant effect of treatment on numerical ability of students in Physics.

Hypothesis 2: There is no significant effect of gender on numerical ability of students in Physics.

Table 3: ANCOVA analysis of effect of gender on numerical ability of students in Physics

Tests of Between-Subjects Effects

Dependent Variable: Pretest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	240.573[a]	2	120.286	27.971	.000	.366
Intercept	341.019	1	341.019	79.300	.000	.450
Gender						
Prettest	208.083	1	208.083	48.387	.000	.333
Gender	14.507	1	14.507	3.373	.069	.034
Error	417.137	97	4.300			
Total	27129.000	100				
Corrected Total	657.710	99				

[a]R squared=0.366 (Adjusted R square= 0.353)

Table 3 presents a one-way between subject analysis of covariance (ANCOVA) conducted on the effect of gender on numerical ability of students in Physics, F(1,99) = 3.373, p<0.05, Partial η^2 = 0.034 which higher than significant value

of 0.05. Hence, the null hypothesis was upheld. Therefore, there was no significant effect of gender on students' numerical ability.

Hypothesis 3

There is no significant interaction effect of treatment and gender on numerical ability of students in Physics.

Table 4: Two-way ANCOVA analysis on interaction effect of treatment and gender on numerical ability of students in Physics

Interaction Effects of treatment and gender						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	244.971[a]	4	61.243	14.096	.000	.372
Intercept	327.982	1	327.982	75.491	.000	.443
Postttest	192.007	1	192.007	44.194	.000	.317
Method	13.624	1	13.624	3.136	.080	.032
Gender	.396	1	.396	.091	.763	.001
treatment* gender	3.922	1	3.922	.903	.344	.009
Error	412.739	95	4.345			
Total	27129.000	100				
Corrected Total	657.710	99				

[a]R squared= 0.372 (Adjusted R square=0.346)

The result in Table 4 shows the effect of students' gender on numerical ability of student taught physics using circle the sage strategy. The ANCOVA reveals that students' gender have effect on their numerical ability in the posttest since $F(1, 99) = 0.903$, $p<0.05$, Partial $\eta^2 = 0.009$. Hence, the null hypothesis was not rejected . This implies that there was no significant interaction effect of treatment and gender on numerical ability of students in Physics.

Discussion of the Findings

The study is on the effect of circle the sage strategy on students' numerical ability in Physics in senior secondary schools in Ekiti state, Nigeria. The

descriptive analysis of the study pointed out homogeneity in the achievement test by the respondents as there was marginal difference in the mean scores of boys and girls taught physics using circle the sage strategy.

The finding of the hypothesis one revealed that there was no significant effect of treatment on numerical ability of students in Physics. The study showed that, circle the sage strategy has no effect on numerical ability of students in Physics. This finding is in disagreement with that of Aronson, (2018), who observed that the significance of using circle the sage strategy in teaching is to promote students learning and academic achievement and this helps increase student's retention.

The finding also revealed that there was no significant effect of gender on numerical ability of students in Physics. This implies that the null hypothesis that state that there was no significant effect of gender on numerical ability of students in Physics was upheld. Hence, there was no significant effect of gender on students' numerical ability.

The finding further showed that there was significant interaction effect of treatment and gender on numerical ability of students in Physics. The study further showed that numerical ability of female students in Physics that were taught using circle the sage strategy performed better than male students with a mean score of 9.75 and standard deviation of 2.381 against 9.80 with a standard deviation of 2.860. However, the finding concurred with Kayode (2012) that gender differences favored girls in learning Physics and that males performed low in tasks that involve learning the concept of Physics. Also, in contrary to this, the finding of Wachanga and Mwangi (2014) found no significant differences between boys and girls who were exposed to circle the sage strategy. He added that boys and girls in the experimental groups who were instructed through circle the sage strategy in Physics performed equally in the posttest. Adeyemi (2010) reported no significant differences in the academic achievement of boys and girls of equivalent abilities when they were taught through circle the sage strategy.

Conclusion

The findings have led the researcher to conclude that circle the sage strategy has no effect on students' numerical ability in physics in Ekiti state. By applying Circle the Sage strategy, the students were more enthusiastic in learning.

Though the students enjoyed the learning process since they were given chance to actively interact each other and shared what they knew about the material.Nevertheless, Circle the Sage strategy made the students more motivated to learn because they were arranged to teach each other and discuss in a team. Meaningful circle the sage strategy is an effective way of explaining concepts to students. Circle the sage strategy has the potential of promoting and maintaining students' numerical ability in physics since it makes the learning process more real and easy to comprehend by learners.

Based on the findings of this study, it is evident that gender has no significant effect on students' numerical ability. Lastly, the study concludes that significant difference existed in gender performance with respect to the two strategies employed in the experimental group. Female students outperformed their male counterpart when been exposed to circle the sage strategy.

Recommendations

Based on the findings made so far, the researchers therefore recommend the followings;

1. Circle the sage strategy should be used in combination with other strategies to teach Physics at all levels.
2. Nevertheless, circle the sage strategy should be incorporated into the teaching of Physics at the secondary school level since it stimulate students to effectively learn and retain the concepts presented to them.
3. Teachers should ensure they plan their lessons with equal learning chances for both male and female students for effective delivery in senior secondary schools in Ekiti State.
4. Teachers should make adequate use of teaching facilities for effective transfer of knowledge in teaching Physics.

REFERENCES

Abubakar, M.N. and Adegboyega, B.B. (2012). The construction of a scale to measure mathematical ability in psychology students: An application of the Rasch model. *Testing Psychometrics Methodology in Applied Psychology, 15(1), 3-18.*

Achor, S.S, Imoko, L.O. and Uloko, K.U.(2013). What is high stakes testing? http://www.http://childparenting.about.com/

Ameer and Singh, P.(2013). Exploring Grade levels and gender differences in numeracy thinking among secondary schools students. 6th International Conference o University Learning and Teaching. *Procedia-Social and Behavioural Sciences 90(2013)187-195.*

Amunga, A.A. Musasia, K.J. and Musera, Y.O. (2011). Factors influencing the selection of standardized tests for the diagnosis of specific language impairment. *Language, Speech, and Hearing Services in Schools, 44(2), 133-146. http://dx.doi.org/10.1044/0161-*1461(2012/12-0093)

Fredel, A.C. (2015). Assessing mathematics competence in introductory statistic courses: An application of the Item Response Theory. *Proceedings of the Eighth International Conference on Teaching*

Freeman, A.E. (2012). A model for conducting a functional analysis of academic performance problems. *School Psychology Review, 26, 554-574.* International Union of Pure and Applied Physics(IUPAP, 2009) Defination of Physics.

Kayode, I.O. (2012). The Inclusive Papers – Strategies to MakeInclusion Work Toronto: Inclusion Press

Kuhn, J.J. and Brekl, G.D. (2012); Psychometric characteristics of cognitive development and achievement instruments in Round 2 of Young Lives. Young Lives Technical Note, No. 15.

National Council of Teachers of Mathematics (NCTM, 2000). Fundamentals of Item Response Theory. SAGE publication: Newbury Park, California. http://dx.doi.org/10.1207/s15327906mbr1901_3

Rova, V.C. (2012). The development, validity, reliability and practicality of a new measure of palliative care: the Support Team Assessment Schedule (Doctoral thesis, University of London).

Satish,A.P and Himanshu, P.S. (2019). A Study of Numerical Ability of Secondary School Students in Relation to their Gender. *International Journal of Research in all Subjects in Multi Languages, 7(6), 1-5.*

Wachanga, W.O. and Mwangi, T.T. (2014) Each Belongs – Integrated Education in Canada Bristol: The Centre for Studies in Inclusive Education

West African Examination Council, (2006-2019). Performances of Students in Physics.