EFFECTS OF YOUTUBE VIDEOS INSTRUCTIONAL STRATEGY IN ENHANCING STUDENTS' ACHIEVEMENT IN MATHEMATICS BY GENDER AND BIRTH ORDER

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Abstract

The study investigated the effect of YouTube videos instructional strategy in enhancing students' achievement in Mathematics by gender and birth order. A pretest-posttest, quasi-experimental design with a non-equivalent control group was adopted. Eighty-eight (88) SS2 students in Bomadi Local Government Area of Delta State, Nigeria, were purposively selected for the study. Two schools were randomly assigned to experimental and control groups and the study lasted for five weeks. The instrument used for the study was the Mathematics Achievement Test (MAT) with a reliability of 0.82 using Kuder-Richardson Formula 21(KR-21). Two research questions were answered and two null hypotheses were tested at 0.05 level of significance. Mean and standard deviation scores were used to analyze the research questions and Analysis of Covariance (ANCOVA) was used for the hypotheses. Treatment was found to have no significant effect on students' achievement in Mathematics by gender and birth order. This is shown by the 2-way interaction of instructional strategies on gender and birth order ($F_{1,83} = 0.446$; $p(0.506) > 0.05$; partial eta squared = 0.005 which gives an effect size of 0.5 percent) and ($F_{1,83} = 0.118$; $p (0.732) > 0.05$; partial eta squared = 0.001 which gives an effect size of 0.1 percent) respectively. The findings showed that YouTube videos' instructional strategy improved students' achievement in Mathematics equally despite differences in gender and birth order. It was recommended among others that, teachers should integrate YouTube videos in instruction to improve students' achievement and to eliminate gender and birth order differences in Mathematics among secondary school students.

KEYWORDS: YouTube videos, Lecture instructional strategy, Mathematics, birth order, gender

Introduction

Mathematics is a field of study that is needed in every human endeavor, any functional system, organizations, industries, skill acquisition and training, and nations as a whole. For instance, mathematics is needed by the housewife for a happy and successful marriage and family. In all domestic activities such as preparing tasty meals, laundry services, management of funds and, etc an element of mathematics is needed. Davies and Hersh (2012) see mathematics as an important school subject not only for getting an academic qualification at school or college but also is a subject that prepares the students for the future irrespective of which walk of life they choose to be a part of. Mefor (2014) stated that mathematics relates to everything in the universe from the smallest to the largest.

Umameh (2011) avers that mathematics is intimately connected to daily life and everybody's life-long planning. Therefore, without mathematics education; human life cannot function effectively.

According to Mushau and Tijani (2011) and Mafiane (2006), any society which aspires to be scientifically and technologically developed must be ready to take mathematics education very serious, since mathematics has ingredients for the effective articulation of the abstract elements of science that gives thrust to the development of technologies. Ukeje in Okigbo and Okeke (2011) state that without mathematics, there is no science, without science, there is no modern technology and without modern technology, there is no modern society. Therefore, mathematics is the precursor and the queen of science and technology and the indispensable single element in modern societal development (Ukeje, 2011).Thus, it is not out of place for mathematics to be a compulsory school subject from primary to secondary levels of education and in most entrance examinations in Nigeria.

However, despite the importance of mathematics as a key school subject in realizing any nation's scientific and technological aspirations, there is ample evidence of continued low interest in the subject by Nigerian students (Okigbo & Okeke, 2011). In the same vein, the achievement of students in mathematics is below expectations. The West African Examinations Council (WAEC, 2012, 2013, and 2014) lamented over the low achievement and interest of students in mathematics by Nigerian candidates. The West African Examinations Council recorded poor results in 2010, 2016, and 2017; only 25, 52.97and 59.22 percent obtained credits in five (5) subjects and above, including English Language and Mathematics respectively.

There are many causes of poor performance in mathematics among senior secondary school students. For instance, Tshabalala and Ncube (2013) were of the view that shortage of well-trained teachers, inadequate teaching facilities, large classes, poorly motivated teachers, lack of laboratories and libraries, poorly coordinated supervisory activities, automatic promotions of pupils, the negative role of public examinations on the teaching-learning process and inequality in educational opportunities, etc hamper the smooth acquisition of mathematics knowledge. In addition to the above causes of poor performance in mathematics, the Science Teachers' Association of Nigeria (STAN), as cited in Ojimba (2012), is of the view that well-known causes of poor performance in mathematics are: an acute shortage of qualified professional mathematics teacher, students' negative attitude toward mathematics, undue emphasis on the coverage of mathematics syllabus at the expense of meaningful learning of mathematics concepts and mathematics laboratories among others. Attwood (2014) attributed poor performance in mathematics to parental attitude, interrupted teaching, poor teaching, and dyscalculia. Karue and Amukowa (2013) pointed out that lack of meaningful library and laboratory, qualified teachers, home environmental factors and family background as well as little participation of parents in the education of their children as the main causes of poor performance in mathematics in Kenya certificate of secondary examination in Embu District in Kenya.

The shortage of professional mathematics teachers has led to adopting poor instructional strategies in teaching mathematics. For instance, the traditional lecture instructional strategy is not a good method of teaching mathematics and science in primary and secondary school levels. Achuonye and Ajoku (2003) gave the following reasons why it is not a good strategy for teaching mathematics. It is not learners-centered; the teacher talks only, write at will on the board, and dictate the pace of the instructional process. The teacher is more active than the learners. Learners are passive listeners and are spoon-fed by the teacher. Frederick-Jonah (2020) describes the lecture strategy as a monopolized teaching strategy of which students are considered as without or with little knowledge of no significant contribution. Thus, learners are easily bored and frustrated. Therefore, there is a need to adopt other strategies that are technology-based such as YouTube videos to enhance the traditional strategies in this modern era.

YouTube has a high potential for improving the learning skills of students. YouTube videos are engaging and entertaining learning mediation tools in a classroom situation (Imathiu, 2018). Educational YouTube videos may promote collaborative and active learning that may improve students' achievement in science and mathematics when students are allowed to share and discuss what they watch. Again, videos can be watched at home, school, and anywhere, they provide constant visualization of abstract mathematics concepts. Research studies, such as Ibrahim; and Dreon, Kerper, & Landis, cited in Ebied, Kahouf, & Rahman (2016) stated respectively that a deeper understanding of learning in subjects in educational practice can be achieved through YouTube content production. YouTube video tutorials are also useful tools in learning skills in general and in particular computer skills. This seasoned idea can be extended to other fields of study likein sciences and mathematics. This was confirmed by Burke, Snyder, and Rager in Garrett-Wright and Abell (2011) that YouTube is an effective teaching strategy in health care and other disciplines and recommended further research regarding YouTube as a teaching strategy.

Whatever strategies educators apply in the teaching and learning of mathematics should yield positive results for both gender and birth order differences. Gender is an important aspect of human relationships that cannot be overlooked. According to Frederick-Jonah, Akporehwe, and Moses (2019), gender relates to the cultural, economic, social, political, and educational chances and considerations connected with being male and female. It has a powerful effect on every social interaction, as well as interactions in the educational sector. Its effects are woven into educational outcomes, and at times contribute to complicated disparities, specifically in the field of mathematics education (Doerr, 2011). Thus, studies such as Ahumaraeze and Ekwueme (2019) and Kurume and Iji (2009) found significant differences in the performance of males and females in mathematics. However, Mman and Tudunkaya (2019) and Ajaegba and Ekwueme (2019) found no significant gender disparity in mathematics.

Another variable of the study is birth order differences. Birth order refers to the order or position a child is born in their family; first-born and second-born are examples. Birth order is often believed to have a profound and lasting effect on the psychological development

of a child (Morales, 2014). The position of a child in his family is a powerful predictor of academic achievement and it is a factor that parents and teachers need to consider as they look for ways to raise happy and well-adjusted children (Groosein Ejekwu, 2016). McNally and Yuen (2015) found a statistically significant relationship between birth order and college Grade Point Average (GPA) and an insignificant relationship in anxiety level and self-esteem. Ejekwu (2016) found a significant difference in the academic performance of the lastborn girl-child performing better than the middle born. Also, a significant difference was observed in the academic performance of middle born and only-child girl-child in primary school.

The procedure for developing the steps of the YouTube videos instructional strategy is born out of the social constructivism of Bandura (1977). Social constructivism emphasized that the learner is an active participant. The learner should be involved in structuring his own learning experience based on his prior knowledge and that learning is best achieved through group or in a collaborative setting with the teacher as a facilitator (Okoli, 2012).This study allows students to watch YouTube videos at home and during the normal class period. The students discuss all that they understand from the videos during the class and the teacher plays the role of a facilitator. Also, the dual cognitive coding theory by Paivo in 1986 cited in Hansen and Erdley (2009) is appropriate to this study. Paivio states that video productions tap the learner's auditory and visual channels in the brain for effective students' learning. The coding, organizing, storing, and retrieving process of the brain is done by the verbal and nonverbal coding system in the brain. The methodology adopted in this study is apt to the theory.

Statement of the Problem

Mathematics is one of the core and compulsory school subjects at the basic and through the secondary levels of education in Nigeria. It is very important as it lays the foundation for the study of science-related subjects at a higher level. The proper implementation of the mathematics curriculum to avoid any disparity in academic achievement among male and female students and on other learner variables like birth order is a concern to mathematics educators. This concern may be addressed through the application of innovative teaching strategies rather than the commonly used traditional lecture instructional strategy which might have contributed to low academic achievement and disparity in learner variables in mathematics. YouTube videos are relatively used in the classroom at the secondary school level of education. Therefore, this study examines the effect of YouTube video as an instructional strategy in enhancing students' achievement in simultaneous linear equations and algebraic fractions by gender and birth order.

Research Questions

The following research questions were raised to guide the study:

1. What is the mean difference that exists in the achievement of male and female students in Mathematics when taught with YouTube videos and those taught with modified lecture instructional strategies?

2. What is the mean difference that exists in the achievement of first-second born and later born students in Mathematics when taught with YouTube videos and those taught with modified lecture instructional strategies?

Research Hypotheses

The following null hypotheses will be tested at a 0.05 level of significance.

HO_1: there is no statistically significant difference in the achievement of male and female students in Mathematics when taught with YouTube videos and those taught with the modified lecture instructional strategies?

HO_2: there is no statistically significant difference in the achievement of first-second born and later-born students in Mathematics when taught with YouTube videos and those taught with modified lecture instructional strategies?

Methodology

The study adopted a quasi-experimental design with non-equivalent control groups. Two schools were purposively selected after satisfying the following criteria. The schools must be public; teachers must be a specialist in mathematics education and are willing to be involved in the experiment. One intact class was randomly assigned to the treatment and control group from the two schools. **A total of 88 students (males=54, females=34) were involved in the study.** Both the experimental and control groups were pretested and post-tested before and after the treatment respectively. Students in the experimental group were given the videos in flash drives, compact disc and etc depending on the electronic device available to them which they watch at home. The first activity for the experimental group is for learners to discuss what they observe and learn from the videos in the class while the teacher plays the role of a facilitator. These videos are replayed in the classroom for more reinforcement; understanding and discussion followed by solving more examples on the chalkboard. The instrument used in this study is the Mathematics Achievement Test (MAT). There were two instructional guides, namely: Instructional Guide on YouTube Videos Instructional Strategy (IGYVIS) and Instructional Guide on Modified Lecture Instructional Strategy (IGMLIS). IGYVIS and IGMLIS were used as teaching guides for the experimental and control groups respectively. The Mathematics Achievement Test (MAT) had a reliability of 0.82 using Kuder-Richardson Formula 21 (KR-21). All the instruments were duly validated by expert review.

The first week was used for the training of the participating teachers in each of the schools by the researchers on the use of IGYVIS and IGMLIS. The second week was used for the administration of pre-test by the teachers and researchers on MAT. The next two weeks (3-4) were used for the administration of treatment to the experimental group; YouTube Videos Instructional Strategy (YVIS) and control group; Modified Lecture Instructional Strategy (MLIS) and week five was used for the administration of posttest on MAT by the teachers and researchers.

Method of Data Analysis

 The data collected were analyzed using Analysis of Covariance (ANCOVA). This was adopted to test the hypotheses using pre-test scores as covariates. The research questions were analyzed using mean and standard deviation scores.

Results

Research Question 1:

What is the mean difference that exists in the achievement of male and female students in Mathematics when taught with YouTube videos and those taught with modified lecture instructional strategies?

Table 1: Summary of the mean and standard deviation of pretest and posttest scores on the effect of instructional strategies on male and female students' achievement in

Instructional Strategies	Gender	N	Pretest scores		Posttest scores		Mean gain scores
			X	SD	X	SD	
YouTube videos	Male	26	19.62	5.85	75.15	5.13	55.53
	Female	16	18.25	6.73	74.75	4.73	56.50
	Total	42	19.10	6.16	75.00	4.92	55.90
Modified lecture	Male	28	20.57	7.34	43.79	7.43	23.22
	Female	18	19.22	7.43	41.56	6.66	22.34
	Total	46	20.04	7.32	42.91	7.15	22.87
Total	Male	54	20.11	6.62	58.89	17.05	38.78
	Female	34	18.76	7.02	57.18	17.77	38.42
	Total	88	19.59	6.77	58.23	17.25	38.64

Mathematics

The data presented in Table 1 shows that the post-test mean score of male students taught withYouTube videos 75.15 was greater than their female counterparts with 74.75. Also, the post-test mean score of male students taught with Modified lecture strategy 43.79 is greater than those of female counterparts with 41.56. On the total, the post-test mean score of male students taught with YouTube videos and Modified lecture strategy is 58.89 greater than their female colleagues with 57.18. The table further indicates that the mean gain score of male students taught with both instructional strategies 38.78 was greater than those of their female colleagues with 38.42.This simply implies that; the achievement of male students was slightly higher than those of their female colleagues when taught with both instructional strategies.

Research Question 2:

What is the mean difference that exists in the achievement of first-second born and later-born students in Mathematics when taught with YouTube videos and those taught with modified lecture instructional strategies?

Table 3: Summary of the mean and standard deviation of pretest and posttest scores on the effect of instructional strategies on first-second and later-born students' achievement in Mathematics

Instructional Strategies	Birth Order	N	Pretest scores		Posttest scores		Mean gain scores
			X	SD	X	SD	
YouTube videos	First-second	17	20.35	7.04	74.59	4.62	54.24
	Later	25	18.24	5.46	75.28	5.19	57.04
	Total	42	19.10	6.16	75.00	4.92	55.90
Modified lecture	First-second	14	20.29	8.41	41.71	7.05	21.42
	Later	32	19.94	6.94	43.44	7.23	23.50
	Total	46	20.04	7.32	42.91	7.15	22.87
Total	First-second	31	20.32	7.56	59.74	17.59	39.42
	Later	57	19.19	6.33	57.40	17.17	38.21
	Total	88	19.59	6.77	58.23	17.25	38.64

The data presented in Table 2 reveals that the post-test mean score of later-born students taught with YouTube videos 75.28 was greater than their first-second born counterparts with 74.59. Also, the post-test mean score of later-born students taught with Modified lecture strategy 43.44 is greater than those of first-second born counterparts with 41.71. On the total, the post-test mean score of first-second born students taught with YouTube videos and modified lecture strategies is 59.74 greater than their later-born colleagues with 57.40. The table further indicates that the mean gain score of first-second born students taught with both instructional strategies 39.42 was greater than those of their later-born colleagues with 38.21. This simply implies that; the achievement of first-second-born students was slightly higher than those of their later-born colleagues when taught with both instructional strategies.

Hypothesis one

There is no statistically significant difference in the achievement of male and female students in Mathematics when taught with YouTube videos and those taught with the modified lecture instructional strategies?

Table 3: 2 x 2 factorial analysis of covariance (ANCOVA) of post-test scores of male and female students' achievement in Mathematics when taught with YouTube videos and modified lecture instructional strategies

Source of Variati	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Decision p < 0.05
Corrected Model	22661.697	4	5665.424	145.413	.000	.875	
Intercept	31577.348	1	31577.348	810.487	.000	.907	
Pretest Scores	1.786	1	1.786	.046	.831	.001	
Instructional Strategies	21605.119	1	21605.119	554.533	.000*	.870	
Gender	34.189	1	34.189	.878	.352	.010	
2Way-interactions Instructional Strategies * Gender	17.358	1	17.358	.446	.506	.005	NS
Error	3233.758	83	38.961				
Total	324252.000	88					
Corrected Total	25895.455	87					

*R Squared = .875 (Adjusted R Squared = .869) *= Significant at p < 0.05 alpha level*

The data in table 3 shows that the main effect was not significant on male and female students' achievement in Mathematics ($F_{1,83} = 0.446$; p (0.506) > 0.05; partial eta squared = 0.005), which gives an effect size of 0.5 percent. Therefore, the null hypothesis, which states that "there is no statistically significant difference in the achievement of male and female students in Mathematics when taught with YouTube videos and Modified lecture instructional strategies", was accepted.

Hypothesis two

There is no statistically significant difference in the achievement of first-second born and later-born students in Mathematics when taught with YouTube videos and those taught with modified lecture instructional strategies?

Table 4: 2 x 2 factorial analysis of covariance (ANCOVA) of post-test scores of first-second born and later-born students' achievement in Mathematics when taught with YouTube videos and modified lecture instructional strategies.

Source of Variation	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	De p <
Corrected Model	22642.768	4	5660.692	144.446	.000	.874	
Intercept	30166.214	1	30166.214	769.762	.000	.903	
Pretest Scores	5.204	1	5.204	.133	.716	.002	
Instructional Strategies	20753.319	1	20753.319	529.570	.000*	.865	
Birth Order	30.896	1	30.896	.788	.377	.009	
2Way-interactions Instructional Strategies * Birth Order	4.624	1	4.624	.118	.732	.001	NS
Error	3252.686	83	39.189				
Total	324252.000	88					
Corrected Total	25895.455	87					

*R Squared = .874 (Adjusted R Squared = .868) *= Significant at p < 0.05 alpha level*

The data in table 4 shows that the main effect was not significant on first-second born and later born students' achievement in Mathematics ($F_{1,83} = 0.118$; p (0.732) > 0.05; partial eta squared = 0.001), which gives an effect size of 0.1 percent. Therefore, the null hypothesis, which states that "there is no statistically significant difference in the achievement of first-second born and later-born students in Mathematics when taught with YouTube videos and modified lecture instructional strategies" was accepted.

Discussion of Findings

The findings from the study revealed that there is no statistically significant difference between the achievement of male and female students in mathematics when taught with YouTube videos instructional strategy. The finding of this study is consistent with (Mman &Tudunkaya, 2019) using web-based practice on students' academic performance in coordinate geometry among college students. The findings of this also agree with that of Ajaegba and Ekwueme (2019) on the use of GeoGebra software on students' performance in plane geometry in secondary schools in Delta State. This could be as a result of the activities both male and female students are exposed to in the experimental group. Provision was made for every student to watch the videos at home and equal opportunities given to both male and female students for class participation. However, this finding contradicted that of Ahumaraeze and Ekwueme (2019) using a constructivist-based

instructional strategy that male students perform significantly better than female students. In the same vein, it is at variance with the findings of Kurumeh and Iji (2009) and George and Enefu (2019) that male students perform better than the female students in mathematics.

Moreover, the findings of the study revealed that there was no significant difference in the achievement of first-second born and later born students in mathematics taught using YouTube videos instructional strategy. This finding agrees with those of Frederick-Jonah, Akporehwe, and Moses (2019) using laboratory instructional strategy on students' achievement in basic science. The finding is also consistent with Frederick-Jonah, Akporehwe, and King (2020) that there is no association between students' birth order and academic achievement in basic science.

However, the finding of this study is incompatible with previous studies of McNally and Yuen (2015) who found a statistically significant relationship between birth order and college Grade Point Average (GPA) and an insignificant relationship in anxiety level and self-esteem. In the same vein, Akgeyi (2013) found a statistically significant difference with last-born scoring higher in Academic Staff and Graduate Education Test (ASGET) than first born and middle born participants. Also, Ejekwu (2016) study showed that there is a significant difference in the academic performance of the middle born and lastborn girl-child. The results also showed that the effect of the performance of the middle born and only girl-child differs significantly in English, Mathematics, Social Studies, and Primary Science.

Conclusion

YouTube videos' instructional strategy improved both male and female students' achievement in Mathematics more than the modified lecture instructional strategy. Also, there is no statistically significant difference between the achievement of male and female students in Mathematics when taught with YouTube videos instructional strategy.

Finally, YouTube videos instructional strategy improved both first-second born and later-born students' achievement in Mathematics more than the modified lecture instructional strategy. Also, no statistically significant difference was observed between first-second and later-born students' achievement in Mathematics when taught with YouTube videos instructional strategy.

Recommendations

Based on the findings of the study, the following recommendations have been made:

1. Training and workshops aimed at equipping teachers with the basic skills of YouTube videos instructional strategy in lesson delivery should be organized regularly by the State and Federal Governments.
2. Mathematics teachers should be motivated to use learner-centered methods of teaching mathematics such as the YouTube videos instructional strategy.
3. Mathematics teachers should regularly update their repertoire of skills in terms of teaching strategies such as the YouTube videos instructional strategy by participation in seminars and workshops.

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