Flipped Learning Method: Possible Antidote for Achieving Gender Equality in Mathematics in Secondary Schools in Cameroon and Nigeria.

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ABSTRACT

The purpose of the study was to compare the effectiveness of the flipped learning method in enhancing students' achievements in mathematics, and also to determine the possibility of this method in minimizing gender inequality noticed in both Cameroonian and Nigerian secondary school mathematics classrooms. The study employed a pretest-posttest non-equivalent control group design. The population size was 5348 Form 3 students (2684 females and 2664 males) in Mezam Division – Cameroon and 5891 Junior Secondary (JS) 3 students (3236 females and 2655 males) in Awka South Local Government Area – Nigeria. A sample of 180 Form 3 and JS3 students from four schools (two from each country) were selected through a combination of simply random and purposive sampling techniques. A Mathematics Achievement Test (MAT) consisting of 20 items and validated by experts, was used in collecting data for the study. The Kudder-Richardson 20 (K-R 20) reliability of the MAT was found to be 0.79. Treatment lasted for six weeks. Mean was used to answer the research questions while the Analysis of Covariance (ANCOVA) was used to test the hypotheses at the 0.05 level of significance. The findings of this study revealed that the flipped learning method enhanced the achievement of students in mathematics no matter their gender or their country of origin. Furthermore, the flipped learning method enhanced the achievement of female students from both countries better than that of the males. It was recommended that curriculum planners and policy makers in education in Cameroon and Nigeria should consider effective alternative teaching-learning methods to be used in teaching mathematics, especially the flipped learning method considered in this study which did not only prove to be an effective enhancer of students' achievement in mathematics but also provided activities which enabled the females to be as competent as or even more competent than the males.

Keywords: Flipped Learning, gender equality, mathematics achievement.

INTRODUCTION

Mathematics in Nigeria and English-speaking Cameroon has come a long way. In the traditional society, before the introduction of formal education, mathematics was used mainly in stocktaking of daily farming, keeping record of livestock and other properties, and trading activities. Counting and representations in most traditional societies in Cameroon and Nigeria were mostly done in groups of fives or twenties. Thus, a single stone, stick, or whatever used by livestock owners in counting their cows was representing five or twenty livestock as the case may be. Such counting system was also greatly used during market days. This, however, is not still the case in both countries.

Since the introduction of formal education in English-speaking Cameroon, mathematics has gone through several stages; from formal Arithmetic, Algebra, Geometry etc, through traditional mathematics, through modern mathematics, to what is now known as general mathematics. These changes similar to those taking place in neighbouring Nigeria have always been necessitated by the realization of the role mathematics should play in the nation's scientific and technological development as well as responses to societal needs and demands (Aguele, 2004). Today, mathematics still plays an indispensable role in all disciplines and fields of work and studies. It is generally seen as an intellectually challenging subject affecting almost every

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aspect of life. Thus the role of mathematics is such that there is hardly any discipline of study in which mathematics is not involved in one form or the other.

Mathematics is widely regarded as the language and working tool of science, engineering and technology. This corroborates the view of Ebude (2016) who equally stated that, while technology is an engine of growth with endless potentials, mathematics is the key to accessing all these potentials. Thus mathematics can be viewed as an intellectually thought-provoking subject affecting every aspect of human activities including politics, economics, science, engineering and technology. With mathematics, scientific concepts could easily be undertood and applied. Some authors like Tukur and Abimbola (2013), have in a similar manner stressed the dependence of other disciplines and modern society on the knowledge of mathematics. To Tukur and Abimbola, mathematics is the queen of all sciences and servant to all disciplines. This suggests that without mathematics, science, engineering and technology will be abstract concepts. Consequently, there will be no such thing as modern society. One can say with certainty that the state of science and technology and the state of modernity of any nation is a function of the development and application, in one way or the other, of mathematics.

Despite the importance and benefits of mathematics in our day-to-day activities, its use as a basic entry requirement into other higher level fields, and its role as an agent of national development and wealth creation, students' achievement in the learning of mathematics in secondary schools in Cameroon and Nigeria have been pitiable. There has been consistent poor performance and failure of students in mathematics at secondary school level in both countries (Akoko, 2010; Olaleye as cited in Umoru & Ubom, 2013).

It is evident that many variables are responsible for students' poor performance in mathematics in both countries. These variables include: poor primary school background, curriculum, mathematics pedagogy, examination bodies, teachers, students, environment and textbooks. Specifically, Okereke (2006) identified, incompetent teachers in primary schools, students not being interested in mathematics, perception that mathematics is difficult, large class syndrome, psychological fear of the subject, poor methods of teaching, and lack of qualified mathematics teachers as some of the main causes of poor achievement in secondary school mathematics in Nigeria. Akoko (2010) on his part pointed out that poor achievement of Cameroonian students in mathematics could be largely attributed to poor instructional practices, mathematics anxiety and students' learning styles.

Visibly, writers from both countries seem to find fault in the way mathematics is being taught and learnt. Evidently, the methods, strategies and models of teaching and learning mathematics have been key areas of interest to researchers, textbook authors and other scholars over the years. The chalk and talk method of teaching, which is a teacher-centered teaching method, is still very popular in Nigerian and Cameroonian secondary school mathematics classrooms. Much of the teaching and learning that goes on within mathematics classrooms is carried out through the lecture method. In the traditional or conventional teacher-centered method, the teacher is the main and very often, even the only source of information with the learners looking up to him/her as 'all knowing'. The mathematics teacher is often seen as the sole content expert who provides information to students, generally via direct instruction or lecture, with little or no classroom interaction. The students are required to complete independent practice (assignment) at home where they may have limited or no resources to help them accomplish such task.

There is an outcry by researchers, parents and other stakeholders in education, that teacher-centered methods methods are not yielding the so much needed achievements in mathematics during end of course examinations at the level of secondary schools in both countries. The teaching methods used by mathematics teachers seem to make students passive receptors of whatever is delivered to them. Some students even display passive presence during mathematics lessons. This is buttressed by Ursula and Eluwa (2013) who opined that many students are often bored and restless during mathematics lessons, sometimes

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hanging their heads down and wondering when the teacher would just shut up and leave the class. Thus, the teaching method used in the class is one of the factors that make students become passive and have less interaction with each other in doing tasks. This passivity has caused much concern among educators in Cameroon because knowledge of mathematics, as earlier mentioned, plays a significant role in enhancing the country's technological and socio-economic development. Thus passive reception of mathematical facts, usually resulting to low achievement scores for learners, will certainly not be able to greatly enhance such development.

The foregoing suggests that to enhance the understanding of mathematics, students must be more active in the classroom and must creatively acquire knowledge, especially in understanding and solving mathematical problems. Students should be given the opportunities to develop, to interact, and to share with friends through interactive and active teaching-learning activities. In this technological age, both teachers and students should also be given the opportunity to integrate technology into the teaching-learning process in a bid to improve on their critical and creative thinking abilities. Thus, through such activities, the cognitive (achievement) and affective (interest) development of students in mathematics can possibly be improved. Among the alternative teaching-learning methods for the delivery of mathematics lessons which can possibly keep all learners (irrespective of their gender) active and allow them to interact creatively with technology and with each other is the flipped learning method.

The Flipped learning method is a relatively new and less widely researched teaching-learning method which is an embodiment of technology and active learning (Robert et al., 2013). As technology develops, the students' learning culture appears to also change. It is therefore necessary to develop and try out other improved methods of teaching and learning that complement and enhance students' learning styles. Thus the possession of deep knowledge of mathematics by teachers must be complimented with the right pedagogies that are most effective for teaching and learning the subject.

The flipped learning method, a contrary teaching-learning method to the traditional teacher-centered method, is suggested by the Flipped Learning Network (FLN, 2014). According to the FLN, flipped learning is a pedagogical method in which teachers shift direct learning/instruction out of the large group learning space or classroom and move it into the individual learning space, with the help of one of several technologies. Teachers create instructional videos of class lessons. Students watch these videos at home. Provision is made in schools for students who do not have internet access (or other facilities) at home to watch these videos in schools. After or while watching the videos, the students write down any questions they have. They can ask these questions during online or class discussions with the teacher or their peers. In most cases students' questions are reviewed in class by the teacher who also guides these students in reviewing and practicing the material. So in a flipped classroom, lecture and homework elements are reversed in the sense that students watch lectures at home through online videos supported by online discussions between students and teacher and in the class these students are engaged by their teacher in concept mastery exercises. Consequently, the two key components of this teaching-learning method are educational technology and activity learning. However, flipped learning is not achieved only through the use of video lessons (technology) as the foregoing may suggest.

Flipped learning refers to a teaching-learning method in which students gain first exposure to new material outside of class, usually via lecture videos and/or reading of other assigned material, and then the class time is used to do the harder work of assimilating that knowledge, perhaps through problem-solving, discussions, or debates (Brame, 2013). Thus capitalizing on the students' preparedness before the lesson, teachers can dedicate more time to opportunities for integrating and applying acquired concepts from the video watched and/or material read, via a variety of student-centered, active learning approaches such as solving problems independently or collectively, engaging creatively in the subject matter with the assistance of the teacher or working on projects with classmates (Butt, 2014). There is thus an interchange between what happens in

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class and what happens at home. That is, lectures (which can be in the form of reading materials and/or watching video lessons) move out of class while assignments move into class.

In the flipped learning method, teachers record and/or create videos of themselves or other experts teaching, or download video lessons from internet sites such as those of TED-Ed and Khan Academy. The videos are available on VCDs, DVDs, internet or other storage devices, for students to access whenever and wherever it is convenient to them, and as many times as they like, enabling them to be well prepared before class time. Such videos include ready-made video lessons produced in Nigeria and made available to the learning community in Cameroon by Global Science Vision Services, a non-gorvenmental organisation (NGO). These videos cover key areas of most subjects written at the GCE O/L in both countries, including mathematics and are used by many Nigerian and Cameroonian students as study aids.

A significant body of research on active learning according seems to supports the effectiveness of the flipped learning method in improving students' learning and achievement in mathematics. This is in consonance with Novak (2011) and Strayer (2012), who all established that the flipped learning method yields better achievement scores than the teacher-centered method to teaching-learning. Thus students learn best when the teacher's pedagogical practices match the students' learning styles. Cameroonian and Nigerian students' learning styles seem to have changed. The present day learners in Cameroon and Nigeria are digital natives who seem to relate better with technological tools. Thus, by allowing students to watch videos at home and complete work (assignment) in class, not only are students given greater resources, but they also develop a culture of using resources to solve problems. Completing work in class provides students with a greater number of resources and rather than skipping problems that are too difficult at home, students would work with their peers and teachers to solve the problem in class. Therefore, even the so called 'weak students' have greater possibilities of also mastering the concepts of lessons.

Evidently, male students appear to have more mathematical talents than their female counterparts in both Cameroon and Nigeria. Thus male students turn to do better in mathematics, to develop higher mathematical skills and self-concepts, than the females. This is buttressed by the Organization for Economic Cooperation and Development (OECD, 2010) report which shows that females, on average, performed worse than males in mathematics in many countries. Notwithstanding, one cannot state with certainty that mathematics per se is stereotyped as male. This is because in the early eighties, studies in the USA, found that mathematics was one of the least gender-stereotyped subject areas (Huston, 1983). Later studies suggest that most children, particularly girls, indicated that neither boys nor girls were more likely to excel in mathematics (Ruble, Martin, & Berenbaum, 2006). This debate is however put to rest by a recent study by Stoet and Geary (2013). Using 1.5 million children from 75 countries, they established that on the whole, boys scored higher than girls in mathematics. However, they did not find a sex difference in mathematics among below average performing students. They further found that there were many countries without a sex difference in mathematics performance and in some countries girls scored higher than boys. Going by the findings of Stoet and Geary, it can be argued that countries in which the performance of students in mathematics is generally low, may not experience any gender difference. Whatever the case, empirical literature seems to suggests that active teaching learning strategies have great potentials in minimizing gender inequality in achievement among learners.

A similar study was carried out by Naderi, Abdullah, Hamid and Sharir (2008) on the effects of gender, intelligence and learning methods on the academic achievement of undergraduate students in Iran. With a sample of 153 students constituting 105 males and 48 females, the findings showed that gender was not a predictor of academic achievement.

Martins-Umeh (2012) also carried out a study to investigate the relative effectiveness of Vygotsky's collaborative and conventional approaches on junior secondary school students' achievement in social studies and the acquisition of social skills. The study also sought to find out the effects of gender on

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students' achievements and the interaction effect of teaching methods and gender on students' achievement. It was carried out in Anambra state and adopted the non-equivalent control group design. The study used a sample size of 126 students with 71 males and 55 females. Two instruments; the Social Studies Achievement Test (SSAT) and the Social Skills Inventory (SSI) were used for data collection. Means, standard deviations and ANCOVA were used to analyze the data collected. The results showed that students in the collaborative approach group had higher means in both social studies and the acquisition of social skills. Gender did not significantly affect students' achievement in the use of collaborative approach in social studies. Furthermore, teaching methods and gender had no significant interaction effect on students' achievements in social studies. The study recommended the adoption of the Vygotsky's collaborative approach in the teaching of social sciences.

Another empirical study reviewed on active methods of teaching is that of Okigbo (2010), carried out in Awka and Ogidi education zones of Anambra state, Nigeria. The study was titled "comparative effectiveness of mathematical games and instructional analogy as advanced organizers on students' achievement and interest in mathematics". It was a quasi-experimental design with two experimental groups and one control group. A total of 246 students constituted the sample of the study. Data was collected using a mathematics achievement test and a mathematics interest inventory. Data was analyzed using means, standard deviations and MANCOVA. The findings of the study revealed that: game and bridging analogy teaching enhanced both the achievement and interest of students in mathematics more than the lecture method; no significant difference exists in the achievement and interest of male and female mathematics students taught with either game or analogy; no significant interactions exist between teaching methods and gender on both students' achievement and their interest. The researcher recommended that mathematics teachers should use games and analogy teaching before, during and after mathematics lessons, in order to relate mathematics to real life.

However, statistics from examination bodies in both Cameroon and Nigeria reveal that males still perform better than females in most mathematics related examinations. It is therefore necessary to establish the current state of gender inequality in the achievement of students in mathematics in both countries using student-centered teaching-learning methods. It is against this background that this study sought to find out the effectiveness of the flipped learning method in minimizing gender inequality in achievements in mathematics for both Cameroonian and Nigerian secondary school students Cameroon.

Purpose of the Study

The study focused on comparing the effectiveness of the flipped learning method in enhancing students' achievements in mathematics, and also to determine the possibility of this method in minimizing gender inequality noticed in both Cameroonian and Nigerian mathematics classrooms. Specifically, the study focused on achieving the following:

- Compare the mean achievement scores of male and female students taught mathematics using the flipped learning method and those of students taught with the conventional teaching method.
- Compare the mean achievement scores of male and female Cameroonian students taught mathematics using the flipped learning method and those of students taught with the conventional teaching method.
- Compare the mean achievement scores of male and female Nigerian students taught mathematics using the flipped learning method and those of students taught with the conventional teaching method.
- Determine the interaction effect between location and gender on students' achievements in mathematics.

Research Questions

- What are the mean achievement scores of male and female students taught mathematics using the

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flipped learning method and those of students taught with the conventional teaching method?

- What are the mean achievement scores of male and female Cameroonian students taught mathematics using the flipped learning method and those of students taught with the conventional teaching method?
- What are the mean achievement scores of male and female Nigerian students taught mathematics using the flipped learning method and those of students taught with the conventional teaching method?

Hypotheses

The following hypotheses guided the study and were tested at 0.05 level of significance.

- **H_{O1}:** The mean achievement scores of male and female students taught mathematics using the flipped learning method do not differ significantly.
- **H_{O2}:** No significant difference exists between the mean achievement scores of male and female Cameroonian students taught mathematics using the flipped learning method.
- **H_{O3}:** No significant difference exists between the mean achievement scores of male and female Nigerian students taught mathematics using the flipped learning method.
- **H_{O4}:** There is no significant interaction effect between location and gender on students' achievement in mathematics.

METHODOLOGY

The study adopted a quasi-experimental research design. Specifically, the design used was a pretest-posttest non-equivalent control group design. Gad (2015) opined that this design is appropriate when independent variables are to be manipulated in an experiment, and their effects on the dependent variable observed, while checking on extraneous variables. The population of the study was made up of all the Form Three (Form 3) students in the 46 English-speaking public secondary schools in Mezam Division – Cameroon, and all the Junior Secondary Three (JS3) students in the 64 public secondary schools in Awka South Local Government Area – Nigeria. The population size was 5348 students in Mezam Division, with 2684 females and 2664 males, and 5891 students in Awka South Local Government Area, with 3236 females and 2655 males. This gave a total population size of 11239 with 5920 females and 5319 males. One hundred and eighty Form 3 and JS3 students constituted the sample of the study (See Table 1). By employing the multistage sampling procedure in three stages, four intact classes from four schools (two from each country) were selected through a combination of simply random and purposive sampling techniques. Sampling in the first stage was between subdivisions/ educational zones. In the second stage, schools were then purposively and randomly sampled from the selected subdivisions/ educational zones. From the researchers' judgement, schools with regular supplies of electricity or in possession of a generator and a computer laboratory could better host the flipped experimental groups as they had to facilitate the conduct of the study. Lastly, each of the selected schools had more than one intact class in Form 3 and JS3. Using the simple random sampling technique, an intact class was selected in each school and then used for the study. Thus, two intact classes of 47 and 54 students were obtained in Mezam Division – Cameroon, and two intact classes of 40 and 39 students were obtained in Awka South Local Government Area – Nigeria. This gives a sample size of 180 students distributed in four intact classrooms. The intact classes with 47 and 40 students were used as the experimental (E) groups while those with 54 and 39 students were used as control (C) groups (See Table 1).

A 20-itemised Mathematics Achievement Test (MAT), made up of objective test questions, was developed and used to collect relevant data. The original MAT had 30 items, drawn from past GCE O/L mathematics examination, mock GCE examination and Form 3 / JS3 promotion examination question papers. Each item has four options among which are three distracters and one correct answer. The MAT was face and content validated by two experts in mathematics (one from each country) and two specialists in measurement and evaluation (one from each country). After trial testing in both countries, the psychometric (difficulty and

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discrimination) indices of the instrument were determined. Thus, the table of specifications, the comments and suggestions of validators, alongside the psychometric indices of the 30 items were considered, based on which the final MAT of 20 items was obtained. Using Kudder-Richardson 20 (K-R 20) method, the reliability of the MAT was established as 0.79. The MAT was administered as a pretest in the first week and also as a posttest in the sixth week, with the items reshuffled and paper colour changed during the posttest.

Sixteen lesson plans (eight for each group) developed by the researcher from video lessons and validated by four mathematics teacher trainers (two from each country), were used as instructional tools. The study was delimited to the topics: Indices, inequalities algebraic expressions, triangles and inequalities. The study was conducted according to the normal time table of the four sampled intact classes, with two lessons; one for 40 minutes and the other, a double period for 80 minutes each week, giving a total of eight lessons taught within the four weeks of the experimental period in each group. Before the start of the experiment, the class teachers for the experimental groups (E_1 and E_2) were trained by the researchers on how to implement the flipped learning method. The researchers equally had contact with the control group teachers (C_1 and C_2) to acquaint them with the objectives and contents of the lesson plans. This was to ensure that the same objectives were attained in all the four intact classes, after each lesson. Thus the teacher variable and experimental bias were systematically checked. Prior to the start of the experiment, the MAT (pretest) was administered to all the groups.

During the experiment, students in the flipped learning groups were encouraged to bring any electronic storage device (flash drive, VCD or DVD) at least three days to the mathematics lesson. This enabled the researchers and the class teachers to copy the video lesson whose content the students were required to study before coming for the mathematics lesson. This also enabled the researchers and respective class teachers to make alternative arrangements for students who did not have the possibility of watching the video lessons at home for one reason or the other; such were required to make use of the school computer laboratory. The first part of each lesson (in class) was focused on clarifying students' difficulties from the video lesson watched out of class. To ensure that the students actually carried out their assignment of studying the content of the video lesson, they were required to write a short quiz within five minutes in each lesson relating to the content of the video watched at home. This was immediately after the clarification of their difficulties. The quiz was followed by individual and/or group work focused on higher level cognitive activities such as applying, analyzing, evaluating and creating. The teachers played a guiding role and provided step-by-step clarification of students' doubts when they were unable to proceed. The teachers also 'scaffolded' most classroom activities. This was aimed at enabling the students to better master the concepts studied in the video lesson. On the other hand, the control groups used the conventional or traditional methods of instruction, that is, lecture, discussion and problem solving. The class teachers for these groups merely kept the students learning the way they are used to. However, to ensure that students in all the three classes involved in this study were exposed to the same material, the class teacher for this group also administered the same quizzes after presentation of the concepts of each lesson.

After the experiment which lasted for four weeks, the MAT (posttest) was again administered to both groups during the sixth week. Each correctly answered MAT item was scored one mark, giving a maximum of 20 marks that could be scored by each respondent. The bench-mark for the MAT was thus taken to be 10. Hence any teaching-learning method with a mean mathematics achievement score from 10 and above was considered to be effective. Furthermore, any group (males or females) who scored a higher mean were considered to have achieved better than the other. After scoring, mean was used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance, and also to check the non-randomization effect in the two intact classes. Other extraneous variables such as: Hawthorne effect, pre-test/ post-test sensitization and contamination effect were also systematically checked.

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Table 1: Distribution of the Study Sample

Name of School	**Males**	**Females**	**Total**
Government Bilingual High School (GBHS) Mankon. (E_1)	21	26	47
St John of God Secondary School Awka (E_2)	19	21	40
Government High School (GHS) Bafut (C_1)	23	31	54
Ezi-Awka Community Secondary School Awka (C_2)	17	22	39
Total	80	100	180

FINDINGS

Findings According to Research Questions.

What are the mean achievement scores of male and female students taught mathematics using the flipped learning method and those of students taught with the conventional teaching method?

Table 2. Mean Mathematics Achievement Scores of Male and Female Cameroonian and Nigerian Students Taught Mathematics Using the Flipped Conventional Methods

Teaching Method	**Gender**	**N**	**Pretest Mean**	**Posttest Mean**	**Mean Gain**	**Remark**
	Males	40	6.06	12.15	6.09	
Flipped Method	**Females**	47	4.57	11.68	7.11	More effective
	Males	40	5.13	9.77	4.64	More effective
Conventional Method	**Females**	53	4.65	8.76	4.11	

Table 2 indicates that for students taught mathematics using the flipped learning method, the males had a pretest mean achievement score of 6.06 and a posttest mean achievement score of 12.15, giving a mean difference of 6.09. Furthermore, the pretest mean mathematics achievement score for the females was 4.57 and their posttest mean was 11.68, giving a higher mean difference of 7.11. This suggests that the flipped learning method was more effective in enhancing the mean achievement score of female students than that of the male students.

On the other hand, for students taught mathematics using the conventional teaching method, the males had a pretest mean achievement score of 5.13 and a posttest mean achievement score of 9.77, giving a mean difference of 4.64, while the females had a pretest mean achievement score of 4.65 and a posttest mean achievement score of 8.76, giving a mean difference of 4.11. This suggests that male Cameroonian and Nigerian students perform better than their female counterparts when taught mathematics using the conventional teaching method. Table 2 further suggests that the flipped learning method is a better enhancer of students' achievement than the conventional teaching method.

What are the mean achievement scores of male and female Cameroonian students taught mathematics using the flipped learning method and those of students taught with the conventional teaching method?

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Table 3. Mean Mathematics Achievement Scores of Male and Female Cameroonian Students Taught Mathematics Using the Flipped and Conventional Methods.

Teaching Method	Gender	N	Pretest Mean	Posttest Mean	Mean Gain	Remark
	Males	21	5.95	12.00	6.05	
Flipped Method	**Females**	26	4.15	12.12	7.97	More effective
	Males	23	5.62	10.01	4.39	More effective
Conventional Method	**Females**	31	4.87	8.52	3.65	

Table 3 suggests that for students taught mathematics using the flipped learning method, the males had a pretest mean achievement score of 5.95 and a posttest mean achievement score of 12.00, giving a mean difference of 6.05. Furthermore, the pretest mean mathematics achievement score for the females was 4.15 and their posttest mean was 12.12, giving a higher mean difference of 7.97. This shows that the flipped learning method was more effective in enhancing the mean achievement score of female Cameroonian students than that of male students.

On the other hand, for students taught mathematics using the conventional teaching method, the males had a pretest mean achievement score of 5.62 and a posttest mean achievement score of 10.01, giving a mean difference of 4.39, while the females had a pretest mean achievement score of 4.87 and a posttest mean achievement score of 8.52, giving a mean difference of 3.65. This suggests that male Cameroonian students perform better than their female counterparts when taught mathematics using the conventional teaching method.

What are the mean achievement scores of male and female Nigerian students taught mathematics using the flipped learning method and those of students taught with the conventional teaching method?

Table 4. Mean Mathematics Achievement Scores of Male and Female Nigerian Students Taught Mathematics Using the Flipped and Conventional Methods

Teaching Method	Gender	N	Pretest Mean	Posttest Mean	Mean Gain	Remark
	Males	19	6.15	12.29	6.14	
Flipped Method	**Females**	21	4.99	11.24	6.25	More effective
	Males	17	4.63	9.53	4.90	More effective
Conventional Method	**Females**	22	4.42	8.99	4.57	

Table 4 shows that for Nigerian students taught mathematics using the flipped learning method, the males had a pretest mean achievement score of 6.15 and a posttest mean achievement score of 12.29, giving a mean difference of 6.14. Furthermore, the pretest mean achievement score for the females was 4.99 and their posttest mean was 11.24. Although the males had a higher posttest mean achievement score, the females had a higher mean difference in achievement of 6.25. This suggests that the flipped learning method was more effective in enhancing the achievement of female Nigerian students than that of their male counterparts.

On the other hand, for Nigerian students taught mathematics using the conventional teaching method, the males had a pretest mean achievement score of 4.63 and a posttest mean achievement score of 9.53, giving a mean difference of 4.90, while the females had a pretest mean achievement score of 4.42 and a posttest mean achievement score of 8.99, giving a mean difference of 3.57. Again, this suggests that male Nigerian students perform better than their female counterparts when taught mathematics using the conventional teaching method.

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Findings According to Hypotheses

H_{O1}: *The mean achievement scores of male and female students taught mathematics using the flipped learning method do not differ significantly.*

Table 5. Summary of ANCOVA Comparing Male and Female Students' Achievement Scores in Mathematics in the Flipped Learning Method.

Dependent Variable: MATPOSTTEST						
Source of Variation	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Decision**
Corrected Model	283.318	2	155.159	19.162	.000	
Intercept	60.570	1	61.570	8.236	.013	
MATPRETEST	250.397	1	258.397	34.383	.000	
GENDER	**36.109**	**1**	**36.109**	**3.138**	**.113**	**NS**
Error	300.682	84	8.187			
Total	6354.000	87				
Corrected Total	602.000	86				

Table 5 indicates that the F-ratio for the test was 3.138, giving a p-value of 0.113. This means that the F-ratio was not significant (NS) at the 0.05 level of significance. Thus, null hypothesis 1 was not rejected. Therefore, there is no significant difference in the mean mathematics achievement scores of male and female students taught mathematics using the flipped learning method, although the females had a higher mean gain in achievements (Table 2).

H_{O2}: *No significant difference exists between the mean achievement scores of male and female Cameroonian students taught mathematics using the flipped learning method.*

Table 6. Summary of ANCOVA Comparing Cameroonian Male and Female Students' Achievement Scores in Mathematics in the Flipped Learning Method.

Dependent Variable: MATPOSTTEST						
Source of Variation	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Decision**
Corrected Model	330.119	2	165.060	20.135	.000	
Intercept	80.934	1	80.934	9.873	.003	
MATPRETEST	329.965	1	329.965	40.252	.000	
GENDER	**78.151**	**1**	**78.151**	**9.534**	**.003**	**S**
Error	360.689	44	8.197			
Total	7531.000	47				
Corrected Total	690.809	46				

Table 6 indicates that the F-ratio for the test was 9.534. This gave a p-value of 0.003. Thus the F-ratio was significant at the 0.05 level of significance. For this reason, null hypothesis 2 was rejected. Hence, there is a significant difference in the mean mathematics achievement scores of Cameroonian male and female students taught mathematics using the flipped learning method. Therefore, the flipped learning method was a significantly more effective enhancer of Cameroonian female students' achievement than that of the males (Table 3).

H_{O3}: *No significant difference exists between the mean achievement scores of male and female Nigerian students taught mathematics using the flipped learning method*

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.Table 7. Summary of ANCOVA Comparing Male and Female Nigerian Students' Achievement Scores in Mathematics in the Flipped Learning Method.

Dependent Variable: MATPOSTTEST						
Source of Variation	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Decision**
Corrected Model	260.226	2	136.219	18.978	.000	
Intercept	53.624	1	55.351	7.241	.011	
MATPRETEST	218.219	1	212.361	29.849	.000	
GENDER	**8.259**	**1**	**8.259**	**2.524**	**.361**	**NS**
Error	285.932	37	8.162			
Total	5562.000	40				
Corrected Total	518.000	39				

Table 7 indicates that the F-ratio for the test was 2.524, giving a p-value of 0.361. This means that the F-ratio was not significant (NS) at the 0.05 level of significance. Thus, null hypothesis 3 was not rejected. Therefore, there is no significant difference in the mean mathematics achievement scores of male and female Nigerian students taught mathematics using the flipped learning method, although the females had a slightly higher mean gain in achievements (Table 4).

H_{O4}: *There is no significant interaction effect between location and gender on students' achievement in mathematics.*

Table 8. Summary of ANCOVA Showing Interaction Effect between Location and Gender on Students' Achievements in Mathematics

Dependent Variable: MATPOSTTEST						
Source of Variation	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Decision**
Corrected Model	1394.742	4	348.686	9.128	.000	
Intercept	1503.991	1	1503.991	39.373	.000	
MATPRETEST	1222.583	1	1222.583	32.006	.000	
LOCATION	29.090	1	29.090	.762	.385	
GENDER	19.516	1	19.516	.334	.112	
LOCATION * GENDER	**2.024**	**1**	**2.024**	**.053**	**.819**	**NS**
Error	3132.246	82	38.198			
Total	55992.000	87				
Corrected Total	4526.989	86				

Table 8 reveals that the F-ratio for the test was 0.053, giving a p-value of 0.819. Thus, the F-ratio was not significant at the 0.05 level of significance. As a result, null hypothesis four was not rejected. Therefore, there is no significant interaction effect between location and gender on students' achievements in mathematics.

DISCUSSION AND CONCLUSION

The findings of this study therefore revealed that the flipped learning method enhances the achievement of students in mathematics better than the conventional teaching method, no matter their gender or their

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country of origin. Furthermore, females achieved better than the males in both countries. Specifically, the flipped learning method enhanced the achievement of female Cameroonian students significantly better than that of the males. On the other hand, although the flipped learning method also enhanced the achievement of female Nigerian students better than that of the males, the difference between their mean achievement scores was not significant. The findings from Cameroon do not agree with those of other researchers (Martins-Umeh, 2012; Naderi et al., 2008; Okigbo, 2010) who studied the effects of gender on students' achievement using other active teaching-learning methods. They all concluded that gender had no significant effects on students' achievements. Meanwhile, the findings from Nigeria and the overall findings corroborate those of the aforementioned authors. However, female students appear to be better digital natives than the males in both the Nigerian and Cameroonian societies. This may be a possible justification why they had a higher mean gain than the males in both countries.

The result from the analyses revealed a non-significant interaction effect between location and gender, on students' achievements in mathematics. Okigbo (2010) and Martins-Umeh (2012) reported similar findings. Since no significant interaction as measured by the MAT was observed in this study, one can appreciate the fact that the main effects of flipped learning on the achievements of male and female students do not change as a function of variations in location. Thus the achievement of female students in mathematics is enhanced by the flipped learning method, more than that of the males, irrespective of their countries of origin.

The findings of this study are expected to spur curriculum planners and policy makers in education in Cameroon and Nigeria to consider effective alternative teaching-learning methods to be used in teaching mathematics, especially the flipped learning method considered in this study. This method did not only prove to be an effective enhancer of students' achievement in mathematics but also provided activities which enabled the females to be as competent as or even more competent than the males. This consideration should also include the materials which need to be provided to various schools for the effective mastery or implementation of the methods and for all learners to actually benefit from them. Thus, if stakeholders in education have worries and are interested in minimizing gender inequality in students' achievement in mathematics, then the flipped learning method is recommended as antidote to their worries.

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