Effectiveness Of Flipped Learning Method On Students' Interests In Mathematics In English-Speaking Secondary Schools In Mezam Division – Cameroon

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Abstract: The purpose of the study was to investigate the effectiveness of the flipped learning method in enhancing students' interests in mathematics. The study carried out in Mezam Division of the North West Region of Cameroon involved all Form Three students in English-speaking public secondary schools. Two research questions and two hypotheses provided focus to the study. The study adopted the pretest-posttest non-equivalent control group design. One hundred and one students drawn from a population of 5348 students and grouped into one experimental of 47 students and one control group of 54 students, constituted the sample of this study. Using the multistage sampling procedure in three stages, the sample was arrived at through a combination of simple random and purposive sampling techniques. Data was collected using a Mathematics Interest Inventory (MINTIV). The Crombach's alpha reliability of the MINTIV was 0.84. Treatment lasted for four weeks. Mean was used to answer the research questions while ANCOVA was used to test the hypotheses. The findings revealed that the flipped learning method was effective in enhancing students' interest in mathematics. With regard to gender, the flipped learning method was more effective in enhancing the mean achievement score of female students than that of male students. Based on the findings, it was recommended among other things that English-speaking secondary school mathematics teachers in Cameroon should adopt the use of the flipped learning method in teaching mathematics.

Keywords: Flipped learning, mathematical learning, secondary schools, students' interest.

1. Introduction

Mathematics is generally seen as a mentally challenging subject affecting almost every aspect of human life. There is almost no discipline of study in which mathematics is not put to use. Seasoned academics and educators have emphasized the important role of mathematics in several ways. Mathematics is widely used as a tool in science and technology [1]. Thus while technology could be seen as an engine for growth with endless potentials, mathematics is the key to accessing all these potentials. Mathematics could also be viewed as an intellectually stimulating subject which affects every aspect of human activities such as politics, economics, science and technology [2]. It is the model by which scientific notions are comprehended and basis for understanding and applying technologies [2]. Some authors [3] have in a similar manner stressed the dependence of other disciplines and modern society on the knowledge of mathematics. These authors view mathematics not only as the queen of all sciences but also as the servant to all disciplines. Mathematics thus has an enormous contribution to the development of science and technology. Hence, without mathematics there will be no sciences, without the sciences there will be no modern technologies and without modern technologies there will be no modern societies [4]. Drawing from the aforementioned authors, one can say that the state of science and technology and the state of modernity of any nation is a function of the development and application of mathematics. Thus mathematics is a sine qua non in the scientific and technological development of any nation. Unfortunately, despite the importance and benefits of mathematics to our day-to-day activities and its role as an agent of national development and wealth creation, students' achievements in the learning of mathematics have been unacceptable. There has been consistent poor performance and failure of students in mathematics at secondary school level [5]. Achievement in mathematics at the General Certificate of Education Ordinary Level (GCE O/L) in Cameroon has not exceeded 21% for quite some time (See Table 1).

Table 1: *Success Rates in GCE O/L Mathematics*

Year	2016	2015	2014	2013	2012
Number sat	102857	97555	86724	81675	79384
% passed	8.90	11.80	9.40	15.32	14.56

2011	2010	2009	2008	2007
65678	60875	55890	50419	44676
18.49	15.00	20.46	15.35	18.38

Students' interest can be said to be the feeling experienced by students whose attention, curiosity or concern is engaged by something or someone. It is the academic inquisitiveness and attention needed for effective learning [6]. On the other hand, academic achievement could be seen as the measure (using scores from tests, examinations, assignments, among others) of the successes recorded by learners in an academic milieu. It refers to students' progress in any academic setting as measured by their scores [7]. Many writers have tried to explain why achievement rates in this very important subject are consistently low. Lack of interest in

mathematics resulting from inappropriate instructional practices, is one of the factors responsible for the ever low achievement rates in mathematics [5], [8]. Others [2] report that the teaching-learning of mathematics have consistently generated low interest among learners over the years. The chalk and talk method of teaching, which is a teacher-centered teaching method, though still very popular with mathematics teachers of English-speaking secondary schools in Cameroon, appears to make mathematics boring to Cameroonian learners. This is buttressed by the fact that many students are often bored and restless during mathematics lessons, with some hanging their heads down and wondering when the teacher would just stop and go out of the class [9]. Thus, the teaching method used in the class is one of the factors that make students develop low interest in mathematics. High levels of students' interest are positively associated with academic achievement [10]. This implies that students interested in mathematics are more likely to seek out opportunities that allow their engagement with the subject and consequently, perform well in the subject. Unfortunately, some researchers [8] claim that students' interests in mathematics is on a steady decline as the years go by. One possible way to inhibit this decline in interest and to narrow the gender gap is to identify and use appropriate methods in teaching-learning; methods that will identify and promote aspects of students' beliefs and behaviors that are important for both girls' and boys' mathematics learning. The foregoing suggests that to enhance the interest of students in mathematics, they must become 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 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 learners active and allow them to interact creatively with ubiquitous technological gadgets is the flipped learning method. 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 [11]. Thus taking advantage of the students' preparedness before the lesson, teachers can devote 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. This method therefore increases active learning opportunities both in and out of the classroom [12]. There is thus an interchange between what happens in 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. This study depended on ready-made video lessons made available to the learning community in Cameroon by Global Science Vision Services (an NGO), since very few homes in Cameroon can boast of internet facilities. Although these video lessons have been in circulation in Cameroon for quite some time in a bid to capture students' interest and consequently their achievement in this subject, GCE O/L results over the years suggest that this has not been achieved. A study [6] revealed that the use of active teaching-learning methods like games and analogy teaching, enhanced the interest of students in mathematics more than the lecture method; no significant difference exists in the interest of male and female mathematics students taught with the active teaching-learning methods. However, statistics from the Cameroon General Certificate of Education Board (CGCEB) indicate that up to 2010, males still performed better than females in English-speaking secondary schools in Cameroon. It is therefore necessary to establish the current state of gender inequality in the achievement of students in mathematics in English-speaking secondary schools in Cameroon, using a student-centered teaching-learning method. The literature reviewed suggests that no known experimental study on flipped learning in mathematics has been carried out in Cameroon [13]. Furthermore, there exist limited quantitative researches on flipped learning. These are gaps the present study intends to fill.

2. Purpose of the Study

The purpose of this study was to investigate the effectiveness of the flipped learning method in enhancing students' interests in mathematics in Mezam Division of North West Region- Cameroon. Specifically, this study was designed to:

- Compare the effectiveness of the flipped learning method in enhancing students' interests in mathematics, with that of the conventional learning method.
- Compare the mean interest scores of male and female students taught mathematics using the flipped learning method.

3. Research Questions

- How effective is the flipped learning method in enhancing students' interests in mathematics when compared with the conventional learning method?
- What are the mean interest scores of male and female students taught mathematics using the flipped learning method?

4. Hypotheses

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

- There is no significant difference between the effectiveness of the flipped learning method and that of the conventional learning method in enhancing students' interests in mathematics.
- There is no significant difference in the mean mathematics interest scores of male and female students taught mathematics using the flipped learning method.

5. Methodology

The study adopted a quasi experimental research design. Specifically, the design used was a pretest-posttest non-equivalent control group design. All the Form Three students in the 46 English-speaking public secondary schools in Mezam Division constituted the population of the study. The population size was 5348 students with 2684 females and 2664 males. One hundred and one Form Three students with 44 males and 57 females constituted the sample of the study. By employing the multistage sampling procedure in three stages, the sample was arrived at through a combination of simply random and purposive sampling techniques. Firstly, through simple random sampling technique, two subdivisions, Bamenda II and Bafut, were selected from the seven subdivisions that make up Mezam Division. Through simple random sampling technique again, the two groups (flipped and control groups) were allocated to the selected subdivisions as follows: Flipped learning group to Bamenda II and Control group to Bafut. Secondly, due to the fact that the flipped learning method required electricity and computers or televisions, a school judged by the researcher to be able to meet the above requirements, was purposively selected from Bamenda II subdivision to host the experimental group on flipped learning. Through simple random sampling, another school was then selected from Bafut Subdivision, to host the control group. Thirdly, the entire exercise in stages one and two gave rise to two schools. Each of the selected schools has more than one intact class in Form Three. 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 giving the sample size of 101 students, and used for the experimental and control groups respectively. A 20-itemised Mathematics Interest Inventory (MINTIV), was developed and used to collect relevant data. The original MINTIV had 32 items. Each item has four point response type scale as follows:

- I Like Very Much (**LVM**), if the student likes very much to engage in the activity.
- I Like (**L**), if the student likes to engage in the activity.
- I Dislike (**D**), if the student dislikes engaging in the activity.
- I Dislike Very Much (**DVM**), if the student dislikes very much to engage in the activity.

The MINTIV was face and content validated by two experts in psychology and a specialist in measurement and evaluation. Thus the comments and suggestions of validators were considered, based on which the final MINTIV of 20 items was obtained. The Cronbach's alpha reliability of the MINTIV was established as 0.84. The MINTIV was administered as a pretest in the first week and also as a posttest in the sixth week. Sixteen lesson plans (eight for each group) developed by the researcher from video lessons and validated by two mathematics teacher trainers and an Inspector of mathematics, were used as instructional tools in both groups. 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 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 teacher for the experimental group was trained by the researcher on how to implement the flipped learning method. The researcher equally had contact with the control group teacher to acquaint him with the objectives and contents of the lesson plans. This was to ensure that the same objectives were attained in both groups, after each lesson. Thus the teacher variable and experimental bias were systematically checked. Prior to the start of the experiment, the MINTIV was administered to both groups. During the experiment, students in the flipped learning group were encouraged to bring any electronic storage device (flash drive, VCD or DVD) at least three days to the mathematics lesson. This enabled the researcher and the class teacher to copy the video lesson whose content the students were required to study before coming for the mathematics lesson. This also enabled the researcher and respective class teacher 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 teacher played a guiding role and provided step-by-step clarification of students' doubts when they were unable to proceed. The teacher 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 group used the conventional or traditional methods of instruction, that is, lecture, discussion and problem solving. The class teacher for this group 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 MINTIV was again administered to both groups during the sixth week. The options for the MINTIV, that is, LVM, L, D and DVM were weighted 4, 3, 2 and 1 respectively for positive items. The weightings were reversed for negative items. An individual's interest score was obtained by summing the scores for all the 20 MINTIV items. Thus a maximum interest score of 80 and a minimum of 20 could be obtained by an individual. The bench mark for the MINTIV was considered at 50 (that is 2.5 x 20 items). Thus any learning method having mean interest above 50 out of 80, was considered to be effective. 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.

6. Results

Research Question 1: How effective is the flipped learning method in enhancing students' interests in mathematics when compared with the conventional learning method?

Table 2: *Mean Mathematics Interest Scores of Students in the Flipped and Conventional Learning Groups*

Group	N	Pretest Mean	Posttest Mean	Mean Gain	Remark
Flipped Learning Method	47	56.68	65.64	8.96	Effective
Conventional Learning Method	54	56.04	59.48	3. 44	Effective

Table 2 shows that the pretest mean mathematics interest score for students taught using the flipped learning method was 56.68. Their posttest mean was 65.64. This gave a mean gain of 8.96. Similarly, those taught mathematics using the conventional learning method had a pretest mean interest score of 56.04 and a posttest mean of 59.48, giving a mean gain of 3.44. This indicates that both the flipped learning method and the conventional learning method were effective in enhancing students' interests in mathematics, considering the MINTIV bench mark of 50. Furthermore, the flipped learning method was a more effective enhancer of students' interests in mathematics when compared with the conventional learning method.

Research Question 2: What are the mean interest scores of male and female students taught mathematics using the flipped learning method?

Table 3: *Mean Mathematics Interest Scores of Male and Female Students Taught using Flipped Learning*

Gender	N	Pretest Mean	Posttest Mean	Mean Gain	Remark
Males	21	60.14	65.43	5.29	
Females	26	53.88	65.81	11.93	More effective

Table 3 reveals that for students taught mathematics using the flipped learning method, the males had a pretest mean interest score of 60.14 and a posttest mean interest score of 65.43, giving a mean difference of 5.29. On the other hand, the pretest mean interest score for the females was 53.88 and their posttest mean was 65.81. This gave a much higher mean difference of 11.93. This suggests that the flipped learning method was more effective in enhancing the mean interest score of female students than that of the males.

Hypothesis 1: There is no significant difference between the effectiveness of the flipped learning method and that of the conventional learning method in enhancing students' interests in mathematics.

Table 4: *ANCOVA Test Comparing Students' Interest Scores in Mathematics in the Flipped and Conventional Learning Methods.*

Dependent Variable: MINTIVPOSTTEST

Source of Variation	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3092.19	2	1546.10	31.22	.00
Intercept	3167.92	1	3167.92	63.98	.00
MINTIVPRETEST	2139.65	1	2139.65	43.21	.00
GROUP	**855.06**	**1**	**855.06**	**17.27**	**.00**
Error	4852.68	98	49.52		
Total	400541.00	101			
Corrected Total	7944.87	100			

Table 4 shows that the F-ratio for the test was 17.27, giving a p-value of 0.00 ($p < 0.05$). Thus, the F-ratio is significant at the 0.05 level of significance. Consequently, null hypothesis 1 was rejected. Therefore, there is a significant difference between the effectiveness of the flipped learning method and that of the conventional learning method in enhancing students' interests in mathematics, with the flipped learning method being the more effective enhancer (Table 2).

Hypothesis 2: There is no significant difference in the mean mathematics interest scores of male and female students taught mathematics using the flipped learning method.

Table 5: *ANCOVA Test Comparing Male and Female Students' Interest Scores in Mathematics in the Flipped Learning Method.*

Source of Variation	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1219.46	2	609.73	14.94	.00
Intercept	1579.71	1	1579.71	38.71	.00
MINTIVPRETEST	1217.79	1	1217.79	29.85	.00
GENDER	**145.40**	**1**	**145.40**	**3.56**	**.07**
Error	1795.39	44	40.80		
Total	205509.00	47			
Corrected Total	3014.85	46			

Table 5 shows that the F-ratio for the test was 3.56. This gave a p-value of 0.07, indicating that the F-ratio was not significant at the 0.05 level of significance. Consequently, null hypothesis 2 was not rejected. Therefore, there is no significant difference in the mean interest scores of male and female students taught mathematics using the flipped learning method, although there is a higher mean gain in favour of the females (Table 3).

7. Discussion of Results

The findings of the study indicate that the flipped learning method of teaching mathematics is a more effective enhancer of students' interests compared to the conventional learning method. This suggests that the flipped learning method provides the necessary intellectual inquisitiveness and attention needed for effective learning [6], significantly better than the conventional learning method. Another author [10] further indicated that high levels of student interest were positively linked with academic achievement. This therefore implies that the flipped learning method can enhance students' achievements in mathematics better than the conventional learning method. The findings further revealed that the conventional learning method was also effective in enhancing students' interests in mathematics, taking into consideration the set benchmark. This contradicts the views of some researchers [8] who claimed that students' interests in mathematics were consistently low. There is a possibility that this claim was over inflated, considering the findings of this study. There is also the possibility that students were not very honest in responding to the MINTIV items. The findings of this study also revealed that although female students had a higher mean gain in interest than the males, the difference in their means were not significant. This study also established that there is no significant difference in the mean interest scores of male and female students taught mathematics using the flipped learning method, despite the fact that there was a slightly higher mean gain in interests in favour of female students. Another researcher, [6], had a similar finding. The researcher used two active teaching-learning methods in teaching mathematics; mathematical game and instructional analogy, and established that no significant difference exists in the interest of male and female mathematics students taught with either game or analogy.

8. Recommendations

English-speaking secondary school mathematics teachers in Cameroon should adopt the flipped learning method as one of the common and alternative methods of teaching and learning mathematic, and should use it more frequently than the conventional method of teaching mathematics. This pedagogical shift will enable students to develop more interest in mathematics while using available technological gadgets in facilitating their learning. These will among other things, help students to do away with some of the social apathy towards mathematics and consequently achieve better in this important subject. This is because once there is interest, attention will be guaranteed and hence learning can be assured. It is also recommended that Government, Non Governmental Organisations, Parent-Teacher Associations and other stake holders in education who do not only expect better achievements in mathematics, but who are also concerned about the achievement of female students in mathematics, should help provide teacher training colleges and secondary schools with computer laboratories, mathematics laboratories, internet and other adequate facilities. This will go a long way to facilitate the training of mathematics teachers and teaching-learning of students within the flipped learning method.

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