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FLIPPED CLASSROOM VERSUS A CONVENTIONAL CLASSROOM IN THE LEARNING OF MATHEMATICS

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ABSTRACT: *The study was carried out to confirm the advantage of a flipped classroom over a conventional one in terms of students, academic achievement. To carry out the study, 100 mathematics students in senior secondary school Hallmark Academy, in Rivers State, Nigeria were used in the study. There were two groups; an experimental and a control group used in the study. A videoCD offline mathematics lesson recorded by the teacher was the ICT instrument in this approach. The t-test was used to analyzed the data. Hence a major finding was that the experimental group had a mean gain of 28.60 as against 16.62 of those in a conventional class in their pretest-posttest scores. A major recommendation is that teachers should incorporate flipped classroom approach as it encourages direct involvement of students in the learning process*.

KEYWORDS: Inverted, reversed Bloom's taxonomy, peer instruction

BACKGROUND OF THE STUDY

School work at home and home work at school courtesy of information and communication technology (ICT) is what has gained attention among educators in the most recent. The reason is that classroom teachers have gone digital (Fitzpatrick, 2012). This belief is in sharp response to the paradigm shift from the teacher-centred learning environment to the student- centred environment, which modern educators and instructional designers advocate. In the former, teachers do the teaching or more appropriately are sage on stage while in the former they are guide on the side. This constructivist approach to learning has it that the teacher's role is less that of transmitting knowledge, more that of facilitating learning in less directive ways (Alison, 1993).

Flipped classroom is a classroom where home works are done at school and school works done at home. This approach affords learners the opportunity to gain a firsthand experience and exposure to novel materials ordinarily outside the classroom using such technologies as hardcopies, softcopies, video tapes or web based lectures, and PowerPoint presentations with voice-over.

The protagonists of flipped classroom, maintain that the use of this approach enables students to gain first-exposure learning prior to class and focus on the processing part of learning (synthesizing, analyzing), problem-solving, etc in class (Walvoord & Anderson,1998). In other words, this is a revised or inverted form of Bloom's taxonomy.

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Fig 1: **Bloom's Taxonomy (Revised)**

In this new taxonomy, students are doing the lower levels of cognitive work, gaining knowledge and comprehension outside of class and focusing on the higher forms of cognitive assignment in class, assisted and peers by the teacher or instructor (Anderson & Krathwohl, 2001). The teacher's role here is more or less that of a facilitator to also qualify the meaning of a true flipped classroom.

An assignment based model is proposed by Walvoord and Anderson (1998). This model of a flipped classroom has it that students are required to do all necessary preparations for productive class session in which they produce works, solve problems prior to class sessions, class sessions in this wise are used to providing feedback to students on works. On turning the traditional classroom on its head, Lage, Platt and Treglia (2000), maintain that this approach is informed by the incompatibility between the conventional classroom and learners' varied learning preferences. Literature is replete with differences in learners' learning styles. In the academic lens of Kolb's (1948), there are convergers, divergers, assimilators and accommodators. The convergers are more comfortable with a uni source of information while divergers prefer multiple sources of information. On the other hand the assimilators prefer theoretical presentations while the accommodators would opt for hands-on-experience. A succinct look at the above will corroborate the positions of Lage, Platt and Treglia (2000) on their distaste for the traditional classroom in favour of the flipped.

Evidence abound on the strength of flipped classroom over a conventional one. Mazur of Harrard University have published results to support his peer instruction method of a flipped classroom. The physicist made his students work in small groups to answer conceptual questions on the use of force concept inventory, which predates the calculus concept inventory, and which tests understanding of the foundations of Newtonian. In his submission, he maintains that simply

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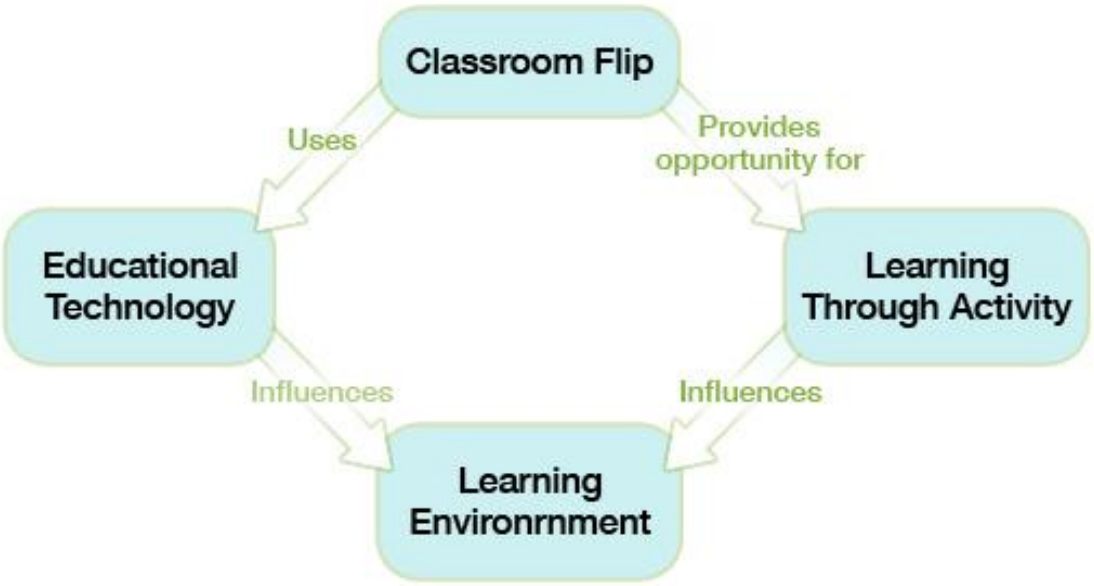

transmitting introduction should not be the focus of teaching, rather helping students to assimilate that information (Mazur, 2009).

Fig 2: Key elements of a flipped classroom (Strayer)

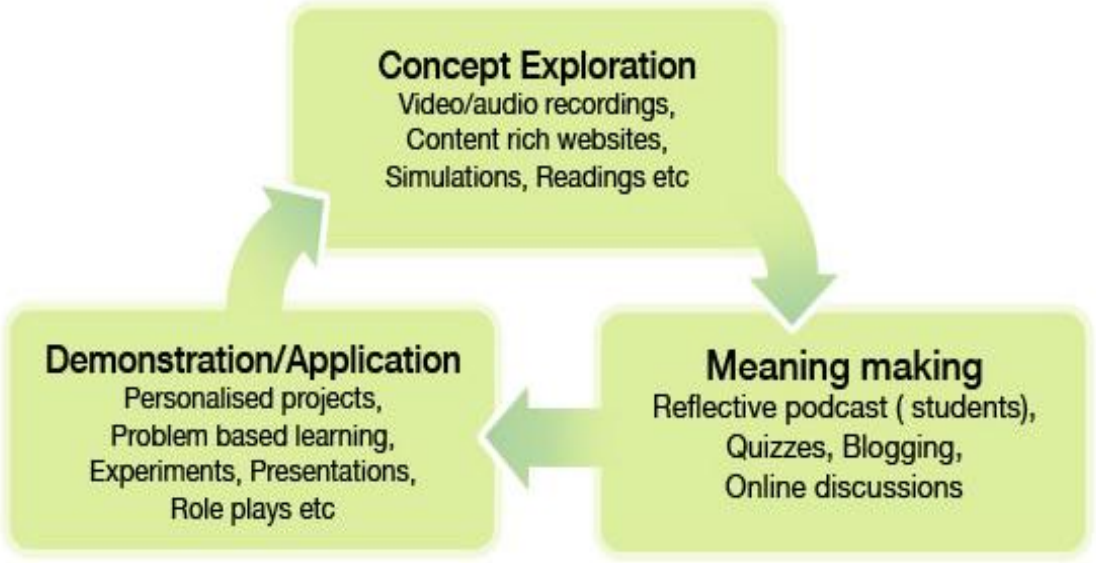

Fig 3: Learning opportunities of the flipped classroom (adapted from Gerstein)

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The flipped classroom of Hake (1998) corroborates the strength of this approach over the conventional classroom. The 4458 students that took part in 48 physics courses had different results. The researcher reported that students taught with interactive engagement methods exhibited learning gains almost two standard deviations higher than those observed in the traditional courses (0.48+/-0.14 vs 0.23 +/- 0004). Assessment of classes taught by the peer instruction (P1) method provides evidence of even greater learning gains, with students in P1 courses exhibiting learning gains ranging from 0.49 to 0.74 over eight years of assessment (Crouch & Mazur, 2001).

The work of Deslauriers, Schelew and Wieman (2011) in their physics class is also another evidence of the relevance of a flipped classroom over the traditional classroom. The experimental group taught via flipped performed better than their conventional counterparts. They reported that during the experiment, students engagement increased in the experimental section (from 45 +/- 5% to 85 +/-5% as assessed by four trained observers) but did not change in their control section. At the end of the study, students completed a multiple choice test, resulting in an average score of 41+/-1% in the control classroom and 74+/-1% in the flipped classroom with an effect size of 2.5 standard deviation. These findings also agree with that of Berret (2012) on how flipping the classroom can improve the traditional lecture.

Statement of the Problem

The need to improve students' achievement in mathematics has been a thing of concern to all stakeholders in the education sector; teachers, parents, counselors, instructional designers, and administrators. Mathematics is the hub of the science and so poor performance of students in the subject is bound to have a negative effect in the scientific age of today driven by technology in which we find ourselves. The reason is that a nation that cannot boost of the needed scientific and technological advancement cannot truly compete among comity of nations.

Purpose of Study

The study sets to ascertain:

If there is any difference in the mean achievement gain of flipped classroom mathematics students and their conventional counterparts.

If there is any difference in the mean achievement gain of flipped classroom male mathematics students and their female counterparts.

Research Questions.

Research Question 1. What are the mean achievement of mathematics education students taught via the flipped classroom approach (FCA) and those taught via the conventional approach (conA)?

Research Question 2. What are the mean achievement of mathematics education male students and their female counterparts taught via the flipped classroom approach (FCA)?

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Methodology

The pretest-posttest quasi-experimental design was used in the study. The reason was to ascertain if the treatment had any resultant effect on the experimental group. The mean $\bar{x}$ achievement scores of mathematics students taught via the flipped approach (FCA) were compared and their conventional counterparts (ConA). The t-test was used to test the two H_o hypotheses used in the study. On the whole, one hundred (100) students in intact claseswere used comparing fifty (55) in flipped classroom and forty five (45) in conventional classroom. Also, out of the control group, thirty (35) males achievement was compared with that of their twenty (20) female counterparts.

Data analysis and discussion of findings.

Research Question1 What are the mean of mathematics education students taught via the flipped classroom approach (FCA) and those taught via the conventional approach (conA) ?

Table 1. Mean Achievement score of FCA Vs ConA.

Measures of central Tendency	**FCA Croup**		**ConA Croup**	
	$\bar{x}$	**S.D**	$\bar{x}$	**S.D**
Pretest	31.60	6.48	27.38	9.02
Post test	60.20	10.36	44.00	8.60
Gain score	28.60		16.62	

The pretest mean value for FCA group from table 1 is 36.60 as against 27.38 of the ConA group. Also their post test mean are 60.20 and 44. 00 respectively. Hence the gain score mean are 28.40 for the FCA group and 16.62 for the conA group.

Research Question 2. What are the mean achievement of mathematics education male students and their female counterparts taught via the flipped classroom approach (FCA)?

Table 2. mean achievement scores of male and female groups with FCA.

Measures of central Tendency	**FCA Croup (Male)**		**Of FCA crap (male**	
	$\bar{x}$	**S.D**	$\bar{x}$	**S.D**
Pretest	33.91	9.41	29.11	7.38
post test	60.00	12.59	58.56	8.67
gain score	28.09		29.45	

Table 2 above shows a pretest mean of 33.91 and 29.11 for male and female groups respectively. It also shows a post lest mean of 60.00 and 58.56 for the different sexes respectively, hence a gain mean of 28.09 and 29.45 in like manner.

H_o1. There is no significant difference between the mean achievement of mathematics education students taught via FCA and their conventional counterpart (conA).

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Table 3. Mean Values (Post Tests), t-values of FCA & ConA group.

Category	N	$\bar{x}$	S.D	t-cal	t-lab	α level
FCA	55	60.20	10.36			
ConA	4,5	44.00	8.60	11.25	2.02.	0.0,5

Table 3 shows that t-cal > t- tab (11.25 >2.02) at α level of 0.05, and so the H_o is thereby rejected which means that there is a significant difference between the mean achievement of both categories and groups.

Tables 1and 3 show that mathematics students taught via the FCA had a mean gain advantage over their conventional counterparts. This major findings is in line with the findings of (Crouch and Mazur (2001), Mazur (2009); Deslauriers, Schelew and Wieman (2011) and Bennet (2012). These findings agree that the flipped classroom approach engages students and makes them to be directly involved in the learning processes than those the conventional approach. And it is obvious that when one is personally involved in a thing that mastery and improvement in performance is guaranteed.

Ho_2 There is no significant different between the mean achievement of mathematics education male students and their female counterparts taught via the FCA.

Table 4. Mean values (post tests), t-values of male and female groups.

Category	N	$\bar{x}$	S.D	t-cal	t-lab	α level
Male	35	62.00	12.59			
Female	20	58.56	8.67	1.56	2.02	0.05

Table 4 shows that t-cal < t-tab (1.56<2.02) at α - level of 0.05, and so the H_o is thereby accepted, which means that there is no significant difference between the mean achievement of both sexes.

Table 2 and 4 above did not implication sex as a variable in a flipped classroom. In other words performance of the students in the flipped classroom was not influenced by the sex to which they belong. That means both male and female students' performance was not related to their sexes. Both sexes enjoyed a flipped lesson and a flipped classroom which provided them ample opportunity to have a first-hand experience (Barbara & Virginia, 1998), making them to be fully involved in the learning process (Walvoord & Anderson, 1998) and meeting their divergent learning styles (Lage, Platt & Treglia, 2000).

CONCLUSION

The flipped classroom encourages peer instruction, provides an opportunity for students to gain first exposure prior to class, provides incentives for students to prepare for class, provides a mechanism to assess students' comprehension and also provides activities that focus on higher-level cognitive activities. Hence the advantages of the flipped classroom approach surpass that of the conventional, which informed the gain in mean scores of students taught mathematics via the flipped classroom approach, over their conventional counterparts.

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RECOMMENDATIONS

Based on the outcome of the study, the following recommendations are made:

1. Teachers who are the main persons that implement the curriculum should adopt this flipped classroom approach because it engages the students rather than waiting to be sponged.
2. The flipped classroom is a technology-driven hence it is expected that teachers of the present age should embrace technology if they must use this approach with all amount of expertise

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