IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388, p- ISSN: 2320-737x Volume 15, Issue 3 Ser. 1 (May. – June. 2025), 01-07
www.iosrjournals.org

Effect Of Innovative Pedagogy And Its Implications For Effective Instructional Delivery In The Digital Age

Oso Senny Oluwatumbi
Faculty Of Education
Vocational And Technical Education
Ekiti State University

Oteze, I. K.
Faculty Of Education
Curriculum And Instructional Technology
University Of Benin, Benin City
Ikponmwosa.Oteze@Uniben.Edu.Ng

Ayodele, C.S.
Faculty Of Education
Institute Of Education
Ekiti State University

Abstract
The study examined innovative pedagogy and its implications for effective instructional delivery in the digital age. The study specifically addressed the impact of flipped classroom approach as an innovative pedagogy in improving first year mathematics Students' Academic Performance in Ekiti State University, Ado-Ekiti University, Ado-Ekiti. The idea and effectiveness of this educational innovation has been widely proved and accepted by many nations of the world at all levels of educational system primary, secondary and tertiary. The objective was to find out if Flipped Classroom approach would enhance first year students' academic performance in Mathematics. It examined the level of the students' digital literacy. The study employed pre-test and post-test a quasi-experimental design. The sample used for the study was an intact class of 30 Mathematics Education students. A package of a pre- recorded video clips was used. The scores from both pre-test and post-test were analysed using descriptive of mean and standard deviation and inferential statistics of t-test. The results revealed that there was significant difference in the post-test scores in the experimental group demonstrating an improved academic performance. The findings showed that the groups were homogeneous at the commencement of the experiment. The findings also indicated that the respondents' academic performance in mathematics was anchored on the pre-requisite digital literacy skills and the flipped classroom approach improved the students' performance in Mathematics. Based on the findings, more institutional training and support systems on digital learning through workshops and seminars were recommended. The implication is that Flipped Classroom approach brought benefits to Mathematics teaching and learning process.

Keywords: *digital. age, innovative, pedagogy*

Date of Submission: 22-04-2025 Date of Acceptance: 02-05-2025

I. Introduction

New educational ideas have come into existence as a result of the widespread adoption of technology in the classroom. Innovative technologies like instructional videos, mobile learning, flipped classroom and blended learning environment among others have continued to transform learning environments and students' preferences. Students' reading habit has changed greatly and no longer value dignity of labour. Technology has overtaken them and they spend long hours on the internet and their phones. This is posing a big problem in higher institutions of learning in particular therefore their learning practices have to change to suit their current yearnings hence introduction of innovative technologies to make current teaching and learning practices relevant in the light of these changes. Teachers therefore need to have understanding and the technical-know-how of the applicability and the integration of digital tools in every teaching and learning process.

Conventional methods of teaching of talk and chalk, demonstration, discussion among others were prevalent before the onset of introduction of technology into classroom. These methods no longer meet the

inquisitive nature of today learners hence their lukewarm attitude to learning. The attention of today learners is focused on technology. They spend all their time on the internet moving from one browser to the other with little or no attention on their school work. The conventional method does not satisfy digital learners of today hence the need to look for another alternative to motivate them to learn. Today classroom environment is no longer a 'cycle of rote memorization, repetition and dictation with note taking' (Pucansky-Brock, 2013) but students are now growing up in a world shaped by technology which has become an integral part of their learning.

This alternative will have to be the type of what they love to do hence the need for innovative pedagogy which is making impacts in teaching and learning that have dramatically affected and transformed the way teachers teach and students learn globally. The learning tools that can create and make learning more interactive and collaborative are found in innovative technologies. One of such innovative technologies is flipped classroom. Teachers cannot continue to teach the way they have always taught and students learn they have always learnt.

Flipped classroom according to Nsofor & Bello (2015) refers to a situation where students would be assigned to video lecture as take-home work and gives teachers more time to support a students' learning journey rather than correcting errors on the students' homework. It allows class time to be used for hands-on activities and subsequently apply the knowledge taught at home. Flipped classroom is an instructional approach that replaces the traditional lecture-in-class with assigned learning activities outside the class and back into the class for interactive learning where the teacher guides the students as they apply concepts and engage creativity in the subject (Willis, 2014). It allows students to learn and practice some basic concepts before coming to class. This method helps them retrieve prior knowledge or create knowledge and such become prepared to learn at a deeper level. Flipped classroom is an active, student-centred approach designed to increase the quality of learning, provides opportunities for structured, active learning (Strelan et al.,2020). It encourages to inquire and to interact with teachers, peers and learning materials. It is pedagogical approach that requires students and teacher interaction with students' active participation in the learning environment before and in the classroom. This helps students to receive deeper understanding and obtain new knowledge and autonomy to be ownership of his learning environment.

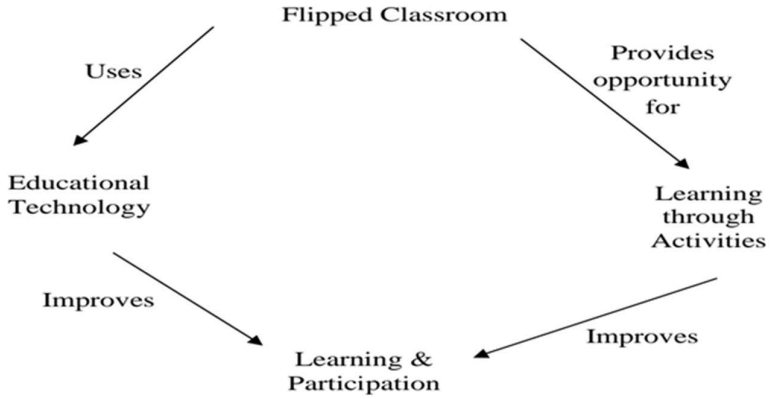
In the literature "flipped classroom" is defined by DeLozier & Rhodes (2017) as a modern strategy in which the teachers assign assignments in different forms such as recorded or video lectures for students to review before attending class. Flipped instruction provide students the prior knowledge of the content materials outside of class through teacher-created video, guiding questions to the material from internet or textbooks, and practice problems as homework. As a result, students are prepared for classes and the classroom encounter focuses on exercises, asking and answering questions, discussions and problem-solving among the students (Kurtz, 2014). StrohMyer (2016) asserted that the application of this strategy results in a number of benefits for both teachers and learners. For students, flipped classroom could enhance their skills such as critical thinking and high thinking skills, self- learning capabilities according to their individual differences, building experiences and communication skills. Alzain (2015) added that the flipped Classroom is a modern technology

The flipped classroom is one of the approaches through which teachers introduce technology to students in a learning environment. This enhances and encourages self-directed learning which invariably increases the number of interactions between teachers and learners. It enables teachers create critical thinking and problem solving skills in the students, building their capacity for lifelong learning and scaffolding and preparing them for the world of work. them

Learning in particular is made available to teachers and Mathematics Education students, allowing them to profit from instructional technology approaches. Literature has it that, there has been a number of research works on the effects of the application of model in the context of education. There is need for educators especially Mathematics Educators to shift from teacher-centred instruction like lecture method (chalk and talk method) to a more participatory active learning environment where students can participate actively and make use of their creative and problem-solving, activity-based and participatory skills. For instance, the direct method of instruction most often used by teachers cannot be completely condemned but can be supplemented with flipped classroom instruction to enhance students' learning. The direct instruction which is sometimes referred to as chalk and talk or lecture method is widely used in institutions as direct instruction which is highly teacher-centred. This mostly promotes passive listening with little or no active participation by students in learning activity which however leads to students' loss of interest and frustration in learning process. Direct instruction does not motivate students to learn and furnish them with skills required in the 21st century hence more activity-based instruction such as flipped classroom is advocated. In flipped classroom, lectures can be shifted online and inform students to use their laptops or iPhones to access them and class time is devoted to discussion and debate.

Flipped classroom is however a new trend in instructional activity as represented by the **acronym** below:
T-transforms learning landscape thereby making learning environment, learner- centred, motivating and exciting.
R- retention of the subject matter for easy regurgitation and creation and recall of new knowledge.
E- encourages learners' participation, interactions and teachers' effectiveness

N-new ideas are received and new strategy in instructional delivery thereby making learning interesting.
D- democratic, individualized learning, enabling learners to learn at their own pace without being coerced or forced. Through this medium they are able to develop several skills of problem solving, critical thinking, cooperative, collaborative learning and team work spirit.



Adapted from Willis 2014

In designing instruction therefore, the mathematics teacher has to take note of learners' learning differences in order to assist them master a domain. To achieve this, effort is made to provide practice that will enable students make connections between component skills and applications as well as knowing when and how such skills should be applied. This type of learning requires enough time and flipped classroom instruction.

In this paper, flipped approach also known as the inverted or reversed classroom is chosen to substitute the conventional method because today students are addicted to technology and the new entrants are just transiting from secondary schools to higher institutions. This approach is also to motivate them to develop interest in this aspect of mathematics that proves difficult. Flipped classroom instruction is an unconventional model in which students gain first-exposure learning prior to class and focus on the processing part of learning such as synthesizing, analyzing, problem-solving in class (Bergmann & Sams, 2012). The events that would have taken place in the classroom such as lectures and demonstrations are moved out of the classroom. The instructor spends time in the classroom providing them with support and scaffolding to assist in applying what they have just learned. (Shahzadi, Shahzadi & Munir 2022). Bergman and Sams (2012) view flipped classroom as a teaching strategy whereby students work on assigned activities outside the classroom and the class time is devoted to building their knowledge base. In this type of instruction, students are empowered to take charge of their own learning at their own pace. Educators who use flipped classroom no longer bear the sole responsibility of imparting knowledge rather students' active participation in the learning process and the classroom session becomes students-centred for effective interaction between the teachers and students.

In the literature "flipped classroom" has been defined by different researchers. DeLozier & Rhodes (2017) defined flipped classroom as a modern strategy in which the teachers assign lectures in different forms such as recorded or video lectures for students to review before attending class. Class time is devoted to a variety of activities including doing exercises, practices or problem-solving and group work. Alzwekh (2014) indicated that flipped classroom involves the smart use of the advanced techniques in order to cater for students' needs as well as make use of the effectiveness of modern technological tools in teaching and learning processes. In this research, flipped classroom is understood as the inverting process of teaching and learning mathematics to support advanced technology. What is done in class in traditional teaching is done at home therefore class time is used for active learning activities such as group discussion or role play.

Educational technology and activity learning are the two major components of the flipped classroom instruction. It is a learning strategy that blends online and in-class learning. It can simply be described as school work at home and home work at school where the teacher guides the students as they apply concepts and engage creativity in the subject (Willis, 2014).

Knowledge of mathematics and technology are pivotal to sustainable development in any nation building and national economy. Mathematics as a branch of science has important contributions to make a nation building and technological advancement. Developed nations such as United State of America boast of so many scientific inventions hence, it is among the super power nation of world. This is because they recognized the importance of Mathematics. The key component for comprehending science and technology is mathematics and a proficiency in mathematics is also essential in problem solving scientific discovery and technical advancement. Technology

is a vehicle which can accelerate economic growth, increased productivity, competitiveness and job creation, development for self-reliance in any nation.

The Federal Republic of Nigeria (FRN) 2008 in the National Policy on Education (NPE) states that teaching has to be practical, activity-based, experimental and ICT supportive. The class time should be used for more engaging and interactive activities to be facilitated by the instructor. This assists students to be active learners and take charge of their own learning process. The Flipped Classroom helps to change learning environment of initial introduction of new topic during lessons to a more interactive class where every student is capable of contributing in the discussion process.

Mathematics teaching has witnessed rapid changes in the 21st century. More new approaches have been introduced to enhance the effectiveness of the mathematics teaching skills. The role of teachers and students in this new approach is changing due to integration of media and innovative technology into the classroom. Educators can elect to provide direct instructional experiences for students using innovative pedagogies to incite discussions and debates thereby building up skills in them to survive in the 21st century workforce. Students are able to see issues and problems from different points of view, angles, negotiate meaning, harvest ideas and develop shared understandings with each other. Many 21st century students use the Internet for research, write seminar papers, class work or homework assignments. It is the wish of educators to help students become high achievers hence it is necessary to introduce innovative pedagogies into teaching of mathematics to enable students participate fully in learning process.

The 21st century students are online 24/7 surfing and moving from one website to the other not necessarily for academic purpose. It is important their attention is tuned to this aspect of learning to enhance their academic performance using flipped classroom with various devices like multimedia package to pass information across to them. This paper attempts to examine effect of innovative pedagogies and their implications for effective instructional delivery in the digital age. Teaching and learning of mathematics pose problem for students especially in this aspect of mathematics **LIMIT AND DIFFERENTIAL CALCULUS**. They consider it difficult probably due to obsolete method of teaching still being employed in teaching process. Observation has shown many students enter the university without the needed knowledge in calculus as showed in their school certificate results and most of the instructors still believe in lecture method, talk and chalk. The study is set to find out if flipped classroom approach as a method of instruction can enhance students' knowledge and performance in Mathematics especially in **LIMIT AND DIFFERENTIAL CALCULUS.**

The purpose of this study is to examine effect of innovative pedagogies and their implications for effective instructional delivery in the digital age. It is also to find out if flipped classrooms can enhance academic performance of undergraduate mathematics students in Ekiti state university.

The objectives included the Following

i. To examine the difference in academic performance of undergraduate mathematics students exposed to flipped classroom and those taught with conventional method of teaching Mathematics in pre-test stage.
ii. To investigate the difference in academic performance of undergraduate mathematics students exposed to flipped classroom and those taught with conventional method of teaching in Post-test stage.
iii. To find out the challenges facing the use of flipped learning approach in teaching Mathematics.

Research Questions

The following research questions guided the study

1. What is the difference in mean performance scores of undergraduate students exposed to flipped classroom and those taught with conventional method of teaching Mathematics in Pre-test stage.
2. What is the difference in mean performance scores of undergraduate students exposed to flipped classroom and those taught with conventional method of teaching Mathematics in Post-test stage.

Research Hypotheses

The following research hypothesis was formulated and tested at 0.05 level of significance

1. There is no significant difference in the pre-test mean scores of the experimental and control groups in mathematics.
2. There is no significant difference in the post-test mean scores of the experimental and control groups in mathematics.

The study would be of great significant in enhancing effective learning and students' retention of mathematical concepts thereby improving their attitude to the subject.

II. Methodology

The research design was pre-test post-test quasi-experimental. The experimental was treated with flipped classroom package while the control group was taught with the conventional method.

The pre-test is used to establish the students' entry behaviour before the commencement of the treatment to determine the efficacy of the package.

In the experimental procedure, the design is schematically represented below:
E O1 x1 O2-----this is the experimental group
C- O3 c O4------this is the control group
E----------recorded lecture for flipped classroom
C----------conventional method
O1, O3-----pre-test in E and C
O2, O4-----post-test in E and C
X1----------Experimental treatment (Flipped Classroom)
C----------conventional method used for the control group

The experimental group and the control group were given some mathematics on LIMIT AND CALCULUS to attempt as Pre-test to ascertain their level of knowledge of the course. Thereafter treatment was given and later both the experimental and the control groups were once again tested. This was the Post-test which determined the effectiveness of the package.

The sample consisted of 50 intact mathematics students from Ekiti State University, Ado-Ekiti, Nigeria. The students for experimental and control groups were selected through multistage.

Research instruments

Three research instruments were used to collect data. One for experimental and Control, questionnaire and the other is oral interview. Mathematics package titled 'innovative pedagogies and their implications for effective instructional delivery in the digital age' was used for both experimental and control while questionnaire and oral interview titled 'innovative pedagogies and their implications for effective instructional delivery in the digital age' was used too.

Experimental Procedure

The research procedure was in three stages. The pre-test, treatment and post-treatment stages.
Stage 1. The pre-test involved the gathering of students together and administer the questions without teaching them.
Stage 2. The treatment stage

This stage involves the treatment of the experimental group with the recorded mathematics package on (LIMIT AND DIFFERENTIAL CALCALUS). The treatment lasted for four weeks. One week for pre-test and four weeks for post-test treatment.

Data Analysis

Data collected were analysed using descriptive and inferential statistics. The research questions were answered using mean, standard deviation while t-test was used to test the hypotheses at 0.05 level of significance.

III. Results And Discussion

Results

Research Question 1: What is the difference in the mean scores of undergraduate exposed to flipped classroom and those taught with conventional method of teaching mathematics in pre-test stage?

Table 1: Mean and Standard Deviation of the difference in the pre-test mean scores of undergraduate exposed to flipped classroom and those taught with conventional method of teaching mathematics.

Pre-test	N	Mean	SD	Mean Difference
Flipped Classroom	30	5.80	2.09	**0.17**
Control Group	30	5.63	2.25	

Table 1 shows the mean and standard deviation of the difference in the pre-test mean scores of undergraduate exposed to flipped classroom and those taught with conventional method of teaching mathematics to be 5.80; 2.09 and 5.63; 2.25 for Flipped Classroom and control group respectively with a mean difference of 0.16. It could be deduced from this table that students in the two groups were of comparable ability in Mathematics.

Research Question 2: What is the difference in the mean scores of undergraduate exposed to flipped classroom and those taught with conventional method of teaching mathematics in posttest stage?

Table 2: Mean and Standard Deviation of the difference in the posttest mean scores of undergraduate exposed to flipped classroom and those taught with conventional method of teaching mathematics

Posttest	N	Mean	SD	Mean Difference
Flipped Classroom	30	9.73	0.58	**0.46**
Control Group	30	9.27	0.98	

Table 2 shows the mean and standard deviation of the difference in the posttest mean scores of undergraduate exposed to flipped classroom and those taught with conventional method of teaching mathematics to be 9.73; 0.58 and 9.27; 0.98 for flipped classroom and control group respectively with a mean difference of 0.46. It could also be deduced from this table that students exposed to flipped classroom had better performance in mathematics than their counterparts in the control group (control group).

Hypotheses Testing

Research Hypothesis 1: There is no significant difference in the pre-test mean scores of students in the experimental and Control Groups.

Table 3: t-test showing significant difference in the pre-test mean scores of students in the experimental and Control Groups

Pre-test	N	Mean	SD	t	P
Flipped Classroom	30	5.80	2.09	1.649	0.068
Control Group	30	5.63	2.25		

p>0.05 (Result Not Significant)

Table 3 shows that the t_{cal} (1.649) is not significant at 0.05 level of significance, the null hypothesis is not rejected, this implies that there is no significant difference in the pre-test mean scores of students in experimental and Control Groups. The implication is that the groups are homogeneous.

Research Hypothesis 2: There is no significant difference in the posttest mean scores of students in the experimental and Control Groups

Table 4: t-test showing significant difference in the posttest mean scores of students in the experimental and Control Groups

Posttest	N	Mean	SD	t	P
Flipped Classroom	30	9.73	0.58	2.017*	0.001
Control Group	30	9.27	0.98		

p<0.05 (Significant Result)

Table 4 shows that the t_{eal} (2.017*) is significant at 0.05 level of significance, the null hypothesis is not accepted, this implies that there is a significant difference in the posttest mean scores of students in experimental and Control Groups. It implies students in experimental group outperformed the students in the control group.

IV. Discussion

The findings revealed that students in the two groups (control and the experimental) were homogeneous with comparative abilities. The study further revealed significant difference in the performance mean scores of students exposed to conventional method and flipped classroom. The implication is that students in the experimental group had better performance in mathematics than their counterparts in the control group meaning the experimental group outperformed the students in the control group. These results corroborate other studies like StrohMyer (2016) who reported that flipped classroom could increase achievement scores, enhance their critical thinking, self- learning capabilities, building experiences and communication skills. Also agrees with the findings of Binoy (2024) that states that flipped classroom approach allows students to work at their own pace with pre-prepared assignment and flexibility which improved their academic performance scores. Flipped classroom approach is very relevant for instruction and an effective learning strategy. The results are also consistent with the findings of numerous studies in the literature that indicated that the flipped classroom model has the potential of motivating students to learn thereby leading to high participation and performance (Ito et al 2022 & Alshawish et al 2021). The high performance could also be as a result of students' positive attitude to the use of technology in instruction and digital literacy. In conclusion, the use of flipped classroom approach is indispensable and effective in teaching and learning of Mathematics. Based on the findings, teachers should be encouraged to use innovative pedagogy in teaching and learning of mathematics especially complex concepts. The University should provide instructional informative videos, computers, interactive smart board, with sufficient gadgets to enable both students and teachers to use flipped classroom and also teachers should be

exposed to seminars and workshops to learn more on the used of technology tools and be updated in order to be current.

References

[1] Alzwekh, N. (2014). The Effect Of Applying Flipped Classroom Concept On Developing Skills Of Self- Learning In Female Students At The Third Level, Computer Course 2. Retrieved On September 8, 2020 From: Http://Almarefh.Net/Show_Content_Sub.Php?CUV=428&Sub Model=216&ID=229

[2] Alshawish, E. El-Banna, M.M., & Alrimawi, I. (2021). Comparison Of Blended Versus Traditional Classrooms Among Undergraduate Nursing Students: A Quasi-Experimental Study. Nurse Education Today, 106. Https://Doi.Org/10.1016/J.Nedt.2021.105049

[3] Allan, L. (2013). Back To The Future. The Australian Educator, Sumer (80),14-15.

[4] Alvarez, B. (2011). Flipping The Classroom: Homework In Class, Lessons At Home. Retrieved From Http://Neapriorityschools.Org/Successfu-Students/Flipping-The-Classroomhomework-Class-Lessons-At-Home-2.

[5] Bergmann, J., & Sams, A. (2012). Flip Your Classroom: Reach Every Student In Every Class Every Day. International Society For Technology In Education.

[6] Davies, R. S., Dean, D. L., & Ball, N. (2013). Flipping The Classroom And Instructional Technology Integration In A College-Level Information Systems Spreadsheet Course. Educational Technology Research And Development, 61(4), 563–580. Https://Doi.Org/10.1007/S11423-0139305-6.

[7] Delozier, S., & Rhodes, M. (2017). Flipped Classrooms: A Review Of Key Ideas And Recommendations For Practice. Educational Psychology Review, 29(1), 141–151 Https://Doi.Org/10.1007/S10648-015-9356-9.

[8] Federal Republic Of Nigeria: NPE, (2008), National Policy On Education, Lagos: NERDC Press

[9] Flipped Learning Network (FLN), (2014). The Four Pillars Of F-L-I-P. Retrieved Http://Www.Flippedlearning.Org/Definition.

[10] Ito, A. Isohama, Y. & Watanabe, K. (2022), Comparison Of Flipped And Traditional Lecture-Based Classrooms For Kampo (Traditional Japanese Medicine) Education In A Medical School. International Journal Of Educational Research Open, 3.Https://Doi.Org//10.1016/J.Ijedro.2022.100156.

[11] Kim, S.-H., Park, N.-H., & Joo, K.-H. (2014). Effects Of Flipped Classroom Based On Smart Learning On Self-Directed And Collaborative Learning. International Journal Of Control And Automation, 7(12), 69–80. Https://Doi.Org/10.14257/Ijca.2014.7.12 .07.

[12] Kurtz, G. (2014). The Flipped Classroom Approach: The Answer To Future Learning? Retrieved From Http://Sebars.Wordpress.Com/2014/08/06/Test

[13] Nsofor C.C. & Bello A. (2015), EMERGING Trends In Educational Technology. Published By Evi-Cole Publishers, Ibadan, Nigeria. ISBN: 978-978-2206-77-6.

[14] Shahzadi, A., Shahzadi, S., & Munir, N. (2022). Flipped Classroom Approach To Enhance Students' Academic Performance At The University Level: Teachers' Perspective. Global Educational Studies Review, VII(II), 498-507. Https://Doi.Org/10.31703/Gesr.2022(VII-II).47

[15] Strayer, J. F. (2012). How Learning In An Inverted Classroom Influences Cooperation, Innovation And Task Orientation. Learning Environments Research, 15(2), 171–193. Https://Doi.Org/10.1007/S10984-0129108-4.

[16] Shorman, A. (2015). Blended Learning As Flipped Learning. Dar Al-Mserh: Amman.

[17] Strohmyer, D. (2016). Student Perceptions Of Flipped Learning In A High School Math Classroom. Ph.D. Dissertations, Walden University, Minnesota. Http://Scholarworks.Waldenu.Edu/Cgi/Viewcontent.Cgi?Article=3281&Context= Dissertations

[18] Tully, D. (2014). The Effects Of A Flipped Learning Model Utilizing Varied Technology Verses The Traditional Learning Model In A High School Biology Classroom. MA Thesis, Montana State University, Boseman, Montana. Retrieved On February 11, 2021. Http://Scholarworks.Montana.Edu/Xmlui/Bitstream/Handle/1/3600/Tullyd0814. Pdf;Sequence =1.

[19] Willis, J.A. (2014). The Effects Of Flipping An Undergraduate Precalculus Class. Retrieved From Http:Lllibres.Uncg.Edu/Ir/Asu/F/Willis,2014.Thesis.Pdf.Dissertation, State University, Appalachian.