

# A Study on the Effectiveness of Flipped Teaching in College Math Classroom

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## Abstract

The purpose of this work is to study how to teach mathematical skills and to determine what effectiveness of flipped teaching in College math classroom for student's achievement in the course. Many researchers are involved in their research work reporting about flip classroom by using different pedagogical approaches. In this work, the effectiveness of flipped Math classroom has been studied by carrying out two types of student surveys and analyzed by using basic statistical tools. The data has been collected on a small scale to analyze the opinion of the students and examined statistically. The results are in good agreement and given in tabular as well as in graphical form. The conclusion and suggestion for work have been given as well.

## Keywords

Flipped Teaching, College Math Classroom, Surveys, Basic Statistical Tools

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## 1. Introduction

In math teaching, the educators have been accustomed to teacher centered traditional teaching style. The teaching and tutoring mathematics in Canadian style of teaching and learning environment, as well as, learning experiences from Teaching and Learning in Higher Education (TLHE) certificate program at Centennial College, have made tangible difference in the teaching style. The interest is how to modify the teaching style from traditional to Flipped Teaching in Mathematics Classroom.

Technology is an essential tool for teaching and learning mathematics, the philosophy on teaching with technology to develop students understanding and increase their proficiency in mathematics. We believe that if we use technology in mathematical education has a great potential, which not only can better serve students aspirations, but can also foster curiosity and critical thinking in mathematics learning.

In flipped teaching, internet technology is used to enhance

learning in a course, allowing the teacher to spend more time interacting with students and helping them directly with their subject matter. Traditionally, the introduction is given in class through a lecture, and the deeper engagement occurs outside of class through homework. Researchers have come to call this flipping of what is traditionally done inside and outside the classroom the "classroom flip".

From teaching experiences, we know that in any institution the students needs better environment of learning all the time and they want to achieve their goals befittingly. As we all know, the use of technology is very essential tool for teaching and learning, so the student learning process can be improved and maximized by technology based flipped teaching.

The two surveys have been conducted from students at Centennial College Progress Campus and a class observation to collect the views of students on flipped teaching in college math classroom. The participations have answered (marked) the queries (inquiries) on the surveys forms related to the topic "The Flipped Math Classroom".

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In this study, we have examined at what frequency and percentage of students agreed on the effectiveness of flipped math classroom approach and their achievement in a required math course for the college credential.

## 2. Literature Review

The flipped classroom has been gaining popularity in recent years. In theory, flipping the classroom appears sound: passive learning activities such as unidirectional lectures are pushed to outside class hours in the form of videos, and precious class time is spent on active learning activities. The Flipped Classroom is an instructional strategy that can provide educators with a way of minimizing the amount of direct-instruction in their teaching practice while maximizing one-to-one interaction. This maximizes classroom time that had previously been reduced to lecturing. Many researchers have reported effectiveness of Flipped teaching in a Math classroom, adopting and justifying different approaches to proceed in this way.

Baker & Mentch (2000) have discussed a typical model of flipping lecture material through online delivery which extends conversations out of class through online discussions, and uses classroom time for applications and doing “homework” guided by the instructor. Lage et al. (2000) was one of the early thinkers who applied the concept to economics classroom. Kirschner et al. (2004) have written in the context of electronic collaborative environments, as well as, identified the necessary relationship between pedagogy, social interaction and technology tools. A study has been done on Comparison of Learning Activity in a Traditional Classroom and a Flip Classroom by Demetry (2010), Houston & Lin (2012), Strayer (2007) and Zappe et al. (2009) provided insights into the use of the flipped classroom with mathematics instruction.

Many educators like Alvarez (2011), Berrett (2011), Dziuban (2004), Fulton (2012), Hughes (2012), Kleiman (2000), Novak (2011) and Talbert (2012) are promoting the use of both technology and some version of an inverted classroom often in a blended learning environment. Moravec et al. (2010) and Strayer (2012) research regarding the specific pedagogical approach of flipping the classroom is another important work in the area. It refers to contextually situated learning circumstances. Bergmann and Sams (2012) and Davies (2011) have discussed that it is important to understand the challenges and what benefits are derived from each pedagogical approach. Recently, Jean McGivney et al. (2013) have discussed flipping pedagogy and how it can transform the teaching and learning of calculus by applying pedagogical practices and how students learned most effectively. Dove, A. & Dove, E. (2014) have examined the

problem of the influence of traditional classroom lecture compared to a flipped classroom approach on math anxiety and math achievement in a required undergraduate mathematics course. Gila Kurtz et al. (2014) have investigated the implications of applying the flipped-classroom approach in an undergraduate course. A learning process such as the flipped classroom forces students to invest time in independent self-study away from class.

From the above literature review, the flipped or inverted classroom provides students opportunities for advanced preparation and time to identify knowledge gaps needing clarification instead of spending the class time in lecturing about topics covered in pre-class reading assignments. Here, faculty interact with students by discussing points of confusion, providing real-life examples relevant to course content, challenging students to think more deeply about complex processes, and monitoring peer-to-peer, team based learning activities.

In this research work, we have analyzed the effectiveness of Flipped Teaching in College Math Classroom through conducting surveys on this topic and examined what benefits of flipping the classroom might have for students taking math course at college level.

## 3. Design and Methodology

This research work has been completed during the study of Teaching Practicum course in the certificate program “Teaching and Learning in Higher Education” at Centennial College which is related to teaching practice or action research on “flipped teaching”. We have worked on this study theoretically through surveys from Centennial College Student to collect their views on flipped teaching in college Math classroom. A definition of flipped class has been explained to the student as: What is flipped teaching? “The students have been provided lecture materials outside the class, while using class time to explore concepts and key points in material as well as create engagement and discussion in the classroom”.

The two surveys have been performed “Student Survey” and “Student Questionnaire” In order to study student views on flipped teaching; ten questions have been formulated in each survey and questionnaire on separate form about effectiveness of flipped teaching (flip class) in college math classroom. Each form has been viewed by alternate student at same time and in the same classroom. The views have been collected from 60 participants that is 30 in student’s survey and 30 in student’s questionnaire. Also, a class has been observed for teaching style, class activity and student involvement.

The data has been recorded for both surveys separately in table 1 and 2. To measures of central tendency of the student's response, we have used basic statistical tools (Mean, Median and Mode) given as below:

The formula for Mean is

$$\text{Mean} = \bar{X} = \frac{\sum x}{n}$$

If the total number of numbers (n) is as odd number then Median is

$$\text{Median} = \left(\frac{n+1}{2}\right)^{\text{th}} \text{ term,}$$

If the total number of numbers (n) is as even number then Median is

$$\text{Median} = \frac{\left(\frac{n}{2}\right)^{\text{th}} \text{ term} + \left(\frac{n}{2} + 1\right)^{\text{th}} \text{ term}}{2}$$

The Mode is the most frequently occurring value in the data.

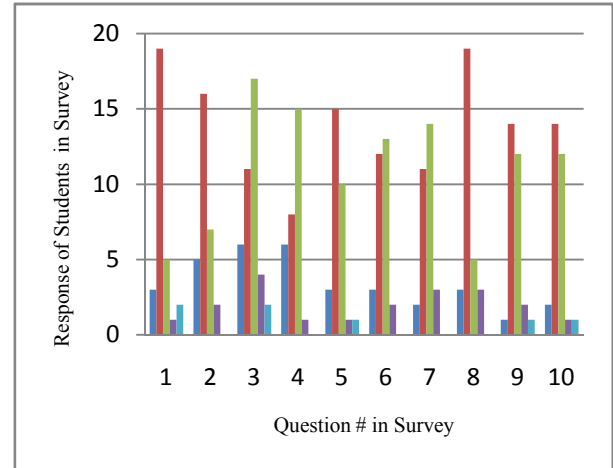
The results and analysis are given in next section.

## 4. Results and Analysis

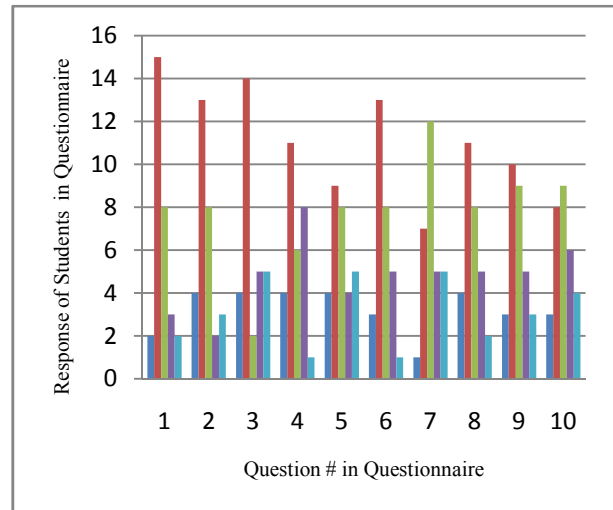
The students have been surveyed regarding their experiences as they are used to with the digital media, the instructional links, and the applied work done in the class, as well as about their impressions of the flipped style in relation to the traditional style of instruction.

We have calculated the results by using basic statistical tools, the frequencies and percentages of each item in both surveys are given in table 1 and 2. In student survey type, the "Agree" column is better than the others column in responses to each item. Similarly, in student questionnaire type, the "Very." column is better than the others column in responses to each item. In table 3, the average result for "Agree" is 14 and the average result for "Very." is 11 this means that the total of best result from both is 25 which is out of 60 views. Also we can observe results from bar graphs which are given in Figures 1 and 2. From these results and analysis, the views of participants to agree with flipped math classroom are less than 50 percent.

The findings here are positive for the flipped teaching approach, but the percentage is around 50, but the traditional form of teaching is far from rejected. The survey for this project was on small scale and not surveyed in actual math classroom because it was not as an action research directly. Thus, these results and finding are not enough to analyze what the effectiveness of Flipped Teaching on College Math Classroom will be. But the study is good for opening the door to do tangible action research on this topic. Also from students comments it is not clear that their thinking are positive and negative. The conclusion and suggestion are given in next section for the reflection on this work.



**Figure 1.** (Students Survey) the bars indicate for (strongly agree, agree, neutral, disagree and strongly disagree) for frequency level of each item.



**Figure 2.** (Students Questionnaire) the bars indicate for (extremely, very, moderately, slightly and not at all) for frequency level of each item.

## 5. Reflections and Consequences

In teaching practicum course of TLHE program, we have learned how to improve teaching philosophy through action research in classroom teaching. In this research, we have completed a project through surveys which are necessary but not sufficient to do such type of action research. This course itself is good learning experiences according to learning point view but teaching practice should be a part of this course to do precise action research.

Consequently, the work in this research report is completed successfully and it is first report on "flipped math teaching" research which gave us better understanding how to do action research. The action research will be continue on flipped math teaching by doing practical in classroom. Finally, the suggestion for future research on this topic is to study the

effectiveness of both “Flipped Model” and “Traditional Model” in College Math Classroom as an action research and to compare the models for their efficiency.

## 6. Tables and Figures

**Table 1.** Student Survey: (Total 30) at Centennial College. The cumulative results of the student response in each category are given below:

#	Item in Survey	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	The flipped classroom will give more engagement in the classroom	3	19	5	1	2
2	The flipped classroom will give you more opportunities to discuss with other classmates	5	16	7	2	0
3	The flipped classroom will give better time to practice math in class	6	11	7	4	2
4	The flipped teaching will give you more skill and knowledge in the course	6	8	15	1	0
5	I will like to watch/study instruction/lecture on the lesson at home	3	15	10	1	1
6	I feel it easy to pace myself successfully through the course	3	12	13	2	0
7	I feel difficulties in problem solving to do homework at home	2	11	14	3	0
8	I feel that mastery in learning will improve my math understanding	3	19	5	3	0
9	I feel that it is more motivating to learn math in flipped classroom	1	14	12	2	1
10	I would like to recommend the flipped classroom to a friend	2	14	12	1	1

**Table 2.** Student Questionnaire: (Total 30) at Centennial College. The cumulative results of the student response in each category are given below:

1.	How much flipped classroom will add to the classroom engagement?	Extremely engage 2	Very engage 15	Moderately engage 8	Slightly engage 3	Not at all engage 2
2.	How flipped classroom will give more opportunities to discuss with other classmates?	Extremely opportunity 4	Every opportunity 13	Moderately opportunity 8	Slightly opportunity 2	Not at all opportunity 3
3.	How flipped classroom will give better time to practice math in the class?	Extremely better 4	Very better 14	Moderately better 2	Slightly better 5	Not at all better 5
4.	How flipped teaching will give extra skill and knowledge to the learner's in the course?	Extremely extra 4	Very extra 11	Moderately extra 6	Slightly extra 8	Not at all extra 1
5.	How will you like to watch/study instruction/lecture on the lesson at home?	Extremely like 4	Very like 9	Moderately like 8	Slightly like 4	Not at all like 5
6.	How will you feel it easy to pace myself successfully through the course?	Extremely easy 3	Very easy 13	Moderately easy 8	Slightly easy 5	Not at all easy 1
7.	How will you feel any difficulty in problem solving to do homework at home?	Extremely difficult 1	Very difficult 7	Moderately difficult 12	Slightly difficult 5	Not at all difficult 5
8.	How you feel that mastery learning will improve my math understanding?	Extremely improve 4	Very improve 11	Moderately improve 8	Slightly improve 5	Not at all improve 2
9.	How you feel that it is more motivating to learn math in flipped classroom?	Extremely learn 3	Very learn 10	Moderately learn 9	Slightly learn 5	Not at all learn 3
10.	Would you like to recommend flipped math classroom to a friend?	Extremely recommend 3	Very recommend 8	Moderately recommend 9	Slightly recommend 6	Not at all recommend 4

**Table 3.** The frequency and percentage of the student response in both surveys (F means Frequency in response and % means Percentage of response).

Item	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
	F	%	F	%	F	%	F	%	F	%
1	3	10	19	63.3	5	16.7	1	3.3	2	6.7
2	5	16.7	16	53.3	7	23.3	2	6.7	0	0
3	6	20	11	36.7	7	23.3	4	13.3	2	6.7
4	6	20	8	26.7	15	50	1	3.3	0	0
5	3	10	15	50	10	33.3	1	3.3	1	3.3
6	3	10	12	40	13	43.3	2	6.7	0	0
7	2	6.7	11	36.7	14	46.7	3	10	0	0
8	3	10	19	63.3	5	16.7	3	10	0	0
9	1	3.3	14	46.7	12	40	2	6.7	1	3.3
10	2	6.7	14	46.7	12	40	1	3.3	1	3.3

Student Questionnaire										
Item #	Extremely		Very		Moderately		Slightly		Not at all	
	F	%	F	%	F	%	F	%	F	%
1	2	6.7	15	50	8	26.7	3	10	2	6.7
2	4	13.3	13	43.3	8	26.7	2	6.7	3	10
3	4	13.3	14	46.7	2	6.7	5	16.7	5	16.7
4	4	13.3	11	36.7	6	20	8	26.7	1	3.3
5	4	13.3	9	30	8	26.7	4	13.3	5	16.7
6	3	10	13	43.3	8	26.7	5	16.7	1	3.3
7	1	3.3	7	23.3	12	40	5	16.7	5	16.7
8	4	13.3	11	36.7	8	26.7	5	16.7	2	6.7
9	3	10	10	33.3	9	30	5	16.7	3	10
10	3	10	8	26.7	9	30	6	20	4	13.3

Table 4. The comparison of measures of central tendency between student survey and student questionnaire.

Students Survey				Students Questionnaire			
Item Rate	Mean	Median	Mode	Item Rate	Mean	Median	Mode
Strongly Agree	3.4	3	3	Extremely	3.2	3.5	4
Agree	13.9	14	19,14,11	Very	11.1	11	13,11
Neutral	10	11	12,7	Moderately	7.8	8	8
Disagree	2	2	1	Slightly	4.8	5	5
Strongly Disagree	0.7	0.5	0	Not at all	3.1	3	5

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