

# POSSIBILITY OF APPLYING FLIPPING CLASSROOM METHOD IN MATHEMATICS CLASSES IN FOUNDATION PROGRAM AT QATAR UNIVERSITY

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## Abstract

With the dramatic increase of using technology in higher education, universities are introducing all possible support for their teachers and students, and providing them with essential equipment inside and outside the classroom like computers, laptops, free internet and Wi-Fi, audio-video devices in the classroom. Also communication methods between teachers and students are available among an e-mail, blackboard, My Labs Plus, mobiles and other smart facilities. In addition, families and parents provide their children with mobiles and laptops to make them able to follow up their teachers. All these available services lead the teachers to apply some new methods of teaching like flipping classroom method. In this paper, the author discussed the possibility of using flipping classroom method in mathematics classes in foundation program at Qatar University by applying it on a pilot group of students, after designing a special model of flipped learning. In addition, the author investigated some of the difficulties and problems that facing this method of teaching in mathematics classes, and he provided some suggestions to reduce these difficulties and to improve this method in mathematics classes. It is found that, applying this method in mathematics classes is more difficult than Art, education or sharia classes; it is possible with some restrictions and conditions on the method of designing the model of flipping classroom. Also it is found that results of the pilot group in the quiz where this method used is better than their results in the quizzes where they didn't use this method. An analysis of the results is presented, some hypotheses are tested. Finally conclusions and recommendations are presented.

**Keywords:** Flipping classroom method, Mathematics, Student, Teacher, Testing Hypothesis.

## 1. LITERATURE REVIEW

In 1993, King published "From Sage on the Stage to Guide on the Side" in *College Teaching*. In 2000, Lage, Platt and Treglia published the paper "Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment". Starting in fall 2000, the University of Wisconsin-Madison used e-Teach software to replace lectures in a computer science course with streaming video of the lecturer and coordinated slides. In 2004, Salman Khan began to record videos at the request of a younger cousin who felt that recorded lessons would let her skip parts she had mastered and replay parts that were troubling her. Khan's model essentially provides one-to-one tutoring. Khan Academy videos are used as part of some educators' flipped teaching strategy. In the "The Classroom Flip" (2006), Tenneson and McGlasson presented an approach for teachers considering whether to flip their classrooms and how various approaches could enhance their teaching process, along. It also explores computer course management systems. In 2006, Maesumi taught a flipped Calculus I class at Lamar University. Students in the flipped class significantly outperformed the controls in Calculus II. Stacey Roshan, a high school math teacher in Potomac, Maryland, reduced student anxiety through flexible testing and student created content. Her mother, also a math teacher, used the videos her daughter had created, as well. In 2007, Jeremy Strayer published his dissertation research conducted at the Ohio State University entitled "The effects of the classroom flip on the learning environment: a comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system. In 2007, Jonathan Bergmann and Aaron Sams, both high school science teachers at Woodland Park High School in Woodland Park, Colorado, implemented their own version of the flipped classroom by first moving all of their direct instruction to online videos, and then introducing the Flipped-Mastery model during the

2008-2009 school year, chronicled in their book "Flip Your Classroom, Reach Every Student in Every Class Every Day. In 2012, Crystal Kirch, a high school math teacher in Santa Ana, California, developed a "Watch, Summary, Question" (WSQ, pronounced "whisk") assignment cycle, writing about it on her blog, her class website, and posting to her YouTube channel. In 2012, Graham Johnson, a high school math teacher in Kelowna, British Columbia hosted the first-ever flipped learning conference in Canada.

## 2. INTRODUCTION

Flip teaching or a flipped classroom is a form of blended learning in which students learn new content online by watching video lectures, usually at home, and what used to be homework (assigned problems) is now done in class with teachers offering more personalized guidance and interaction with students, instead of lecturing. This is also known as reverse teaching. Inverting the classroom means that events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa. The use of learning technologies, particularly multimedia, provide new opportunities for students to learn. For example, the use of the world Wide Web and multimedia computers enables students to view lectures either in computer labs or at home, whereas homework assignments can be done in class, in groups. The general principal is to provide a menu of options for the students to use in learning. Table (1) contains some characteristics of the effective and ineffective lecture.

Table 1. Characteristics of the Effective and Ineffective lecture

| Characteristics of the Effective and Ineffective Lecture |   |
|--|---|
| Effective  | Ineffective                                     |
| Educator-student interaction                             | 100% educator talk with limited interaction     |
| Two-way communication                                    | One-way communication                           |
| Educator-student questions                               | Few if any questions (educator or student)      |
| Shared responsibility for active learning                | Student depends on educator for all information |
| Small group, problem solving activities                  | No student activities                           |
| Variety of supporting media                              | No supporting media                             |
| Limited note taking required                             | Extensive note taking required                  |

### 2.1. Active Learning:

A substantial body of research on student-centered, active learning strategies supports the effectiveness of these approaches in increasing student learning and achievement (Prince, 2004; Michael, 2006). Active learning is associated with improved student academic performance (Michael, 2006; Freeman, 2007; Chaplin, 2009), and increased student engagement, critical thinking, and better attitudes toward learning. When problem-based active learning occurs in science courses, for example, students report learning more, and their attitudes toward class improve (Akinoglu and Tandogan 2006). Moreover, misconceptions are significantly reduced.

Student-centered models are usually defined in opposition to "teacher-centered" models (Michael, 2006). Teacher-centered models focus on the acquisition of knowledge outside of the context in which it will be used, and instructional delivery includes lecture, homework, and exams, used for assigning grades. Little time is allotted for teachers to work directly with students to guide them as they attempt to meaningfully apply the information. This approach has been described as a "one-size-fits-all" model of instruction, in which effective teaching is characterized as presenting information well, and those who can learn, will learn. In contrast, teachers using a student-centered approach engage students in actively constructing knowledge and they work together to evaluate students' learning. According to Michael (2006), students build mental models of what is learned, deliberately test the validity of those models, and fix faulty models. He cites multiple studies supporting that students learning in this way are more likely to achieve meaningful learning.

### 2.2. Comparison between Online education, Blended classes and Flipped Classrooms:

Flipped Learning has been compared to online, blended, and distance learning because of the screencast or video components, but, there are clear differences. **Online education**, for example, occurs only remotely, and the teacher and student are never face-to-face. Virtual class meetings, assignments, and lectures happen online through a course management website usually, but not always, asynchronously. Sometimes the lectures and other activities are augmented by group chats or other means of facilitating collaboration

and peer instruction.

**Blended classes** also have an online element, but that usually occurs during class time along with direct student-teacher contact. Students' experiences in face-to-face sessions vary, however, and are not necessarily different than what occurs in a traditional classroom.

That is also the case in some **flipped classrooms**. The use of videos or other digital technologies to deliver content outside of class does not guarantee that anything different will occur during class time. However, due to the emphasis on students becoming the agents of their own learning rather than the object of instruction, the Flipped Learning model can enable educators to make the shift from teacher-driven instruction to student-centered learning.

### **3. FLIPPED CLASSROOM:**

Researchers defined the flipped classroom as an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom. There are four pillars of flipped learning that allow Flipped Learning to occur. These four Pillars of **F-L-I-P** are **F**lexible Environment, **L**earning Culture, **I**ntentional Content, and **P**rofessional Educator.

#### **3.1. Previous published case studies about the Flipped Classroom**

Jacob Bishop and Matthew Verleger (2013) collected all studies that done through 2012, they found 24 studies related to the flipped classroom. A spreadsheet with a complete encoding of study features was created, including the publication type, year of publication, course, educational institution, study type, sample size, measurement instruments, theoretical framework, in-class activities, and out-of-class activities. In summary, of all the studies on the flipped classroom, there is only one that has examined student performance throughout a semester. While the results from this study are encouraging. Thus, additional research is needed to examine the influence of flipped classroom instruction on objective learning outcomes.

The performance of Byron High School's students in math was perennially low. In 2006, fewer than one-third of students (29.9%) passed the state mathematics test (Minnesota Comprehensive Assessments) and ACT composite scores averaged 21.2. After flipping their math classrooms, the teachers found that engagement increased and students began exceeding expectations. By 2011, nearly three-quarters (73.8%) of students passed the state math test, more than double the performance from just three years earlier, and the ACT composite scores improved to 24.5. Moreover, by 2012, 86.6% of Byron's seniors completed four or more credits of math.

Faculty at California State University, Los Angeles in 2008 flipped the freshman and sophomore Introduction to Digital Engineering course in order to increase opportunities for collaborative project-based learning. The shift was intended to address what was perceived to be the limited professor-student interaction and the prevalence of passive learning in engineering classrooms. In a post-course analysis, flipping the classroom seemed to be effective in helping students understand course material and develop design skills (Warter, Perez & Dong, 2012). Their findings were reinforced by satisfaction surveys and focus groups in which over 70% of students said the class learning environment was more interactive. In the same study, all students strongly agreed that the new learning environment allowed them to gain better hands-on design skills and agreed that the flipped class helped them to learn the content better. Overall, the results suggest that flipping the classroom in this instance had a positive effect on student learning and helped extend learning objectives.

#### **3.2. Advantages of the flipped classroom:**

Some advantages can be summarized such as; students move at their own pace, doing "homework" in class gives teachers better insight into student difficulties and learning styles, teachers can more easily customize and update the curriculum and provide it to students 24/7, classroom time can be used more effectively and creatively. Also, teachers using the method report seeing increased levels of student achievement, interest, and engagement, learning theory supports the new approaches. the use of technology is flexible and appropriate for "21st century learning." there is more time to spend with students on authentic research, and the method "promotes thinking inside and outside of the classroom". In addition, students get more time working with scientific equipment that is only available in the classroom, students who miss class for debate/sports/etc. can watch the lectures while on the road, students are more actively involved in the learning process, and students also really like it.

### **3.3. Disadvantages of the flipped classroom:**

Some disadvantages can be summarized as the following:

- 1) Students new to the method may be initially resistant because it requires that they do work at home rather than be first exposed to the subject matter in school. Consequently, they may come unprepared to class to participate in the active learning phase of the course.
- 2) The homework (readings, videos) must be carefully tailored for the students in order to prepare them for the in-class activities. For most teachers (and students), videos are the method of choice for delivering the out-of-class portion of the instruction.
- 3) Finding a good quality videos is difficult.
- 4) Videos produced by sources such as the Kahn Academy and Bozeman Science do not coincide with the syllabus of the course.
- 5) Creating own videos using software programs like Camtasia, Paper Show, and Show Me or apps on the iPad like Educreations and Explain Everything, requires a significant amount of time from the instructor.

## **4. A CASE STUDY TO INVESTIGATING POSSIBILITY OF APPLYING FLIPPING CLASSROOM METHOD IN MATHEMATICS CLASSES IN FOUNDATION PROGRAM AT QATAR UNIVERSITY**

### **4.1. Qatar University:**

Qatar University is the only governmental university in State of Qatar, it consists of seven colleges and two programs. The colleges are Arts and Sciences, Business and Economics, Education, Engineering, Law, Pharmacy and Sharia and Islamic Studies. The programs are Foundation Program and Honors Program. The mother tongue of the students is Arabic but the teaching medium in Qatar University is English except some colleges like Education, Law and Sharia and Islamic Studies and some departments of college of Arts. In the academic year 2013/2014, Qatar University experienced an unexpected increase of almost 30% in student body. The average class size was also increased. Students were divided into male and female campuses. Classes in the University are spread overall the day from 8:00am to 7:00pm.

### **4.2. Foundation Math Program:**

The Foundation Math Program at Qatar University is a remedial program that assists conditionally admitted Qatar University students to achieve the University/Colleges admission requirements of Mathematics. Math course run for 4 contact hours each week. In addition, most students are, at the same time, enrolled in an intensive ESL English course of 20 contact hours per week. The mother tongue of the students is Arabic but the teaching medium in the Foundation Program is English. There are two math courses in Foundation Math Program; Elementary Algebra and Pre-calculus. Elementary Algebra course is non-credited course.

On the other hand, the Foundation Math Program has 19 full-time faculty members. The normal teaching load is 4 Math sessions per semester (16 contact hours per week). Head of the department and Program Coordinator have a reduced teaching to administrate their assigned duties. Math classes are delivered in two patterns, Morning sessions (between 8:00 am and 12:00 pm) and afternoon sessions (between 12:00 pm and 4:00 pm). Classes are spread overall male and female campuses based on classroom availabilities.

### **4.3. Designing the Flipped Classroom:**

Designing the flipped classroom depends on thinking and preparing in-class activities and out-class activities. The combination of in-class and out-of-class activities was evaluated to determine possibility of applying the flipped classroom. Out-of-class activities prepared to include required video lectures from Khan Academy website and math TV website beside written notes with answers; in-class activities prepared to involve interactive learning activities, like dividing the students into pairs or small groups. Some of these activities required students to read material before class, rather than having it presented in an audiovisual format.

During the academic semester Spring 2014, I chose one pre-calculus course from my groups as a pilot group. This group consists of 40 female students. Students agreed to help me in applying the method of flipped classroom for two weeks to cover three sections from the syllabus, these sections are inverse function, exponential functions and logarithmic functions. These three sections cover the contents of quiz (3). Written

notes with answers are submitted to all students in this group by blackboard and their e-mails to be read before the classes. Also, some videos related to these three sections from khan academy and math TV sites are sent to students to be seen before the classes. I checked by the blackboard that most of students if not all opened these websites and the notes before the day of the class. On the other hand, several worksheets are prepared to be solved in the classroom, and I changed the design of the seats in classroom to divide my students into small groups or in pairs, and to make it easier for me to walk around them, also to be easy for me to reach to all students.

To evaluate this method, all students sat to take quiz (3) covered the three sections, the results are compared to results of previous quizzes 1 and 2. Statistical analysis is done to these results. In addition, a questionnaire is distributed among all students in this pilot group at the end of these two weeks to investigate their opinions about the flipped classroom method, the results are analyzed.

**4.4. Results of students:**

Table (2): The results of students in quiz 1, quiz 2 and quiz 3 for the pilot group.

| Quiz | A | B+ | B | C+ | C | D+ | D | F  | Total |
|------|---|----|---|----|---|----|---|----|-------|
| 1    | 4 | 4  | 5 | 4  | 6 | 4  | 3 | 10 | 40    |
| 2    | 5 | 5  | 6 | 3  | 6 | 5  | 3 | 7  | 40    |
| 3    | 6 | 5  | 7 | 5  | 8 | 2  | 4 | 3  | 40    |

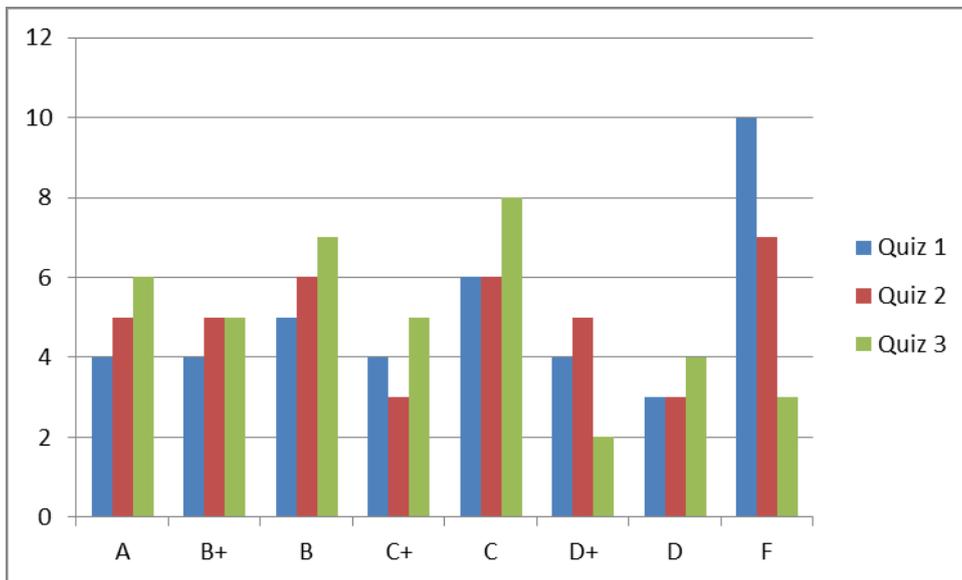


Fig. 1. The results of students in quiz 1, quiz 2 and quiz 3 for the pilot group

The passing average of the three quizzes are 75%, 82.5% and 92.5 respectively, which means that the results of the students in quiz 3 using the flipped classroom method is better than the first two quizzes. But the question is can we apply this method during the whole semester?

**4.5. Analysis of the questionnaire:**

To investigate the students opinions about the flipped classroom method in teaching mathematics courses, a questionnaire consisted of 10 questions was distributed during Spring 2014 semester after quiz (3). All students answered the questionnaire, the answer key of the questionnaire is as the following: Strongly Agree =5, Agree =4, No opinion =3, Disagree =2, Strongly Disagree=1 .

**4.5.1. Testing The Hypotheses Of The Study**

To test the study hypothesis, one sample t-test with level of significant ( $\alpha = 0.05$ ) is used, the null hypothesis is  $H_0$ : No difference between students' results in quiz 2 and quiz 3 and the alternative hypothesis is  $H_1$ : There is a difference between students' results in quiz 2 and quiz 3.

By comparing the  $p$ -value and the significant level  $\alpha$ :

If  $p$ -value  $< \alpha$  then we reject  $H_0$ , otherwise we don't reject  $H_0$ . The test is summarized in the following table:

Table (3): Test of the hypothesis

| The hypothesis $H_0$   | p-value | The Result  |
|--|---------|---|
| No difference between students' results in quiz 2 and quiz 3 | 0.023   | Reject $H_0$<br>So there is a difference between students' results in quiz 2 and quiz 3 |

#### 4.5.2. Percentages of students answers

Also the percentages of students answers are summarized in the table (4).

Table (4): percentages of students answers

| The question   | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|--|----------------|-------|------------|----------|-------------------|
| Learning using flipped classroom is more active process                                    | 45%            | 37.5% | 7.5%       | 7.5%     | 2.5%              |
| Students are more likely to have a choice in what they want to solve in the classroom      | 35%            | 37.5% | 12.5%      | 10%      | 5%                |
| Using flipped learning students have more positive interactions                            | 42.5%          | 45%   | 7.5%       | 5%       | 0%                |
| Using flipped learning students are more likely to work in collaborative together          | 37.5%          | 40%   | 15%        | 2.5%     | 5%                |
| Students are more likely to work in critical thinking and problem solving                  | 50%            | 32.5% | 12.5%      | 2.5%     | 2.5%              |
| Students have greater opportunities to work at own pace                                    | 45%            | 45%   | 10%        | 0%       | 0%                |
| Teacher is more likely to take into account students' interests, strengths, and weaknesses | 42.5%          | 47.5% | 2.5%       | 5%       | 2.5%              |
| Students have greater access to course material and instruction                            | 45%            | 45%   | 7.5%       | 0%       | 2.5%              |
| Students have more choice in how they demonstrate their learning                           | 35%            | 42.5% | 20%        | 2.5%     | 0%                |
| Students feel that the teacher is closer to them than before                               | 50%            | 45%   | 5%         | 0%       | 0%                |

## 5. RESULTS AND RECOMMENDATIONS

### 5.1. Results of the study:

The following results are obtained:

- 1) 82.5% of students view learning using flipped classroom method as a more active process.
- 2) Using flipped classroom method, 72.5% of students are more likely to have a choice in what learning tasks they engage in.
- 3) 87.5% of students have more constant and positive interactions using flipped classroom method.
- 4) 77.5% of students are more likely to engage in collaborative decision making by using flipped classroom method.
- 5) 82.5% of students are more likely to engage in critical thinking and problem solving using flipped classroom method.
- 6) 90% of students have greater opportunities to work at own pace using flipped classroom method.

- 7) 90% of students agree with the statement "Teacher is more likely to take into account their interests, strengths, and weaknesses using flipped classroom method".
- 8) 90% of students have greater access to course material and instruction using flipped classroom method.
- 9) 77.5% of students have more choice in how they demonstrate their learning using flipped classroom method.
- 10) 95% of students feel that the teacher is closer to them than before using flipped classroom method.
- 11) Evidence suggests that students generally preferred the inverted classroom to a traditional lecture and would prefer to take future mathematics classes using the same format.

## 5.2. Recommendations

The following recommendations are introduced:

- 1) This method should be reviewed and applied on more students and groups to investigate the performance of students during the semester and comparing their results to traditional methods.
- 2) providing specific professional development sessions to explain and clarify this method to other colleagues in the department and persuading them to use this method in teaching, because this method needs a great effort in preparing out-class activities like suitable videos and readings.
- 3) Raising the awareness of students about this method, because new students to the method may be initially resistant because it requires that they do work at home rather than be first exposed to the subject matter in school.
- 4) The homework (readings, videos) must be carefully tailored for the students in order to prepare them for the in-class activities and to be coincide with the objectives of the lesson.
- 5) Searching for or preparing a good quality and suitable videos related to the objectives of the lesson, because videos produced by sources such as the Kahn Academy and Bozeman Science do not coincide always with the syllabus of the course.
- 6) This investigation should be replicated in similar Math courses with different teachers in order to compare results and to draw the right conclusions.

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