# STUDENT ATTITUDES TOWARDS ACTIVE LEARNING METHODS IN A SENIOR-YEAR COMPUTER ENGINEERING COURSE

**Abdel Salam Sayyad**

*Birzeit University (PALESTINE)*

## Abstract

Active Learning is gaining momentum as a method to ensure best use of class time in science and engineering classrooms by focusing on the intended learning outcomes rather than the traditional focus on coverage of material via lecturing and homework sets. Active Learning is not the same as the Flipped Classroom approach, where the students are expected to read the material or watch lectures at home and then solve problems in class. Active Learning utilizes class time to introduce the material by engaging the students in exercises that aim at two things: 1) to discover new concepts by bringing out misconceptions that might have previously been held by individual students, and 2) to gain practical skills in design and problem solving. This study presents the results of student surveys which evaluate the students' experiences with various teaching/learning methods, and show a clear advantage for methods that depend more on active learning within the class, and student one-on-one discussions, while the students thought least of slide-based lectures and homework problems.

Keywords: Active Learning; Flipped Classroom.

## 1 INTRODUCTION

The flipped classroom is a new pedagogical method, which employs asynchronous video lectures and practice problems as homework, and active, group-based problem solving activities in the classroom. [1] The diagram in Fig. 1 shows the flipped versus the traditional classroom, adopted from [2].

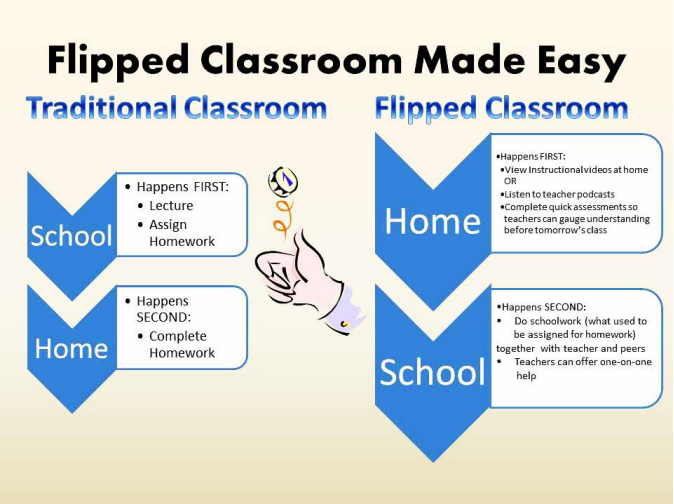


Fig. 1. Traditional versus flipped classroom, adopted from [2].

Bishop and Verleger [1] conducted a comprehensive survey of prior and ongoing research of the flipped classroom. Results of this survey show that most studies explore student perceptions and use single-group study designs. Reports of student perceptions of the flipped classroom are somewhat mixed, but are generally positive overall. Students tend to prefer in-person lectures to video lectures, but prefer interactive classroom activities over lectures. They also mention anecdotal evidence that student learning is improved for the flipped compared to traditional classroom. However, there is very little work investigating student learning outcomes objectively. They recommend that future work studies investigate objective learning outcomes using controlled experimental or quasi-experimental designs.

Jensen et al. [3] conducted a controlled study to investigate the reason that flipped classrooms produce better learning, and concluded that "improvements from a flipped classroom may simply be the fruits of active learning." In that study, they compared an active nonflipped classroom with an active flipped classroom, and found that both low-level and deep conceptual learning were equivalent between the

conditions. Attitudinal data revealed equal student satisfaction with the course. Interestingly, both treatments ranked their contact time with the instructor as more influential to their learning than what they did at home. We conclude that the flipped classroom does not result in higher learning gains or better attitudes compared with the nonflipped classroom when both utilize an active-learning, constructivist approach and propose that learning gains in either condition are most likely a result of the active-learning style of instruction rather than the order in which the instructor participated in the learning process.

This paper reports on the experience of using Active Learning in the classroom of computer architecture course, a senior-level computer engineering course, blended with lecturing, so that the students are not expected to pre-study the material or view lectures at home, but are engaged in problem solving in the classroom, with varying methods of discussion to evaluate the student solutions.

## 2 RELATED WORK

Amresh et al. [4] evaluated the flipped classroom approach in teaching CS1, the introductory programming course. Their results show that the flipped approach has promise in improving student scores, but many students found this new approach to be overwhelming and intimidating.

Campbell et al. [5] also evaluated the flipped classroom approach in teaching CS1. Their results show low lecture attendance, high completion of lecture preparation, students ranking inverted lectures and online material as less helpful than traditional lectures, increasing enthusiasm and enjoyment, typical drop, pass, and fail rates, and comparable performance.

Gannod et al. [6] report on using inverted classroom in teaching a few courses in software engineering. They surveyed student attitudes and obtained positive responses in general.

Gehringer and Peddycord [7] reported on using inverted classroom for teaching senior undergraduate computer architecture. Their results showed lower scores for students in inverted classrooms than those in traditional classrooms, but their experiment was not well-controlled, and the class they described as “traditional” was a graduate level course that used in-class active learning.

Mason et al. [8] evaluated the inverted classroom against the traditional classroom in senior-level control systems course. The results show that: 1) the inverted classroom allowed the instructor to cover more material; 2) students participating in the inverted classroom performed as well or better on comparable quiz and exam questions and on open-ended design problems; and 3) while students initially struggled with the new format, they adapted quickly and found the inverted classroom format to be satisfactory and effective.

## 3 SURVEY RESULTS

The author used a mix of teaching and learning methods in a senior-year course in Computer Architecture, with a total of 78 students divided into two sections.

At the end of the semester, the students were presented with a survey that asked them to rank the teaching and learning methods according to how much they felt they had benefited in learning. 54 students participated in the survey.

The students were asked to rank the following methods, which have been used with varying recurrence during the semester. The most favorite method is ranked with the number 1, and the least favorite method is ranked with the number 8.

1. Listening to a lecture with optical projection slides.
2. Listening to a lecture where the instructor writes on the whiteboard.
3. Self-reading from the textbook.
4. Self-reading from the lecture notes/slides.
5. Solving homework problems.
6. Solving problems in class and then the instructor discusses the solutions with the class.
7. Solving problems in class and then discussing the solutions with a peer before the instructor discusses the solutions with the class.
8. Working on problems in small groups in class.

Table 1 shows the statistics of the classes and the survey participation. As shown, 44 valid responses were obtained and are tallied in Table 2.

Table 1: Survey participation

| Item | Total |
|---|---|
| **Total number of students in 2 sections** | 76 |
| **Number of students who filled out the survey** | 54 |
| **Number of invalid survey papers** | 10 |
| **Number of valid survey papers** | 44 |

Table 2: Tally of survey responses

| Method | Tally of ranks |
|---|---|
| **Solve In class - discuss in pairs** | 108 |
| **Solve In class - individual** | 117 |
| **Solve In class - group** | 162 |
| **Whiteboard lecture** | 180 |
| **Solve Homework** | 213 |
| **PowerPoint lecture** | 214 |
| **Read from PowerPoint** | 282 |
| **Read from Textbook** | 308 |

Fig. 2 shows a plot of the Tallies in Table 2.

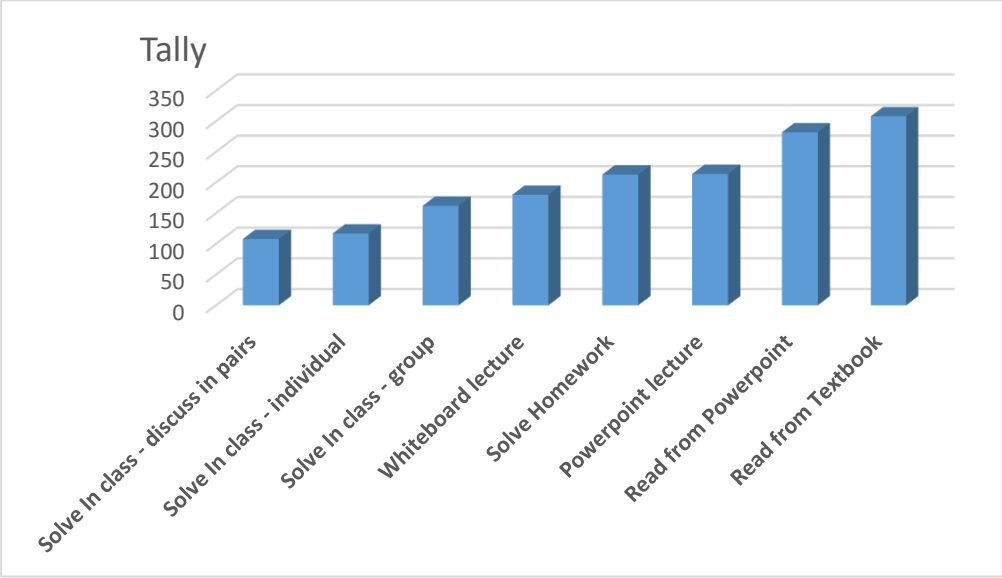


Fig. 2: Tally of rankings for each teaching/learning method.

The students were also allowed to write additional notes on the survey papers. A few relevant notes are presented here:

1- “The teaching method you used by making the student a participant through problem solving in class is one of the best methods that I loved and was the most beneficial in my opinion; since I absorbed the contents of the subject before studying them at home, and I knew whether or not I understood the material.”
2- “The method of solving problems in class is the best method in my opinion, since there not enough time to solve problems at home, and it deepens the understanding during class.”

3- “I don’t prefer PowerPoint slides, and I strongly prefer group discussions.”
4- “Using PowerPoint slides scatters the attention.”

## 4 CONCLUSION AND RECOMMENDATIONS

With regard to self-learning methods, the results show a clear advantage for solving problems in class, and discussing the solutions among the students before the correct solutions is presented and discussed with the class. Small-group discussions were also favored. Least favorite were the methods that involved working at home, whether it was self-reading or solving homework problems.

When it comes to lecturing styles, the students clearly did not like optical projection slides as a method of lecturing. They preferred a lecturing style that relied on writing on the whiteboard.

The author supports a hybrid teaching/learning method that includes:

1. Dividing class time into periods with varying styles of lecturing and student work to avoid boredom and disengagement.
2. Student classwork that aims at both discovering the concepts and gaining the intended skills that will be measured in the exams.
3. Short but recurring homework that emphasizes the learned skills and concepts and prepares for upcoming classes.
4. Allowing students to learn from their own mistakes and to learn from their peers in class, which is shown to benefit more than the limited time that an instructor can allocate to each individual student during the class or the office hours.

## REFERENCES


[1] J. Bishop and M. Verleger, "The Flipped Classroom: A Survey of the Research," in *ASEE Annual Conference and Exposition*, Atlanta, USA, 2013.

[2] R. Rutherfoord and J. Rutherfoord, "Flipping the Classroom - Is It For You?," in *Proc. SIGITE*, Orlando, USA, 2013.

[3] J. Jansen, T. Kummer and P. Godoy, "Improvements from a Flipped Classroom May Simply Be the Fruits of Active Learning," *Life Sciences Education,* vol. 14, no. 1, 2014.

[4] A. Amresh, A. Carberry and J. Femiani, "Evaluating the Effectiveness of Flipped Classrooms for Teaching CS1," in *IEEE Frontiers in Education Conference*, 2013.

[5] A. Campbell, D. Horton, M. Craig and P. Gries, "Evaluating an inverted CS1," in *Proc. SIGCSE*, Atlanta, USA, 2014.

[6] G. Gannod, J. Burge and M. Helmick, "Using the Inverted Classroom to Teach Software Engineering," in *Proc. ICSE*, Leipzig, Germany, 2008.

[7] E. Gehringer and B. Peddycord, "The Inverted-Lecture Model: A Case Study in Computer Architecture," in *Proc. SIGCSE*, Denver, USA, 2013.

[8] G. Mason, T. Shuman and K. Cook, "Comparing the Effectiveness of an Inverted Classroom to a Traditional Classroom in an Upper-Division Engineering Course," *IEEE Transactions on Education,* vol. 56, no. 4, pp. 430-435, Novermber 2013.