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To cite this version:
Tore Alexander Forbregd, Magdalini Lada. The flipped learning model in teaching abstract algebra. CERME 10, Feb 2017, Dublin, Ireland. hal-01940052

HAL Id: hal-01940052
https://hal.science/hal-01940052
Submitted on 29 Nov 2018

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The flipped learning model in teaching abstract algebra
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Keywords: College mathematics, algebra, flipped learning.

Introduction

Flipped learning is a relatively new model of instruction currently growing both in popularity and success. In a flipped classroom the elements of typical lecture and homework are reversed. Students are introduced to new material at home, mostly through videos prepared by the teacher, while the classroom time is reserved for solving problems, group work, discussions and other activities that help students control, deepen and extend their understanding and knowledge.

The board of the Flipped Learning Network has defined Flipped Learning as

… a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter (FLN, 2014)

The number of college and university instructors who practice Flipped Learning has increased over the past two years and has expanded in all subject areas. Research in Flipped Learning has shown positive impact both on students’ achievement and engagement (Overmeyer, 2015).

Methodology

During our study we collected data from the students, the lecturer and the class. We conducted a semi-structured interview with the lecturer in the middle of the semester at the university campus and had several informal discussions through Skype and emails at the end and after the end of the semester. The students were given evaluation forms to fill out both in the middle and in the end of the semester, the latter being enriched with open questions where the students were asked to describe their experience with the flipped course. In addition, we visited the class and observed how in-class time was spent and how the students interacted with each other and with the teacher.

The researchers in this study have direct experience with the course material and the way it was previously taught, as they attended it as students. The second author has also taught the course.

The structure of the course

The lecturer-informant recorded videos, using a mobile phone, while writing down on a blanc A4 paper what he would otherwise write on the blackboard in a traditional lecture. The videos were then made available to the students through the course’s webpage. The problem sheets, which are, except from small changes, the same sheets that were used in previous years, were also put out on the web. The students were instructed to watch the videos at home and work with the problems when they met in class.

Ten to twelve students on average were normally attending the class, which is an expected number for this course. In a relaxed and informal environment, students formed groups freely and worked with the problems, while the lecturer was walking around answering questions and guiding them.
through the problems. The groups were let to progress through the problem sheets at their own tempo and already in the middle of the semester different groups were working with different parts of the curriculum. Thirteen students took the exam at the end of the semester.

**Findings**

Even on this primitive form the Flipped Learning Model turned out to be beneficial to the learning outcome of the students. The students spent more time working on computational problems, concretizing difficult abstract concepts such as for example the radical of rings and modules, projective and injective modules, exact sequences, resolutions and dimensions, clarifying in this way the connection between theory and concrete problems on special classes of algebras.

Some more advantages pointed out by the lecturer include, among others:

- Differentiated guidance according to the level of each student
- Students forced to work more actively with the course, during the whole semester
- Better balance between learning the theory and working on problem solving

What the students found more beneficial was, among others,

- Watching the videos at their pace. Pause it, think, watch it again.
- Thorough explanations from the lecturer
- Working the problems in groups, learning from each other.

There was a slight improvement on the average of the grades, compare to the previous years the lecturer-informant had taught the course, though the class is too small to make any safe conclusions.

**References**
