Lessons Learned from the Implementation of the Flipped Classroom in a Freshman Programming Course

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1   Blended Learning Scenario

Universidad Carlos III de Madrid (UC3M) offers a freshman course on Java programming in the second semester of the first-year of several degrees on Telecommunication Engineering. This course implements a flipped classroom strategy, interleaving students' work with online contents at home, and face-to-face sessions (see Figure 1) [1]. Online contents include videos, automatic correction exercises, and small programming projects. These online contents have been first released in three MOOCs on Java programming on edX and subsequently improved based on data collected from MOOC learners' interactions. Face-to-face classes include a brief summary of the session contents, collaborative programming activities and interactive questionnaires created with Kahoot!. Between 50 and 100 learners typically attend each face-to-face class.

Fig. 1. Flipped classroom interleaved model: online activities (red), and 14 face-to-face sessions (blue) including two midterm exams and an introductory session to review basic concepts.

The ultimate goal of implementing this flipped classroom strategy is to design a better teaching and learning environment that fosters students' success in a freshman course whose passing rate is usually very low. According to authors such as [2], an environment with a low friction, facilitates the achievement of the expected objectives. Other expected results include: 1) automating content delivery in a way that students are forced to dedicate regular time weekly to work in the course; 2) getting students in the appropriate working flow by taking advantage of the interaction with teacher and classmates in face-to-face sessions; and 3) subtracting negative behaviors related to students coming to the classroom with a passive attitude, or procrastinating not to catch up with the course until it is too late.

2   Metrics Used for Assessing the Blended Learning Experience

Numerous metrics are used to evaluate the results of the blended learning experience. In the online part, with activities to be completed prior to the class, the metrics include: the number of points obtained by the students per week and in total, and their ranking

in each week and in the overall course (based on the points obtained). Points can be obtained by: 1) watching videos (in three levels per video, less than 30% of the duration watched, between 30% and 80% and more than 80%); and 2) completing automatic correction exercises (in three levels per exercise, completed correctly at the first attempt, at the second attempt, or in subsequent attempts). In the face-to-face part, with activities to be completed inside the classroom, metrics include: a motivation questionnaire filled by students halfway through the course, interviews with selected students, and a satisfaction questionnaire with the flipped classroom model implemented and its different elements filled in by students at the end of the course. Global metrics include: students' grades in two midterm exams and at the end of the course, passing rate and dropout rate at the end of the course, and students' evaluation of teachers' performance.

3　　Lessons Learned

The implementation of a flipped classroom strategy involves several challenges, especially in the case of freshman courses (as students are not used to this type of strategy), beyond offering quality, well-structured contents in an online platform and redesigning face-to-face sessions to include hands-on activities and interactive questionnaires. The most important lesson learned is the difficulty of setting up an appropriate teaching and learning environment that contributes to shape the expected behavior for students to dedicate enough time to regularly work in this course. Some actions that are shown to be successful in this line are: 1) to increase students' self-awareness on their overall situation in the course, and the average situation of their classmates through appropriate learning analytics dashboards; 2) to coordinate the weekly workload of all the courses students are taking in that semester so that it is easier for them to allocate time to do the activities planned at home; 3) to design different implementations of the face-to-face sessions, ranging from a "pure" flipped classroom to a more traditional lecture, and to decide which one to use based on data collected regarding students' work in the online part (it might be the case that students did not dedicate enough time to the activities planned at home because of a high workload or midterm exams in other courses).

References

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2. Clear, J., Atomic Habits: An Easy & Proven Way to Build Good Habits & Break Bad Ones, Random House Business (2018).