Promoting Student Engagement in Large Lecture STEM Courses: An Institutional Approach

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Abstract

The main purpose of this research project was *to assess the impact of the Cambio Magistral initiative (CMI) on student engagement* in the STEM courses involved. CMI is an institutional program aimed at supporting professors in the implementation of changes in their large lecture courses with the following goals: increasing student participation and engagement, fostering formative assessment practices, and incorporation of technology in support of pedagogical practice. The study responds to the following research questions: How do students perceive their learning experience in *Cambio Magistral* courses? How do students evaluate their commitment to their learning in *Cambio Magistral* courses? What kinds of engagement do student demonstrate during the Cambio Magistral classes? The study followed a quantitative research design, descriptive in nature, using class observations protocols and survey as the main data collection techniques. The students in the STEM courses involved were observed and surveyed during two semesters. Results both in terms of class observations and self-reported student data show a high level of student engagement with course content and increased frequency of higher-level cognitive activities in response to the pedagogical strategies enacted by professors.

Introduction

At Uninorte the offering of large lecture courses averaging 100 to 150 students is on the rise. We have developed institutional policy to regulate the implementation of such courses. While this policy specifies criteria such as number of students, credit hours, and number of teaching assistants, among other aspects, it does not offer orientation in regards to the pedagogical practices that prove to be effective for student learning in these kinds of classes. In their majority large lecture courses at our institution are offered in core subjects for specific academic programs, as well as in electives open to students from all programs. Therefore professors may be faced with teaching students with varying levels of previous knowledge in regards to their subjects. They perceive the teaching of these large lecture courses as a pedagogical challenge given primarily the number of students involved. Our professors sentiment concurs with current literature in the following: the difficulty of implementing active learning methods in lectures (Cardaciotto and Smith, 2011; Orchard, 2007) may foster the enactment of pedagogical strategies where students take a passive role in their learning, and professors limit themselves to transmitting knowledge (Buckley, Bain, Luginbuhl and Dyer, 2004) (1). Although large lecture courses may represent a challenge for professors in order to foster student engagement in subject matter learning, it is possible to attain such a goal through the implementation of creative pedagogical approaches. Current research shows the positive effects of activities that encourage active learning in students attending large lectures, such as study groups facilitated by peers (Stanger, Lang and Maas 2010), problem-based learning (Bledsoe, 2011), and the exploration of key concepts through questions in class (Gray, Steer, McConnell, Owens, 2010).

In light of our institution´s policy in regard to large lecture courses and the need to foster and support pedagogical innovation among the faculty teaching such courses, the Center of Teaching Excellence (CEDU) launched an initiative in 2012 aimed at promoting change in professors ´teaching in large lecture courses, specifically geared to promote active and meaningful student learning. The name of this initiative is *Cambio Magistral* , which translates into Major Change[1]. In CMI, all professors teaching large lecture courses were asked to submit proposals suggesting a full transformation of their course with the implementation of more learner centered approach (Wiemer, 2004). In 2012 50% of the proposals fell in courses related to STEM. The main goal of the CMI initiative was to foster both in class and out of class student engagement by helping professors create, plan and implement their proposals. Professors received support from the CTL throughout the

process. In order to explore the impact of *CMI* on students and their learning experience we decided to explore student engagement in this transformation course project. Although the initiative included professors teaching non-STEM courses, for the purposes of this presentation we will include the results obtained from the mathematics and physics courses only.

Methodology

The study followed a quantitative approach and is descriptive in nature. We used survey and in–class observation as data collection techniques to explore student's perception about the course and how they evaluated their engagement with the course content inside and outside the class. Table no. 1 specifies the techniques and instruments associated with each of the research questions. A total of 450 students from Mathematics and Physics participated in the study. Through the fall term of 2012 and the spring term of 2013 a total of 12 observations were undertaken in each of the 3 STEM courses participating in the CMI initiative. Additionally the students enrolled in the course completed items of the NSSE (National Survey of Student Engagement) at the end of each course.

Table 1: Research objectives, techniques and instruments

Research Question	Technique	Instrument
How do students perceive thr learning experience in *Cambio Magistral* courses?	Survey	Quick Course diagnosis protocol
How do students evaluate their commitment to their learning in *Cambio Magistral* courses? ?	Survey	Items from the National Survey of Student Engagement NSSE
What kinds of engagement do student demonstrate during the Cambio Magistral classes?	Observation	Wiest Harris (2012) observation protocol for large lectures
	Survey	Items from the National Survey of Student Engagement NSSE

Main Findings

Overall, study findings show that students positively rated their learning experience in *Cambio Magistral* courses. On a scale of 1 to 5 over the course of two semesters an average of 46% of students evaluated their satisfaction level with a 4, and 29% with a 5. Related with student's engaged behaviors we found that the most frequently reported by students were the following: to meet with other partners to study or do some homework (59%), to work with other partners on activities during the class (50%) and to integrate concepts from other courses to complete a homework or to discuss during the class (44%). Engaged behaviors at an individual level were less frequent, for example: to prepare two or more draft of a work before present it (31%) or to make questions to

contribute to a class discussion (12%). In this sense the results shows a preference by students for to collaborative learning inside and outside the classroom rather than individual work. This relates to the pedagogical strategies implemented by the professors, which aimed at fostering collaborative learning in large lecture settings. In addition, given the size of the courses professors opted for individual in-class evaluations as opposed to project-type work. Class observation results support students' self-reported behaviors. In general, students demonstrated a high level of engagement as evidenced in observed in-class behaviors such as: note taking, commenting class content with peers, formulating questions to the professor about course content and listening carefully. On average throughout class observations 74% of students demonstrated some kind of engagement during class. The specific behaviors or actions on the part of the professor that prompted such engagement are the following: professor posing questions to the whole group and pairing students to interact in order to solve a problem (92% of students were attentive during this activity), when the professor solved a problem with students help, for example asking, what should I do next? (86%) and when professor answered questions posed by peers (74% were attentive). In sum, study findings demonstrate that pedagogical innovation in large lecture classes focusing on collaborative learning, formative assessment and adequate use of technology to support these goals can prompt significant levels of student engagement. Promoting student engagement in large courses offered in STEM areas may seem like a daunting task for professors; study results show that it is attainable with the appropriate balance of challenge and support for both students and professors.

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