Computers & Education 78 (2014) 227–236

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

It's not about seat time: Blending, flipping, and efficiency in active learning classrooms

Paul Baepler [a,*], J.D. Walker [a], Michelle Driessen [b]

[a] University of Minnesota, Center for Educational Innovation, Office of the Senior Vice President for Academic Affairs and Provost, 210 Walter Library, 117 Pleasant Street S.E., Minneapolis, MN 55455, USA
[b] University of Minnesota, Department of Chemistry, 113 Smith Hall, 207 Pleasant Street S.E., Minneapolis, MN 55455, USA

ARTICLE INFO

Article history:
Received 10 January 2014
Received in revised form
9 June 2014
Accepted 11 June 2014
Available online 18 June 2014

Keywords:
Learning spaces
Blended learning
Flipped classroom
Active learning
Engagement

ABSTRACT

This study examines the effect of reducing the seat time of a large lecture chemistry class by two-thirds and conducting it in an active learning classroom rather than a traditional amphitheater. To account for the reduced lecture, didactic content was recorded and posted online for viewing outside of the classroom. A second experimental section, also in a blended and flipped format, was examined the following semester as a replication. To measure student subject-matter learning, we used a standardized multiple-choice exam, and to measure student perceptions of the classroom, we used a validated survey instrument. Our findings demonstrated that in an active learning classroom, student faculty contact could be reduced by two-thirds and students achieved learning outcomes that were at least as good, and in one comparison significantly better than, those in a traditional classroom. Concurrently, student perceptions of the learning environment were improved. This suggests that pedagogically speaking, active learning classrooms, though they seat fewer students per square foot, are actually a more efficient use of physical space.

1. Introduction

As economic pressures demand that universities graduate more students, physical classroom space has grown increasingly scarce. Many colleges are experiencing rising enrollments and, consequently, large class sizes are common. Some pressure on classroom space has been relieved as the technology and infrastructure to put lectures online has matured and been made easier. More courses are being offered entirely online, and some courses have been flipped, placing didactic lectures on the web and using face-to-face time to build conceptual understanding and cognitive skills. Typically this is done using some form of active learning or any number of what Edgerton (2001) termed "pedagogies of engagement," a concept, that as Smith, Sheppard, Johnson, and Johnson (2005) noted, was prefigured in the foundational publication, *The Seven Principles for Good Practice in Undergraduate* Education (Chickering & Gamson, 1987). These pedagogies have many names: POGIL (process-oriented, guided-inquire learning), peer learning, team based learning (TBL), cooperative learning, and more.

Although these methods have certainly worked in traditional classrooms (Deslauriers, Schelew, & Wieman, 2011; Lyon & Lagowski, 2008; Mazur, 2009), the environment of a large lecture hall with fixed seating in rows makes peer collaboration difficult and awkward. A better environment for these pedagogies would be a room designed to facilitate small group work, such as an active learning classroom (ALC). Currently, however, extremely large active learning classrooms that can accommodate class sizes of over 350 do not exist, and it is not clear that ALCs of that size would be workable in any case (Baepler et al., 2013). The only way to teach such a large class without increasing the amount of time an instructor spends in the classroom is to blend and flip the course; that is, split the section into three parts that meet only once a week rather than 3 times each week, and move online a large portion of the course's learning activities, which were previously conducted face-to-face.

To do this, however, would mean reducing the number of hours students spend in the classroom by two thirds. Many instructors and administrators believe that reducing instructor-student contact should hinder student learning because the quantity of interaction with

* Corresponding author.
E-mail addresses: BAEPL001@umn.edu (P. Baepler), JDWALKER@umn.edu (J.D. Walker), MDD@umn.edu (M. Driessen).

http://dx.doi.org/10.1016/j.compedu.2014.06.006
0360-1315/

faculty members—asking and answering questions during lecture, for example—is positively associated with the learning outcomes students achieve. Theoretically, less time in the classroom should result in lower student performance. The current study was designed to test this contention, by determining whether the use of active learning spaces in tandem with a flipped and blended classroom model could overcome the anticipated reduction in student learning outcomes hypothetically to be expected from decreased face-to-face instructional time. The study has a practical implication as well. Those administrators and planners who are considering building and retrofitting new spaces are concerned with the financial cost of these classrooms. A secondary concern of this study is to shed light on the potential efficiencies and cost savings of the blended model in the active learning classroom.

The research question guiding this study was as follows: Can student inclass time and student-faculty face-to-face contact time be reduced by 66% without undermining the student learning experience or student learning outcomes by moving the course from a traditional format to a flipped, blended ALC-based format?

1.1. Active learning classrooms

In the recent past, several alternative classroom designs that support active and collaborative learning have emerged (Gierdowski, 2013; Oblinger, 2006). With names like Student-Centered Active Learning Environment for Undergraduate Programs (SCALE-UP), Technology Enabled Active Learning (TEAL), and Spaces to Transform, Interact Learning, Engage (TILE), these ALCs typically feature tables with moveable seating that support small group work. The tables are often paired with additional learning technologies such as whiteboards and student computer-projection capabilities for sharing work, microphones to hear student voices, and wireless Internet access to retrieve resources (Fig. 1). The net effect of the classroom design is to create a learning environment in support of active learning pedagogy and collaborative problem solving. These new designs have been adopted in small and large scale. For example, the University of Minnesota has over 20 ALCs, and the University of Southern California is in the process of reengineering 185 classrooms and 20 auditoriums (Demski, 2012).

Empirical research on active learning classrooms can be traced to courses in physics education at North Carolina State University, which, in contrast to similar courses taught in traditional classrooms, recorded gains in students' conceptual understanding and improved attitudes (Beichner et al., 2007). Similar gains were found in physics courses at the Massachusetts Institute of Technology, and researchers noted the importance of social interactions—a key target of the learning environment design—in how students developed their conceptual understanding (Dori & Belcher, 2005). After 6 years of study at the University of Minnesota in multiple disciplines and using quasi-experimental designs to control for a myriad of influences and isolate the effects of different learning spaces, researchers concluded that indeed "space matters." The researchers found that students in active learning classrooms outperformed aptitude-based expectations in terms of learning outcomes when compared to students in traditional classrooms; students also perceived that the space in active learning classrooms is

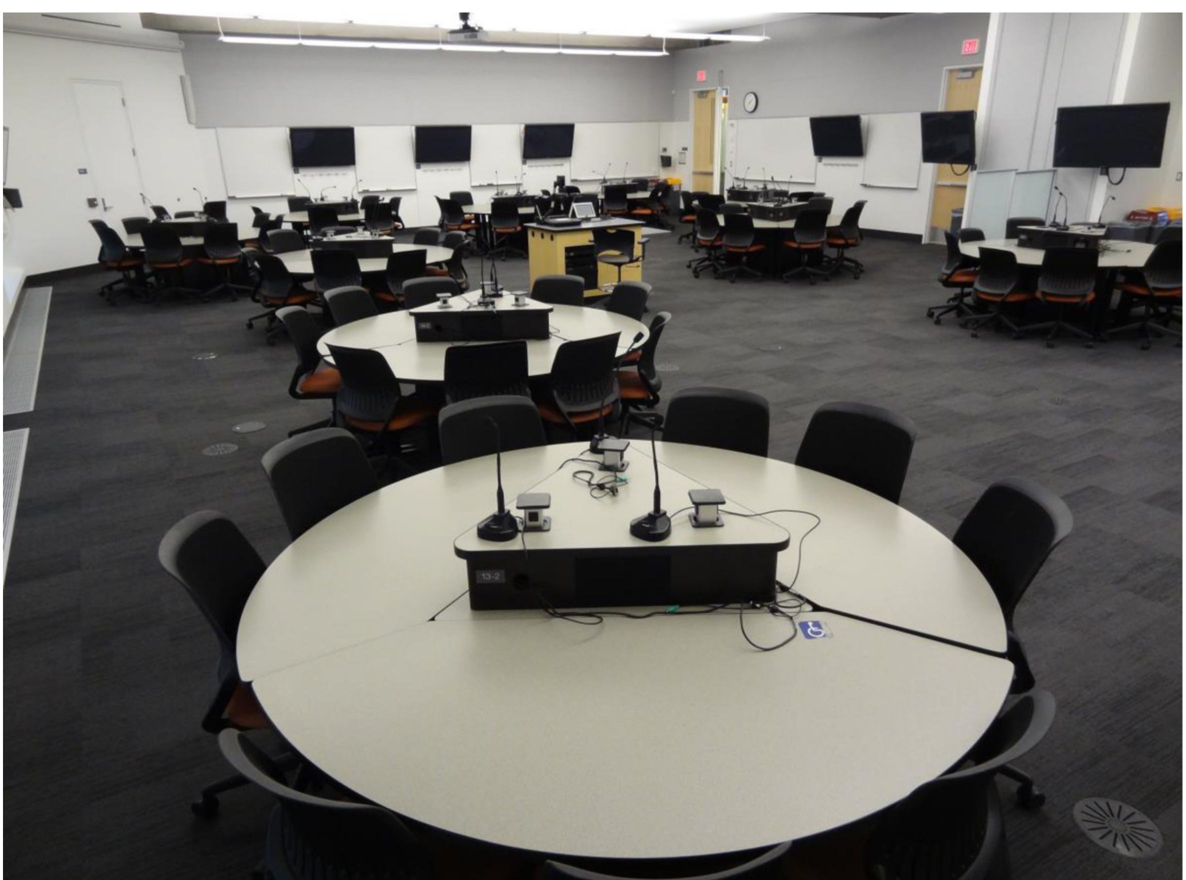

Fig. 1. An Active Learning Classroom, characterized by round tables, microphones, large-screen monitors, whiteboards, and wireless.