FLIPPING THE CLASS: USING ONLINE RESOURCES

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Abstract
Over the past year, instructors have developed a wealth of instructional resources to aide in the shift to fully online teaching and learning. With the resumption of face-to-face instruction, we now have the opportunity to repurpose those resources to enhance instruction and advance student learning. In this paper, we will present how instructors in undergraduate trigonometry and statistics courses have created flipped, active learning courses using online video content and guided worksheets.

A flipped course design is an instructional approach that reassigns the introduction of content as preparatory pre-class assignments, allowing in-class activities to focus primarily on delving into problem-solving and application of content. The flipped class activities used in this research also incorporate active learning techniques, such as cooperative grouping and guided work. We will discuss the structure of our typical pre-class, in-class, and post-class procedure as well as current modifications after the first semester of implementation.

This paper presents the preliminary qualitative results for the Delta State University Plane Trigonometry sections for fall 2021 and spring 2022. From these results, we will discuss perceived success and failure, as well as future course plans.

Introduction

Delta State University is a regional public university situated in the heart of the Mississippi delta which is located in the southeastern region of the United States. The following institutional demographic data provides an accurate picture of the students enrolled in Plane Trigonometry.

In the fall of 2020, 2,331 students attended DSU. Of these students, 59% are female and 41% are male. The average class size at the institution is 11:1; however, the Plane Trigonometry classes typically have a 35 student enrollment. As seen in Table 1, from Fall 2012 to 2018, of the incoming students who provide ACT scores (transfer students are exempt from this requirement), 58% earned less than a 21on the ACT (Institutional Research, 2019). The U.S. Department of Education (2018) has determined earning a 21 or higher on the ACT as an indicator of readiness for college-level mathematics. Therefore, historically, 42%, or significantly less than half, of the entering freshmen are considered ready to learn the subject matter at hand.

Table 1
Percent of incoming students earning a 21 or higher on the ACT

	Fall 2012	**Fall 2013**	**Fall 2014**	**Fall 2015**	**Fall 2016**	**Fall 2017**	**Fall 2018**
Percent of first-time *freshmen* who have an ACT composite score of 21 or above	41.4%	41.2%	47.6%	46.4%	55.5%	54.6%	53.8%

At Delta State, students may use their ACT math sub-scores to place into various general education math pathways. In particular, a student with an ACT math subscore of 23 or higher may begin their college math coursework with Plane Trigonometry. A lower ACT math score will require the student to successfully complete College Algebra before entering into Plane Trigonometry.

Educational Framework

We now introduce the instructional approaches known as a flipped classroom and flipped learning. By and large, instructors have routinely utilized out-of-class preparatory sets such as reading assignments and worksheets. With the increased focus on effective incorporation of technology in the classroom, the use of pre-recorded videos has become more prevalent in recent years as well. A flipped classroom is defined by the use of these preparatory sets. In this paper, we will extend our approach to incorporate flipped learning, which is not interchangeable with the term "flipped classroom."

Flipped learning was formally defined in 2014 by the Flipped Learning Network (FLN) 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 matter" (The Flipped Learning Network, 2014). Thus, a flipped classroom, where students are required to complete assigned preparatory sets, does not necessarily imply that the instructor is also incorporating flipped learning. To further illustrate this distinction, an instructor utilizing flipped learning will have restructured in-class activities in a purposeful way. In particular, the instructor must apply the following four pillars F-L-I-P: Flexible Environment, Learning Culture, Intentional Content, and Professional Educator (The Flipped Learning Network, 2014).

First, a flexible learning environment requires that an instructor provide both space and time for students to interact with the content and with each other as they reflect on their learning. This process requires continual monitoring, reflection, and readjustment by the instructor to best fit the needs of the students. Moreover, a flexible learning environment

should incorporate differentiated assignments and assessments so that student have multiple avenues to acquire feedback as they progress through the course.

Next, the learning culture should reflect a learner-centered approach. As such, activities should be designed so that the instructor is not at the forefront of the process. Students should have the opportunity to engage in knowledge construction in a way that is personally meaningful (The Flipped Learning Network, 2014). To encourage this process, assignments should be scaffolded in increasing levels of difficulty and should provide varied forms of feedback to the student. Essentially, in-class activities should provide time to delve into the content using rich learning opportunities such as real-world application, scaffolded problem sets, or group discussion.

Another pillar of flipped learning is intentional content. It should be noted that content for flipped learning can be carefully curated by the instructor, so that it need not be original. The content provided to the students should be chosen to maximize instructional time. For example, a series of remedial content videos and quizzes can be provided to make the content more accessible to students. The instructor should consider carefully what information needs to be taught in person and what content the students should be encouraged to explore independently.

Finally, a flipped learning environment needs a professional educator. While the instructor should be less visible and not centered in class activities, the role of the educator remains vital. The instructor should be present and available to students for quick, real-time feedback. Formative assessment in the frame of commentary and active questioning should take a more prominent place in class. The instructor should exercise observation, reflection, and collaboration between colleagues to continually improve practice.

Keeping the F-L-I-P pillars in mind, we now introduce the flipped learning implementation during the fall of 2021 and spring of 2022 in the Plane Trigonometry sections at Delta State University.

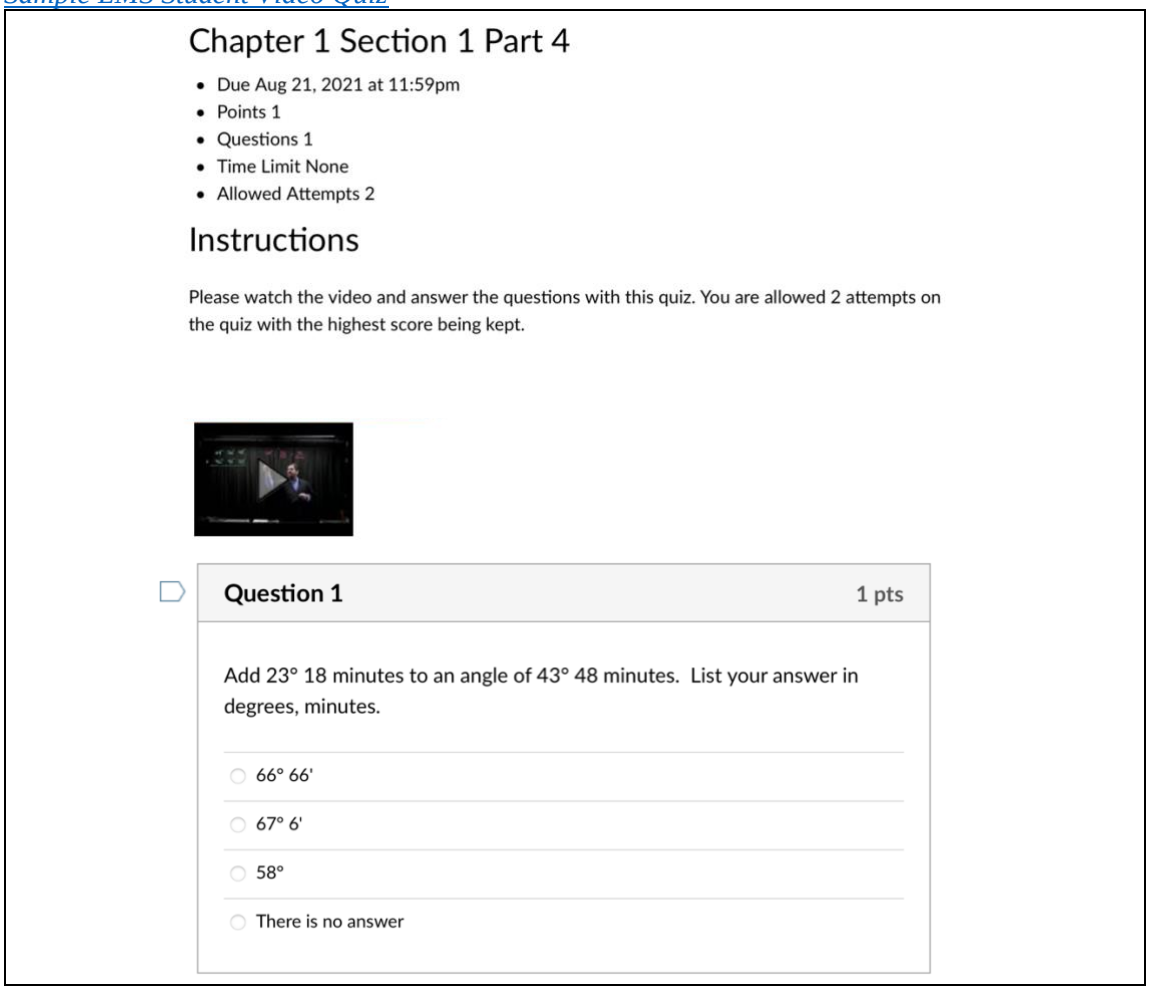
Model

The inspiration for this instructional design originated with the creation of an overwhelming volume of high quality pre-recorded video lessons necessitated by the onset of online learning due to COVID-19. The instructors of the Plane Trigonometry courses sought to effectively incorporate those online materials in a return to in-person instruction.

During the spring and summer of 2020, all Delta State instructors participated in a series of professional development courses targeting effective online course design. In these courses, we were trained to create short, pre-recorded videos for our students. From this process, the Plane Trigonometry instructors developed more than fifty videos. Each video was embedded into a quiz within the students Learning Management System (LMS) to track student engagement. Table 1 shows a sample LMS quiz with a link to one of the videos created by Dr. David Jay Hebert. Each section of content covered in the course was broken into multiple short videos that the students could access via their LMS on their own

time. Subsequent homework, quizzes, and unit assessments were aligned to the videos and also delivered via the LMS. In this way, the Plane Trigonometry courses were delivered online during the fall of 2020 and spring of 2021.

Table 1
Sample LMS Student Video Quiz



Rather than abandon the videos with the return to in-person classes in the fall of 2021, the instructors used the same videos and LMS quizzes to move the delivery of direct instruction to preparatory sets that the students could access and complete on their own time prior to class. In this way, we were able to restructure in-class activates to reflect a more inquiry-based mode of instruction.

During in-person class meetings, student worked in groups of two to five. Groups were chosen by the student or were determined by the instructor based on physical proximity. At the start of each class, students were given a problems set aligned to the video quizzes. Problems were chosen from their LMS homework sets. Students worked together in groups to attempt the problems by first using the notes taken from the video quizzes. The instructors monitored the groups and provided feedback in the form of active questioning

during the students' first attempt at the problem set. During the latter half of each class, the instructors addressed observed gaps in content knowledge and verified the correct solutions for each problem within the set.

The original objective of the implementation of video quizzes aligned to in-class problem sets was to provide opportunities for the students to engage with recently acquired course content in meaningful and interesting ways. Another objective at the onset of this academic year was to foster self-efficacy and to reduce math anxiety through in-class collaboration.

Results

After implementing flipped learning in the fall of 2021, the instructors quickly recognized a need to modify part of the original design. The problem sets were modified to include an answer key so that the student groups could independently check solutions prior to the close of class. Also, the instructors made available the upcoming problem sets as well as guided notes aligned to the videos to promote student engagement with the video quizzes.

Conclusion

Overall, student response to the flipped learning format was positive. Students were able to watch and re-watch instructional content on their own time, and many appreciated the ability to access the content in shorter videos.

Moving forward, the instructors plan to create instructor-chosen heterogeneous groups. Heterogeneous grouping refers to the data-driven process of grouping individuals with varied levels of ability. In this way, the instructors hope to foster more effective communication and collaboration within the student groups. Also, the problem sets will be merged into a booklet available for students to purchase at the beginning of the semester. The instructors hope that having access to the problem sets will encourage better organizational skills.

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