

Adult Learners, a Flipped Classroom, and an Online Biostatistics Course: a Recipe for Disaster?

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Abstract

Teaching statistical concepts to health science students who have a mathematics aversion is challenging. Combined with the needs of adult learners and an online environment, this task becomes even more complex. We implemented a flipped classroom concept in an online statistics course for Nursing PhD to address this complex situation. Two statistics courses were taught in fall 2017 and spring 2018, and strategies have been adapted based on student feedback obtained throughout both semesters. Success was measured using scores obtained from the electronic evaluations system for learning (E-value) as well as de-identified comments provided by the students. The results will be used to further develop the flipped classroom concept in the adult learner/online environment for the subsequent cohort of students.

Key Words: adult learner, online teaching, flipped classroom

1. Introduction

Statistical concepts are often challenging for students in health professions programs who have an aversion to mathematics. When combined with the needs of adult learners and an online environment, this task is even more complex. An innovative flipped classroom concept within an online teaching platform has potential to address this challenging learning context.

Students enrolled in health science programs often perceive themselves as incapable of thinking in mathematical terms. Though today's health care environment routinely expects nurses, for example, to apply mathematical concepts to carry out complex drug calculations, many nursing students enter statistics courses with low expectations of being able to understand and apply these methods.

Most students who enroll in a doctoral nursing program are adult learners, having worked for years, often in leadership or other management roles. According to Malcolm Knowles (Knowles 1990; Andragogy 2017), adult learners have 5 core characteristics linked to learning: their self-concept tends to be more self-directed, adult learners can rely on their experience as additional resource, they are typically ready to learn, they prefer learning oriented towards application, and they are typically motivated to learn. Similarly, four principles should be applied to adult learning: adults expect to be involved in planning and evaluation of their instructions, they gain experience by applying content even if they make mistakes, they prefer learning subjects relevant to their jobs or lives, and they prefer problem-centered learning rather than focusing on content. In our program, most learners have fulltime jobs and families, adding additional stress to their educational demands.

Our doctoral program has transitioned from a traditional face-to-face to a fully online, asynchronous program in 2004, and to an accelerated, 3-year program in 2014. There are four on-campus learning-intensive experiences of 3-4 days over the duration of the program, but the asynchronous setup of all courses ensures that very few sessions are held that expect all students to be online simultaneously. This design provides the students maximum flexibility in time management. The typical student enrolled in this program has a nursing or health science related background with little knowledge of or training in statistics despite the prerequisite of having taken an introductory statistics course within the past 5 years. When combined with the challenges of adult learners and an asynchronous online program, teaching these students is challenging.

Mills and Raju (2011) provide a literature review of strategies employed in online instruction across several disciplines. Effective practices reported in several studies included interactive tutorials or whiteboards and videoconferencing to increase interaction with the course instructors. On the other hand, most studies reported high levels of student dissatisfaction due to limited interaction as part of the distance learning.

In recent years, the concept of the flipped classroom has gained traction and has moved from K-12 schools to higher education. In contrast to the traditional teaching, with lectures in the classroom and problem-solving at home, the flipped concept emphasizes that the first contact with new material happens in the individual space (i.e., the student's home) through structured activities, including direct instruction through recorded lectures and readings. Subsequently, the group space (i.e., the equivalent of the face-to-face classroom) is transformed into a dynamic, interactive learning environment where instructors guide students as they apply concepts and engage creatively in the subject matter (Talbert 2017).

Although the “flipped” classroom may not seem immediately relevant to online education, the core idea may prove fruitful for learners in fully online, asynchronous courses. In statistics, students and teachers face additional challenges that we attempted to address in our course design and that we report here.

2. Methods

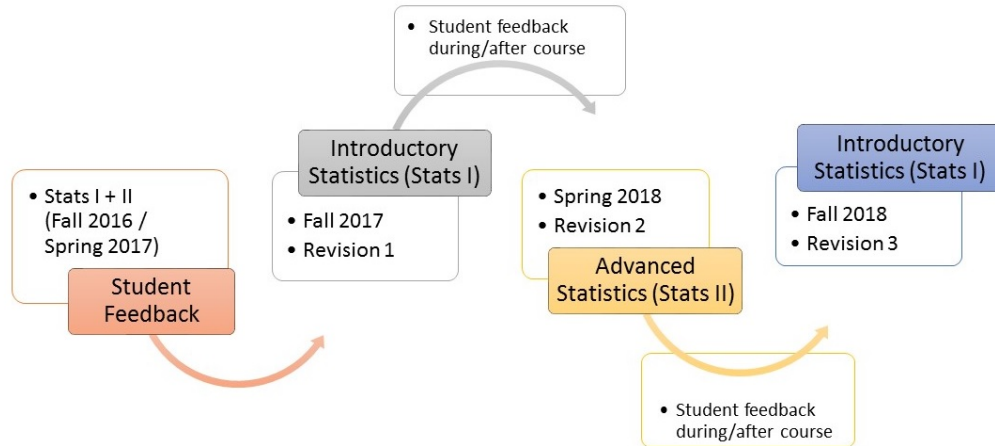
2.1 Introductory statistics course

The original versions of both, the introductory and the advanced statistics courses taught in our program were set up such that learning was essentially limited to the individual space. This setup entailed expected reading of specific chapters in one or more textbooks and subsequent submission of homework. Homework assignments typically included answering questions focused on understanding statistical concepts and completing projects where the newly introduced statistical method had to be applied. Students were able to ask questions directed at the course faculty via email or online using a discussion board where questions and answers could be viewed by all participating students. Students were graded on homework (correctness), midterm and final multiple-choice type exams, as well as participation on asynchronous discussion boards. However, these discussion boards were rarely used by the students except for occasional posting of links to additional online resources. Group work that would at least partially mimic learning in the classroom was not included in this setup; to the contrary, students were not allowed to ask peers for advice or feedback.

On closer inspection, this structure reflected independent study rather than a course intended to assist the student to develop self-learning skills. Consequently, the burden of learning the material rested squarely on the shoulders of the students themselves. Cognitive load was rather high and results were disappointing. Even after successful completion of both the introductory and advanced courses, students had few skills that would allow them to identify or use appropriate analysis procedures for a given set of variables as required for quantitative or mixed methods dissertation projects. This situation was, at best, frustrating to the course instructors and, at worst, created ample additional work since any student who conducted a dissertation study involving more than the most basic descriptive analyses required extensive mentoring to achieve proficiency in analyses and interpretation. Therefore, we restructured our course to provide additional instructional approaches to the students during course work.

2.1.1 Results

This decision led to discussions with course instructors from our clinical doctoral program, who had started applying flipped classroom principles. These meetings resulted in several ideas on potential improvements to provide learning opportunities for the students as first steps towards mimicking the classroom experience. Improvements included a discussion board for each module through which a question related to the current topic was posted, and students were required to post an answer and comment on at least one answer of their peers. Students could only see their peers' answers after they themselves had posted their answers – posts had to be substantive and could not be “place holders,” such as “Just posting so I can read” or similar non-participatory workarounds. A second change to the course setup was that homework was to be completed in groups, with one person submitting the assignment for the entire group and group sizes of 2-3 participants due to the small number of students ($n=8$) enrolled in the course. Toward the end of the semester feedback was solicited from the students – one student volunteered to collect feedback from all peers so anonymity could be ensured. The resulting student feedback centered around 3 issues: time, specifically related to scheduling meetings for group work, repetition, and examples. Scheduling challenges were mentioned several times as the students are geographically distributed, living not only in different time zones but on different continents. Most work part- or full time and in general have families, which presents significant challenges in scheduling meetings to carry out the group work as required. In addition, students felt that weekly modules introducing new concepts required more time to prepare individually for the expected homework assignment group work and the did not fit well with group work and the associated scheduling problems. Repetition of assignments was criticized: similar questions were posed on the discussion board as in homework assignments. Students found this repetition more redundant than helpful. Finally, students criticized a lack of worked examples of statistical methods. Though the initial intent for the feedback obtained at the end of semester was to improve the current (introductory) course, this was postponed in favor of making immediate modifications based on these comments to the advanced statistics course to follow in the subsequent semester (Figure 1). This way the students were able to benefit directly from their own feedback as it was applied to the course they were about to start.



Revision 1: Discussion boards, groups
 Revision 2: Revision 1 + Two-week modules, revision of discussion board questions, homework discussion board
 Revision 3: Revision 2 + guided practice recordings, chat platform for homework discussions

Figure 1: Revisions of the introductory and advanced statistics courses based on student feedback

Table 1. Original course structure and modifications based on student feedback				
<i>Structure Changes</i>	<i>Modules</i>	<i>Content</i>	<i>Homework</i>	<i>Questions</i>
- (original structure)	weekly	book chapters, recorded lectures	individual analysis projects with questions	directed at instructors via email or discussion board
1	weekly	discussion boards with questions to answer/discuss added	groups	questions within groups or directed at instructors via email or discussion board
2	bi-weekly	added links to examples, Jeopardy-type quiz to review content added,	homework combined and reduced for bi-weekly projects, development and narration of at least one PPT slide explaining a statistical concept	homework discussion board for entire class with monitoring by instructors

2.2 Advanced statistics course

To address the concerns raised by the students, the advanced statistics course underwent further reorganization in addition to that carried out for the introductory course (Table 1). To address scheduling issues related to group meetings and allow the students more time for new concepts, topics were combined to create two-week modules for all but two topics, which remained in single weeks. At the same time, homework for the two weeks in each new module was merged to reduce workload. At the start of the course a review of concepts from the previous semester (introductory statistics) was included in the form of Jeopardy-type questions and answers. Based on the order of student group’s combined Jeopardy score, groups chose a statistical concept that they had to explain through the development

and narration of at least one PPT slide by the end of the semester. An additional discussion board was also created specifically to provide the opportunity for the students to discuss issues related to the homework among themselves. Discussions were not restricted to groups but open to all students and were encouraged for any issue related to course material except for exams. Discussion board questions posted by the instructors were based on problems that had become apparent in homework from previous classes to avoid repetition and proactively focus on concepts that were harder for the students to grasp on their own as opposed to questions similar to their homework. To address the request for more examples of working through statistics problems, topic links were provided to YouTube videos with step-by-step worked example analyses conducted via the statistical software used in the course (SPSS) rather than leaving it up to the students to find a suitable example.

2.2.1 Results

Feedback from students obtained at the beginning of this semester indicated they appreciated the two-week modules. Further, the students appreciated being provided with links for examples that were “vetted” by the course instructors versus having to decide themselves whether a certain video discussing an example for a statistical topic was of the needed quality. Questions posted by students on the new homework discussion board were initially entirely directed at the instructors. With additional explanations of the purpose of the discussion board, i.e., a supervised discussion among the students with the instructors moderating if the students got stuck or went off in a wrong direction, the use of the board improved at first. However, throughout the semester this discussion board was mostly abandoned in favour of discussions within a Whatsapp group. As the app resides on the student’s smartphones, it supported timely discussions compared to the time delay of postings on the course discussion board that also required logging in before being able to respond, making the discussion cumbersome and awkward. Since this app represented the student’s personal connection with each other, the course instructors were not invited to be part of the Whatsapp group, therefore moderating any ongoing discussion was not possible for the instructors.

To obtain feedback from the students at the end of the semester specific to the different components of the course revision, a REDCap survey was created, addressing each course component with two questions: “Did you find this <component> helpful? Yes/No.” and “Should this <component> be kept? Yes/No”. In addition, open-ended comments were solicited for each of the components, as well as for the course more generally at the end of the survey. At the end of the semester, after grades had been submitted, a link to this questionnaire was provided via email to all students (n=7), indicating that their responses would be anonymous.

Five of the seven students provided feedback. Students agreed on several components. The two-week modules were uniformly liked. In contrast, while some students enjoyed working with their peers on homework projects, one student perceived no benefit from group work (Table 2). Similarly, one student did not find the general discussion board helpful, and two students did not consider the homework discussion board as helpful. Overall comments were positive; however, students felt that the amount of work required exceeded the amount of credit for the course. This was also reflected in the average evaluations system for learning (E-value) score of 4.3 (with a possible maximum of 5.0) with 6 of 7 students responding. In the open-ended responses, four students reported having enjoyed using a jeopardy-type question and answer format for content review at the beginning of the semester. All five students liked the narration of the slides that allowed them to develop a deeper understanding of the concepts they had chosen. Two

students thought that the amount of homework required went beyond a 3-credit hour course but appreciated the homework as preparation for midterm and final exams as well as their future dissertation projects.

Table 2. Frequencies of student responses about helpfulness of course components

	<i>Very helpful</i>	<i>Somewhat helpful</i>	<i>Neutral</i>	<i>Not very helpful</i>	<i>Not helpful at all</i>
Two week modules	5/5				
Jeopardy quiz	2/5	2/5	1/5		
Slide narration	5/5				
Assignment discussion board	1/5	1/5	2/5		1/5
Homework discussion board		2/5		1/5	2/5
Homework projects	2/5	1/5	2/5		
Group work	4/5				1/5
Midterm/Final project	2/5	1/5	2/5		
Midterm/Final quiz	1/5	2/5	2/5		

3. Remarks

Though the current course design has much improved over the initial setup where learning was to take place in the individual rather than group space, it is still not reflective of a true flipped learning design.

The improved design took into consideration that the enrolled students are adult learners with characteristics and needs different from younger students by implementing changes based on feedback obtained throughout the semester. For example, the use of two-week modules allowed the students additional time to schedule group work while the discussion board provided a space to brainstorm issues related to statistical concepts for their homework projects. However, the use of Whatsapp instead of the designated homework discussion board led to frustration: a) on the part of the instructors who were only involved once the students had reached the conclusion that they were stuck or were not sure whether their thoughts went in the right direction; and b) on part of the students, when the instructors did not immediately provide guidance or help when requested by the students. Since the instructors were unaware of the presumably lengthy discussion that had occurred prior to the students asking their questions, they expected student involvement in the discussion on how to resolve a given issue, prior to providing guidance or help. For subsequent iterations of teaching the two statistics courses, a different discussion board platform needs to be identified that provides students the flexibility of Whatsapp and the instructors the possibility to monitor and intervene as needed without being the focus of the questions.

In addition, comments pointed out a continued need for tutorials on how to apply the statistical concepts to actual data. Though several links to YouTube videos vetted by the instructors were provided, comments indicated that recordings created by the instructors would serve not only as the requested practice but also produce a feeling of connectedness within the course. Furthermore, these tutorials could incorporate intermittent quizzes that could feed into the discussion board to address issues that are not clear to the students.

Further, following the recently published guidance on flipped learning by Talbot (2017), the courses need additional structure for better guidance of the student's learning, for example specific objectives for each module and should provide stronger guided practice, which could be achieved through guided discovery learning, such as the aforementioned tutorials interspersed with quizzes.

In summary, the students acknowledged the significant value of working applied problems, such as required by the homework assignments and midterm and final projects. However, they requested more examples of problems being worked out step by step, as would be common in a traditional lecture. Despite the use of discussion boards to encourage dialogue similar to the traditional face-to-face classroom, students still desired more interactions between them and the instructors. Students appreciated being closely involved in the redesign of their courses by providing frequent feedback on what worked and what did not – we believe that this strategy was instrumental for us when confronted with the challenge of redesigning the asynchronous statistics courses using the flipped classroom concept to improve the students' learning experiences.

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