Updating Technology and Outcomes in Introduction to Statistics

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Last Updated: May 5, 2020

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1 Challenges

As part of our ongoing efforts to improve our courses, the Mathematics department uses research-based methods to inform curricular decisions aimed at meeting the needs of our students. As with any instructional design project, the first step is to identify the problem (Morrison et al., 2013). Our Introduction to Statistics (MATH 2510) course is designed to engage students in active learning where the majority of class time students work through problems and discuss them with their peers. These activities are intended to encourage reflection as students work through meaningful learning activities (Glass & Sue, 2008). Unfortunately, the activities being used in the course rely on antiquated technologies and costly copyrighted materials provided by publishers. The goal of this project is to update these materials with minimal cost to students.

When students engage in meaningful learning, they are actively engaging in connecting new concepts to prior knowledge in an organized way. This is in contrast to rote learning, where a student's knowledge structure lacks organization and there is little commitment to incorporating new information (Novak, 2002). A student's approach to learning has two distinct processes: deep and surface level (Biggs, 1979; Biggs et al., 2001; Marton & Saljo, 1976). Deep approaches to learning are motivated by a desire to understand, while surface approaches are oriented more toward reproduction. Studies have shown that in student-centered environments, students are more likely to adopt deep approaches if interventions have clear goals, offer support, emphasize independent learning, provide a reasonable workload, present information in a straight-forward manner, and highlight relevance and usefulness of curriculum (Baeten et al., 2010).

In moving to a more active learning model, Introduction to Statistics has been successful in encouraging independent and group work as well as, establishing a reasonable workload. However, the technology in the course has become outdated and has led to several challenges: (1) a need for new technology that will be relevant to students and useful in the future, (2) a need to formally establish course learning outcomes, and (3) a need to update curricular materials to ensure alignment with course outcomes and begin transitioning away from costly licensed materials toward more open sources and materials provided for free by the University.

1.1 Technology

Introduction to Statistics requires students use a TI-84 calculator to complete course assignments and in-class activities. Students are expected to purchase this device in addition to the digital course materials the provide reading and homework assignments for the course. As an entry-level statistics course, greater emphasis is on students understanding when and how to apply statistical analysis than calculating these functions by hand. Thus, there is a heavy reliance on a computing device to handle the computations that students then analyze. While this hardware generally performs all the requisite functions one would want to calculate in a statistics course, it is unlikely something they will be use outside of this course. Ultimately, students spend a significant amount of time learning how to use a device they are unlikely to use again. It would be advantageous to adopt technology that is more in line with what they are likely to encounter in their future careers.

1.2 Course Outcomes

The Introduction to Statistics course covers the same general topics each term, however there does not currently exist a formalized set of course learning outcomes. Students who enroll in the course

may feel that the goals of the course are unclear and struggle to identify the relevance and usefulness of curriculum. To ensure that our activities are relevant, and their purpose is transparent to students, it is vital that we clearly identify the course learning outcomes that frame our course curriculum.

1.3 Alignment

As we work toward moving away from outdated technology and toward developing clear course goals, we have to keep in mind the importance of alignment. Our course outcomes should be supported and aligned with our module learning outcomes. Similarly, our daily activities should be aligned with both the module-level and course level objectives. These outcomes should also be addressed in all assignments and measured by our assessments. With the increasing importance of having courses that can transition to remote instruction, the need for alignment and clarity become even more important.

2 Desired Result

2.1 From Calculators to Excel

Students and instructors have expressed great concern over the required use of the hand-held calculator. It is a costly instrument that has almost become irrelevant in the workplace. The same computations can be completed by using Microsoft Excel, a tool that is free to CU students and widely used in many industries. Proficiency in this software is a skill that is perceived as useful by students and employers that can then immediately be used upon entering the workforce (Bell, 2000). By using Excel, instead of calculators, we would be saving the students money, providing them a skill they are more likely to use later in life, and improve the usefulness of the course.

2.2 Clear Course Goals

At the student level it is currently unclear what the overall course goals are. Students are tasked with completing activities and assignments without a clear demarcation of what they will learn in the course.

2.3 Alignment

As many of our activities are problems and examples pulled directly from the published text, they have not been necessarily mapped to the intended course outcomes. Course activities will be redesigned to align with the course outcomes and organized into modules. Weekly quizzes and exams will be created and assigned via Canvas. We will generate our own quiz banks, aligning questions with the activities we are doing in class. Students will be allowed to use the Excel tools we have been working with in class.

3 Course Development/Redesign Timeline

3.1 Course Learning Outcomes

- During the summer of 2020, course outcomes will be generated using the course catalog and current topics list as a guide. Multiple subject matter experts in both mathematics and business will be consulted to approve the final list of course outcomes.
- Content will be organized into modules, and module level learning objectives will be developed in alignment with course-level learning objectives.

3.2 Excel Tools

- Excel tools will be designed for each module and in consultation with subject matter experts in both mathematics and business.

3.3 Course Materials/Assessments

- Daily activities will be revised as needed to meet module and course level objectives and compiled into a course pack.
- Module level quizzes/exams will be created in Canvas that assess the module and course level learning outcomes.
- WebAssign will continue to be used for homework as additional practice as we work on building our own homework assignments using question banks in Canvas.
- WebAssign homework assignments will be modified to remove/include materials as needed for fall 2020.

4 Assessment

4.1 Student & Faculty Survey

Following the fall 2020 semester, students and faculty teaching the course will be given a survey on their experiences with the course. Feedback will be collected and adjustments to the course will be made as needed.

4.2 Revision/Continuation

Based on the outcome of the surveys, the course will modify materials to better meet the needs of students. This includes identifying any supplementary open educational resources needed to eliminate reliance on publisher provided materials.

5 Reporting

The results of the surveys and developed materials will be shared with the undergraduate mathematics committee. This will underscore the importance of alignment of course outcomes with curricular materials. It will also help illustrate how technology can enhance a course when used in conjunction with course learning outcomes.

6 References

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