An Examination of Best Practices to Teach Statistics: A Case Study

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Introduction

The scholarship of teaching and learning facilitates improvement in teaching methods to better enable learning. It has been documented that the teaching of statistics creates anxiety in some students that hinder their learning (Dunn et al., 2016; McGrath, 2014). It has also been documented that students who complete statistics courses are not readily able to apply what they have learned (Gardner & Hudson, 1999; Schau & Mattern, 1997). Given the importance that statistics plays across the agricultural sciences and the disconnect between teaching statistics and students learning statistics (Tishkovskaya & Lancaster, 2012), it is imperative that we examine strategies to improve how we impart the knowledge and skills needed for students to fully understand and utilize statistics. This study, employing a qualitative approach, analyzed data collected from semi-structured interviews with 19 students and provided insights into the learning experiences within an introductory statistics course that can guide teaching practices and strategies.

Theoretical Framework

Problem-based learning (PBL) is a student-centered instructional method where students acquire knowledge by actively solving problems (Barrows, 2000; Hmelo-Silver, 2004). PBL focuses on group work, reflection, and reasoning for students. The role of the teacher is a facilitator through support, guidance and monitoring the learning journey (Schmidt, et al., 2011). Problem-based learning (PBL) is the approach used in our case study and included a combination of simulation-enhanced, project-based learning, and a flipped-classroom strategy.

Procedure

Our study employed a case study research design that utilized in-depth interviews with students enrolled in the statistics course under investigation. Interviews were conducted with nineteen students across three semesters. Effort was made to interview students three times - once in the middle of the semester and once at the end of the semester and one follow up interview,resulting in a total of 44 interviews. Interviews were recorded and transcribed using Otter. In addition, the researcher conducting the interviews took notes and recorded observations and reflections and students provided documents from the course under investigation as well as other statistics courses as appropriate. Creswell and Poth (2016) emphasize the importance of notes and observational data in qualitative research which help capture the context and nuances of the environment, interactions, and behaviors observed during the study. Schwandt, T. A. (2014) emphasized the role of reflexivity in qualitative research, highlighting the importance of researchers' reflections on their own experiences, biases, and perspectives. Those methods supported rich, detailed data gathering and ensured the researcher's thorough understanding and interpretation.

Findings

Students overwhelmingly reported that the course had benefited them. They provide insight into what practices have been helpful in their learning. 1.Pre-course modules would be helpful for preview; post-course materials would benefit continuous learning. 2. Tailored and

detailed feedback from assignments in LMS enable students to understand where they went wrong. LMS as a tool provided materials like course slides, recordings help them rewatch and review the content after class. Students reported using other supplementary learning resources like youtube. 3. Teacher shared her own learning experience connected to students personally, inspired and improved their confidence/self-efficacy for this course. They become less" intimidated of math", group project allows them to ask peer questions /be more comfortable instead of dealing with the anxiety caused by feeling embarrassed in front of the whole class/teacher. 4. PBL is beneficial. Scaffolding provided in class with live coding sessions. Most students perceived group projects helpful while some indicated partner projects would be helpful when it comes to a particular subject for some students. PBL connects real world problems with class, enhancing their application skills.

Students also reflected some limitations and how we might improve the process:1. Technical issues, like access to the materials. When watching the recordings without being able to see what was written on the board hinders students' comprehension. 2. The sequence of the course with other statistical courses, without a distinct difficulty level differentiation, some of the topics are covered in other courses. Better design course sequence for the department and close collaboration with other instructors are needed.

Conclusions

Based on the findings, we conclude that it is necessary to think beyond the traditional course lecture and assignments when teaching statistics if we are to enable deep learning by students. We must think holistically about the topic and provide opportunities for students to engage in the topic both leading up to the course and after the course is completed.

Recommendations

While students reported that the course was beneficial, our study points to several recommendations for teaching statistics that could provide scaffolding of the learning process and thus building confidence. These recommendations include: 1) *Self-Study Modules for Continuous Learning*. The creation of self-study modules that can be used for transition into and between statistics classes; 2) *Enhanced Supporting Materials through LMS*. instructors are encouraged to incorporate modern educational technology such as LMS and make sure it serves the students the best. Provide recordings of class lectures and detailed, tailored feedback via the LMS to help students review content and understand their mistakes.3) *Building Confidence and Reducing Anxiety.* Creating peer group mentorship of students or a small group tutoring can help in reducing anxiety of students in learning statistics. 4) *Emphasizing PBL and Real-World Application.* The practice time and open conversation in the PBL classroom provided in the class was valued by the students. Statistics courses should focus on how knowledge can be applied. This connects to "knowing" formulas and then "understanding" formulas and then "being able to use" formulas. PBL helps students apply skills. Instructors are encouraged to use tailored and detailed feedback to scaffold students' comprehension online and in class. In addition, recording lectures should incorporate a digital whiteboard to capture board content clearly and more collaboration in designing different statistical courses are encouraged among instructors.

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