Teaching Tips/Notes NACTA Journal

Exploring Best Practices in Teaching Statistics: Student Insights from a Case Study

Introduction

Teaching statistics can be especially challenging when students enter the classroom with anxiety or struggle to apply concepts in real-world settings. In agricultural disciplines, statistics is an essential tool, yet many students complete their coursework without feeling confident in using what they have learned. Previous research has also shown that teaching statistics in agricultural contexts often induces math anxiety, further impeding students' ability to apply knowledge effectively (Dunn et al., 2016; McGrath, 2014).

This teaching tip shares insights from a qualitative case study examining students' experiences in an introductory statistics course designed around a Problem-Based Learning (PBL) framework. The course design incorporated PBL, flipped classroom elements, and scaffolded live coding sessions to support active learning. By analyzing interviews from 19 students over three semesters, this study identified specific instructional practices that students found beneficial, as well as areas for improvement. The goal of our teaching tip is to provide actionable insights to inform practical strategies for teaching statistics more effectively in agricultural and related contexts.

Theoretical Framework

Problem-Based Learning is a student-centered instructional method where students develop knowledge by actively engaging in problem-solving (Barrows, 2000; Hmelo-Silver, 2004). Rather than delivering content through traditional lectures, the instructor in a PBL environment acts as a facilitator—guiding, supporting, and monitoring student progress (Schmidt et al., 2011).

In this graduate-level introductory statistics course (STAT 1), most students were from an Agricultural Leadership, Education, and Communications (ALEC) department, with fewer than five from other related disciplines and a mix of master's and doctoral students. PBL was combined with simulation-enhanced assignments, flipped classroom strategies, and live coding sessions to foster a more interactive and applied learning experience. This approach aimed to provide opportunities for students to engage with statistical content in a way that built both competence and confidence.

Procedure

The study followed a qualitative case study design. Nineteen students enrolled in the statistics course across three semesters were interviewed. Each student was interviewed twice—mid-semester to provide formative feedback on the ongoing instruction and end-of-semester to reflect on their overall learning, confidence with statistical concepts, and perceptions of the course experience. One student participated in only one interview, resulting in a total of 37 interviews.

All interviews were recorded and transcribed with the help of a speech recognition software program (i.e., Otter.ai, Inc. Mountain View, CA). The interviewer also took field notes, documented reflections throughout the process, and collected documents from students related to their experience in statistics courses. These varied data sources allowed a broad view of the students' learning experiences.

In alignment with qualitative research practices (Creswell & Poth, 2016; Schwandt, 2014), multiple data types were triangulated, including interview transcripts, artifacts from the Learning Management System (LMS, specifically Canvas), and student reflections. Field notes and observations offered contextual depth and served to triangulate the behavioral nuances revealed by the Canvas log data.

What We Learned

Effective Teaching and Learning Strategies

Students revealed course features that supported their learning:

- *Preview and After-Class Resources.* Students described that access to learning materials before class and reinforcement after the class session through the LMS helped them prepare for lessons and strengthen their understanding. Lecture recordings, slides, and downloadable content allowed them to revisit lessons on their own.
- *Feedback within LMS*. Students appreciated the detailed feedback they received on their assignments through the LMS.
- *Instructor Connection and Self-Efficacy*. Students noted that the instructor sharing her own learning experiences made the material feel more relatable. Students reported that this helped reduce anxiety and build confidence. Group work provided a safe space to ask questions and discuss ideas with peers.
- *Importance of PBL and Scaffolding Learning*. Students reported that the PBL approach was effective because it connected statistical concepts to practical experiences through:
    - *Class Practice*, which provided regular hands-on problem solving.
    - *Real-world examples*, that demonstrated the application of statistics to agricultural contexts.
    - *Live coding sessions*, which allowed them to follow along with the thought process and build skills through a step-by-step process.
    - *Group projects*, which encouraged collaboration and peer support, typically involving 4-6 students per group.

Challenges and Student Suggestions

Students also shared areas that could be improved:

- *Access to Complete Materials*. Students recommended improving the quality and completeness of recorded content. Some recordings lacked visuals from the board, which made it difficult for students to review concepts clearly. In addition, some students reported using outside tools like YouTube to address gaps in understanding. Adding a curated list of accessible help videos organized by topic was suggested.
- *Clarity in Course Sequencing*. Some students noticed an overlap between this course and other statistics courses completed. Students recommended better coordination across courses to create a clearer learning sequence within the topic of statistics.

Recommendations

Based on student feedback, the following ideas can improve instruction in similar settings:

- **Offer Self-Study Modules**. Pre-course modules can help students prepare, and post-course access can support continued learning.
- **Maximize LMS Tools**. Organize feedback and learning materials clearly and provide course content recordings that students can access at any time.
- **Foster Peer Support**. Peer mentoring or small tutoring groups can reduce anxiety and create a supportive environment.
- **Focus on Application with PBL**. Students valued PBL methods, indicating they were able to shift from memorizing formulas to applying them contextually.
- **Improve Recording Quality**. Tools like digital whiteboards or screen capture software, used to include audio and board visuals in lecture recordings, can improve student learning experiences.
- **Coordinate Curriculum.** Collaboration across courses is encouraged to ensure that topics are appropriately sequenced to facilitate deep learning while preventing redundancy.

References

Barrows, H.S. (2000). Problem-based learning applied to medical education. Southern Illinois University Press.

Creswell, J.W., & Poth, C.N. (2016). Qualitative inquiry and research design: Choosing among five approaches. Sage Publications.

Dunn, P.K., Carey, M.D., Richardson, A.M., & McDonald, C. (2016). Learning the language of statistics: Challenges and teaching approaches. Statistics Education Research Journal. 15(1): 8–27.

Hmelo-Silver, C.E. (2004). Problem-based learning: What and how do students learn? Educational Psychology Review. 16(3): 235–266.

McGrath, A.L. (2014). Content, affective, and behavioral challenges to learning: Students' experiences learning statistics. International Journal for the Scholarship of Teaching and Learning. 8(2): Article 6.
Schmidt, H.G., Rotgans, J.I., & Yew, E.H. (2011). The process of problem-based learning: What works and why. Medical Education. 45(8): 792–806.
Schwandt, T.A. (2014). The Sage dictionary of qualitative inquiry. Sage Publications.

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