MENTORED TEACHING PROJECT - 6-Steph Outline
MSU Graduate School Certification in College Teaching

<u>Teaching and Learning Goal:</u> What skill or ability do you want students to acquire? What behavior do you want to change? What knowledge do you want to test? What assumptions (either students' or the instructor's) do you want to test? Focus on only one such goal

To develop students' ability to use R/RStudio to analyze and interpret ecological data, while increasing their confidence and perceived competence in quantitative data analysis.

This project focuses on building both technical skills (data analysis, visualization, interpretation) and self-efficacy, which are critical for success in ecology and other data-driven disciplines.

<u>Teaching Question:</u> Adapt the teaching and learning goal to a specific course. Make this question narrow and focused so that it can be measured.

The teaching and learning goal is developed for a 4-week field-based ecology lab course.

What relationship, if any, exists between teaching students how to use R/RStudio and their ability to analyze and interpret ecological field data, as well as their confidence, skills, and attitudes toward ecological data analysis?

<u>Assessment Technique:</u> What instrument are you going to use to collect information? Is it simple enough that you know how to analyze the results? Will the information it provides answer the teaching question?

Assessment instrument:

- Pre- and post-course surveys (Google Forms) using Likert-scale questions and open-ended responses
- Surveys assessed:
    - Confidence and skills (5 questions)
    - Attitudes and relevance (5 questions)
    - Post-only perceptions of R (5 questions)
    - Open-ended reflections

Analysis approach:

- Paired Wilcoxon signed-rank tests for pre/post comparisons (appropriate for ordinal Likert data)
- Adjusted p-values (Benjamini-Hochberg) to control for multiple testing

See *Classroom Assessment Techniques* p. 59 for a helpful "Checklist for Avoiding Problems with Classroom Assessment Projects"

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- Descriptive summaries for perception questions
- Qualitative interpretation of open-ended responses

This approach aligns closely with the teaching question by measuring both quantitative changes in confidence/skills and qualitative student experiences.

<u>Classroom Practice:</u> What assignment or activity are you going to use in the class to try to test the question? When are you going to do it? Who will conduct it? Will it be graded? Will it be anonymous or will students sign their names? How long will it take? How will students know what to do with it? Who will explain it? How will the relationship between this assignment and activity and the course be explained?

Instructional intervention:

- Implemented in a 4-week field-based General Ecology lab course (n = 18 students) at the University of Michigan Biological Station
- Students received:
    - An introductory R/RStudio lesson during the second day of the course
    - A guided, hands-on assignment after the introductory R/RStudio lesson
    - Continued use of R for group lab exercises and final group research projects

Key features:

- Data came from real, student-collected ecological field data
- Instruction emphasized:
    - Data visualization
    - Statistical analysis
    - Interpretation and communication of results

Structure:

- Pre-survey administered at course start
- R instruction + scaffolded practice throughout the course
- Post-survey administered at the end
- Lab assignments and final projects evaluated using a rubric-based assessment (group-level)

This intervention was embedded in normal course activities and framed as an essential tool for conducting ecological research.

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<u>Summary of Results:</u> What does the information you collected through the assessment instrument tell you about your teaching question?

please see full write-up for graphs

The assessment revealed clear patterns:
Confidence and Skills

- Students started with low confidence and limited experience (median = 3–4)
- Post-course responses shifted to higher confidence (median = 2)
- All five confidence/skill measures showed statistically significant improvement
    - Adjusted p-values ≤ 0.008
    - Large effect sizes ($r \approx -0.70$ to -0.86)

Attitudes and Relevance

- Students already held positive attitudes toward R at the start
- These attitudes remained high, with minimal change
- One significant improvement:
    - "R is essential for research" increased ($p = 0.02$)

Perceptions of R (post only)

- 88–94% of students agreed R:
    - Helped them understand data
    - Increased control over analysis
    - Made them feel more like scientists

Qualitative insights
Students reported:

- Increased confidence
- Reduced anxiety
- Greater enjoyment of data analysis
- A shift from intimidation to engagement

Overall, the intervention strongly improved confidence and perceived skills, while reinforcing already positive attitudes.

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<u>Conclusion:</u> What have you learned? What surprised you? What would you do differently? What implications does this have for your future classroom practice?

This project demonstrated that targeted, hands-on R instruction can substantially improve students' confidence and perceived ability to analyze ecological data, even within a short, 4-week course.

What I learned:

- Confidence is highly responsive to active, applied learning experiences
- Students benefit from working with real data collected in the field
- Attitudes may already be positive, but confidence requires practice to develop

What surprised me:

- The magnitude of improvement in confidence over a short time frame
- Attitudes were already high, even when skills were low
- How strongly students connected using R with feeling like scientists

Limitations:

- Reliance on self-reported data
- Small sample size (n = 18)
- Group-based assessments limited individual skill evaluation

Future improvements:

- Incorporate individual R assignments to better assess student learning
- Include objective measures of coding proficiency
- Evaluate long-term retention and application of skills

Implications for teaching:
Going forward, I will:

- Use scaffolded instruction to build skills gradually
- Include reflection activities to support metacognition
- Combine self-reported and performance-based assessments

This project reinforced the importance of designing learning experiences that build both technical competence and confidence, which are essential for student success in ecology.

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