

Innovative Assessment Through Mini-Projects: A Case Study in Biotechnology Education

Abstract

The case study demonstrates how carefully designed assessment can drive engagement, create authentic learning experiences, and develop professional skills through an innovative mini-project approach. By transforming traditional standalone laboratory sessions into an integrated investigation, students develop real-world research capabilities while maintaining high levels of engagement. The success of this approach, evidenced by positive student feedback, external examiner commendation, and consistent coursework completion, suggests it could serve as a model for other programs seeking to enhance laboratory-based teaching and assessment.

Keywords

Real-world, Engagement, Collaborative, Problem-based

Overview

Dr. Femi Olorunniji has developed an innovative assessment approach in a Level 5 Biotechnology module focused on synthetic biology and bioengineering. The approach transforms traditional disconnected laboratory sessions into an integrated mini-project that drives student engagement and creates authentic problem based learning experiences, formative feedback opportunities and strong links with the summative assessment.

The Challenge

Traditional laboratory teaching in science often involves standalone practical sessions, each focusing on a specific technique with little connection between sessions. This can

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lead to poor student attendance and engagement, as students may not see the relevance of individual techniques to real-world applications. Additionally, students often struggle to develop the investigative and problem-solving skills needed in professional scientific environments.

The Innovation

Dr. Olorunniji developed a mini-project group-based approach that spans four practical sessions, where students work on a continuous investigation rather than isolated experiments. Key features include:

- **Problem-Based Learning:** Students are presented with an initial problem and starting materials at the beginning of the project
- **Progressive Investigation:** Results from each session inform the direction of subsequent sessions
- **Multiple Techniques:** Students learn 8-10 different laboratory techniques in context
- **Group Work:** Students work in small groups (typically 3 students per group)
- **Cross-Group Learning:** Groups are encouraged to discuss approaches and compare results, the initial data for each group is different to reduce collusion and mimic the working environment.
- **Inbuild differences:** Students are allocated to groups to make sure weaker students are in groups with stronger students to ensure peer support occurs naturally, enabling knowledge sharing and skill development while building confidence through collaborative learning
- **Authentic Assessment:** The final report mirrors a scientific manuscript format

Assessment Design

"it's very, very difficult to pass the coursework if you didn't attend the lab sessions." Femi

The module assessment consists of:

- **Coursework (40%):** An individual 2500-word scientific manuscript-style report
- **Final Examination (60%):** Including a question specifically related to the mini-project

Reducing the negative use of Large Language Models (AI):

- Students generate and work with their own unique experimental data sets
- Each student participates in real-time problem-solving during labs
- All coursework requires interpretation of personal experimental results, including the final exam with a question specifically about their mini-project experience
- Problem-based learning creates a personal investment and ownership of the process, motivated by solving real challenges in real-time
- The progressive nature means each decision influences next steps, requiring authentic engagement
- Learning and the demonstration of that understanding happens simultaneously in the lab

Feedback Design

Formative Feedback (During Sessions):

- Immediate guidance from demonstrators during practical work
- Peer discussion encouraged between groups to compare approaches
- Students share and discuss different problem-solving strategies
- Real-time feedback as results emerge and inform next steps
- Active discussion about methodology and decision-making

Summative Feedback:

- Detailed written feedback on final reports
- Written general class feedback addressing common issues
- Individual feedback sessions available on request
- Feedback used to refine teaching: "If they are missing a particular point, then I begin to ask maybe I wasn't clear enough... and then we will find it the next year we fix that particular area."

This multi-layered feedback approach ensures students receive guidance throughout their learning journey, from initial experimental design through to final report writing.

Support Structure

The assessment is supported through multiple channels:

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1. Pre-project briefing session explaining the format and expectations
2. Two post-practical support sessions: Data interpretation guidance, Report writing workshop
3. Online drop-in sessions for additional questions

Impact and Outcomes

"It's actually one of the sessions students enjoy most, and they've mentioned it at the Board of studies... The feedback we get back from them shows they're excited about it."

Femi

The assessment approach has achieved several positive outcomes:

Student Engagement:

- High attendance rates at practical sessions
- Positive student feedback through NSS and Board of Studies
- Students report enjoying the investigative nature of the work
- No coursework failures since implementation

Learning Benefits:

- Development of authentic research skills
- Enhanced problem-solving abilities
- Improved understanding of scientific methodology
- Better preparation for Level 6 studies and future careers

External Recognition:

- External examiner highlighted the assessment design and feedback as "best practice"
- Positive feedback from program leaders about student preparation for further study

Success Factors

Several key elements contribute to the success of this approach:

1. Careful Project Design:

- a. Six months of preparation to develop appropriate projects
 - b. Projects are challenging but achievable
 - c. Clear connection to real-world research
2. Strategic Group Formation:
 - a. Instructor uses knowledge of student abilities to form balanced groups
 - b. Stronger students paired with those needing more support
 - c. Promotes peer learning and collaboration
3. Progressive Structure:
 - a. Each session builds on previous work
 - b. Students see clear connections between techniques
 - c. Results drive decision-making for next steps

Challenges and Solutions

The main challenges identified include:

1. Resource Development:
 - a. Significant time investment needed to develop suitable projects with variation in the data for each group
 - b. Projects must be both innovative and appropriate for level
 - c. Regular refinement based on student feedback
2. Student Adaptation:
 - a. Some students initially struggle with the investigative approach
 - b. Additional support needed for less confident students enabled by the strategic group formation helping address varying ability levels
3. Scalability:
 - a. Currently successful with 20 students
 - b. Potential challenges for larger cohorts requiring additional staff resources for bigger groups

Future Development

The success of this approach has led to its implementation in Level 6 and Level 7 modules. The method continues to evolve based on student feedback and outcomes, with regular refinements to support materials and delivery.

Transferability

While developed in a biotechnology context, the core principles could be adapted for other laboratory-based sciences. Key transferable elements include:

- Integration of multiple techniques through a single project
- Progressive investigation structure
- Authentic assessment format
- Strategic group formation
- Comprehensive support framework

The case study demonstrates how carefully designed assessment can drive engagement, create authentic learning experiences, and develop professional skills. The success of this approach suggests it could serve as a model for other programs seeking to enhance laboratory-based teaching and assessment.