Inquiry-based Learning in an Introductory Agronomy Class

Virginia M. Moore and William F. Tracy
Department of Agronomy, University of Wisconsin-Madison

Motivation

Agronomy 100: Principles and Practices of Crop Production is an introductory course with a weekly two-hour lab section. Early in the semester, the learning goals are more focused on memorization (e.g. plant parts and identification), and in later weeks there are broader and more integrated topics such as soil management in crop plants. Although the lab includes some hands-on activities, much of the instruction has historically been delivered through lecture. In previous semesters, teaching assistants encountered low motivation and poor student performance, especially with higher-level competencies within Bloom’s taxonomy of levels of learning (e.g. the ability to analyze, evaluate, or create) (Bloom 1956).

This teaching-as-research (TAR) project incorporated an inquiry-based learning activity in addition to a lecture-based activity with the goal of increasing motivation and higher-level Bloom’s competencies.

What is inquiry-based learning?

From Inquiry and the National Science Education Standards: A Guide for Teaching and Learning

- Learners are engaged by scientifically oriented questions.
- Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.
- Learners formulate explanations from evidence to address scientifically oriented questions.
- Learners evaluate their explanations, particularly those reflecting scientific understanding.
- Learners communicate and justify their proposed explanations.

Project Design

Class Context: The intervention took place during the pest management unit. The class had 60 students, ranging from freshman to senior and varying widely in their exposure to agriculture. The intervention took place in the lab sections, which had up to 25 students each.

Learning Objectives:

- Students will be able to analyze emerging pest problems and identify possible management approaches using frameworks such as the "disease triangle" and integrated pest management (IPM).
- Students will be able to analyze emerging pest problems and propose solutions.
- Students will cooperate in small-groups to investigate problems.
- Students will synthesize information and propose solutions.

Intervention: The pest management unit began with a traditional 15-20 minute lecture period highlighting the different types of pests and the damage they cause on crop plants, the management strategies available to farmers, and frameworks such as the "disease triangle" and integrated pest management (IPM) which can be used to understand and manage pests.

Students then completed the inquiry-based activity. They were divided into groups of 3 to 4 and assigned a short popular press article about a new pest problem affecting field crops in the Midwest. They were asked to imagine they were agricultural extension agents and prepare a mock "extension bulletin" and a brief presentation for the following class.

Students completed surveys about their knowledge and interest in pests and pest management at three key time points: before the unit, after the lecture, and after the inquiry-based activity. The surveys included self-assessments of interest and knowledge as well as short essays aimed at assessing both lower-level and higher-level Bloom’s competencies.

Conclusions

- Different majors responded differently to the intervention. On average, students showed slight increases in interest and higher-level Bloom’s scores, but some majors did not fit these trends (e.g. other CALS majors showed decreased interest after the inquiry-based activity, and Dairy Science majors showed decrees higher-level Bloom’s scores after the lecture) (see Figure 1).
- The Inquiry-Based Activity narrowed the gap between lower- and upper-classmen. Freshmen and Sophomores started with lower scores than Juniors and Seniors on the Higher Level Bloom’s questions but after the Inquiry-Based Activity the gap was much smaller (see Figure 2).
- Male students responded to the Inquiry-Based Activity more than female students. Male and female students had similar Higher-Level Bloom’s scores until the Inquiry Activity, but male students showed more improvement after the activity than female students (see Figure 2).
- Asian students showed a significant drop in scores after the lecture, while white students did not, but both racial groups had similar scores after the Inquiry Activity (see Figure 4).

Activities and Data Collection:

- Intro Questionnaire: Demographics, Agricultural background
- Academic background
- Pest Unit
- Survey 1: Pest management background, Low-level Bloom’s, High-level Bloom’s
- Survey 2: Same topics as Survey 2 + motivation questions
- Survey 3: Same topics as Survey 3
- Inquiry-based activity (remaining time, 1 hour 20 mins)
- Pest Unit
- Dec. 4
- Pest Intro Activity & Lecture (15-20 minutes)
- Pest Presentations (10 minutes per group)
- Pest Unit
- Dec. 11
- Before Intervention
- After Lecture
- After Inquiry-Based Activity

Higher-Level Bloom’s Assessment Questions

Before Intervention: Imagine you are a farmer, and you notice an unfamiliar insect feeding on the leaves of your crop. How would you figure out what to do to manage the insect? Please write 1-2 paragraphs, including observations, questions, or resources that might be important.

After Lecture: How does integrated pest management (IPM) differ from other methods of pest management in terms of its "philosophical approach" - i.e. how might IPM practitioners think about pest management differently than others? Please write 1-2 paragraphs.

After Inquiry-Based Activity: Reflect on one of the other presentations you saw today. Given what you learned about the pest, please describe the conditions that allowed an outbreak to occur. Which intervention(s) do you believe are the most promising? Please write 1-2 paragraphs.

References