



Improving online student comprehension in a plant biology lab course through research literature quizzes

Introduction

Plant Science Lab (AGRO/HORT 134) is offered by the Department of Agronomy and Horticulture at the University of Nebraska-Lincoln in the spring and summer terms as a fully online 1 credit course. The online AGRO/HORT 134 is one of three lab options to accompany AGRO/HORT 131, an introductory plant science course offered in resident, online, and blended modalities. Students enrolled in the online option may be fulfilling course requirements for their major (e.g. turf or golf course management) or may be seeking an additional 1 credit of science, but typically represent majors in the College of Agriculture and Natural Resources. The curriculum for AGRO/HORT 134 supplements that of AGRO/HORT 131, by relating plant science fundamentals to management decisions for a variety of plant production systems including turf, rangeland, crop field, greenhouse, and landscape management. In addition to the textbook (*Botany for Gardeners 3e*, Timber Press), students are assigned primary literature articles to introduce them to real-world plant science topics and enhance their understanding of course material. These literature explorations are accompanied by a quiz administered through Canvas. This paper discusses how these quizzes were designed, administered, and graded, and evaluates student feedback and survey results.

Methods

The literature quizzes were designed to help the students read and interpret the literature. Questions were aimed at multiple objectives: to isolate the main points of the article, such as the research goal or subject under review; to identify the structure and process of a research article, such as summarizing the abstract or methods; and to apply the research findings to real-world plant science or the mainline course curriculum (Table 1). The rationale in these question types was to highlight the most useful information from the paper in the absence of an instructor's guidance, all the while showing students how to understand the literature. The featured articles covered topics such as plant breeding, organic farming, seed priming, and global plant biodiversity (see references for articles used in Spring 2020).

The quizzes were written to feature nine one-point multiple-choice or matching questions, automatically graded by the Canvas quiz tool, and three two-point short essay questions, graded manually by the instruction team. The five literature quizzes were administered biweekly over the Spring 2020 semester, totaling 75 points (~15% of course grade). Each quiz was accessible to students for a 10-day period of time prior to the due date and had a time limit of 90 minutes, which was intended to allow students to re-read and reference the articles while taking the quiz.

As with most online courses, this lab was limited in the amount of student-instructor communication during assignments; however, students were encouraged to ask questions about these quizzes when necessary. The quizzes also doubled as a tool to monitor student comprehension as the semester progressed. Feedback was given on every incorrect short-answer question in order to guide students toward the target answer or demonstrate how the question connects to the curriculum.

In week 13 of the semester, a voluntary survey was deployed where students could leave feedback on the quizzes. This survey asked if students felt the articles contributed to their understanding of the course material, if scientific articles were pertinent to their career goals, and if students felt more comfortable reading scientific literature as a result of the quiz structure. Questions were presented on a Likert scale, with values 1-5 from strongly disagree to strongly agree, respectively. It was assumed that scale distances between answer choices were equal. Student responses were scored and averaged per question.

Results & Assessment

After being open for 14 days, 17 of 29 students (58%) responded to the optional survey. Thirteen of 17 respondents (76%) had previously been assigned reading scientific articles in university courses, indicating a large proportion of the students had some background with research interpretation. At course's end, 88% of respondents agreed or strongly agreed that these quizzes improved their understanding of a scientific article and 88% of respondents agreed or strongly agreed that they feel more comfortable approaching scientific articles in the future (Table 2).

The purpose of these quizzes was to improve students' understanding of course content. Although some students came into AGRO 134 with a working understanding of how to read and use scientific literature, many reported that their comfort with scientific literature increased; 88% of respondents either agreed or strongly agreed that the literature quizzes had an overall positive effect on their learning experience – indicating success in the goal of the quizzes. Although not quantified, it is likely that short-answer question feedback was helpful to students, as it was intended to demonstrate the thinking process to successfully apply the literature broadly.

This method of reinforcing course material with primary literature quizzes is a possible means of improving students' comprehension of course content in a fully online course.

The quiz structure increased the degree of engagement and active learning during the process of reading literature articles. Moreover, this course component increases engagement by exposing students to real-world applications of the curriculum, giving them an idea of how to actualize a career and enriching their knowledge of their major area of study.

Tables

Table 1. Examples of questions and question types used in quizzes to help students in a fully online plant science lab understand assigned literature.

| Question Purpose | Example Question | Answer |
|--|---|---|
| How to read a paper; identify paper type | Read the abstract of this article. Using only the abstract to summarize, this article is: | A review paper on the roles and adaptations of secondary meristems |
| Test of comprehension | Some plants are referred to as hybrids, while other plants are referred to as varieties. It is important to understand that there is a biological difference. Which pollination type results in a hybrid? | Cross-pollination |
| Encourage thought on application of literature | From a management perspective, you would want sterile male parts on corn plants because: | Manual de-tasseling is expensive and labor-intensive |
| Encourage broader thought and reasoning | If you were involved in designing this study, would you use biomes as a prediction unit, or would you use some other way to measure how biodiversity would be affected by climate change factors? | Answer would include biome-scale metrics, species richness, species surveys, mapping gene abundance, etc. |

Table 2. Results of survey administered in fully online plant science lab to determine student's reaction to assigned literature and associated quizzes. Respondents choose from 1= strongly disagree to 5= strongly agree.

| Question | Mean Likert Score | Median Likert Score |
|---|-------------------|---------------------|
| After reading the articles and taking the literature quizzes, I better understand the structure and layout of a scientific article. | 4.18 | 4 |
| I felt that the assigned articles were appropriately related to the rest of the course material. | 4.18 | 4 |
| After reading the assigned articles and completing assignments for them, I feel more comfortable approaching scientific articles in the future. | 4.12 | 4 |
| The literature quizzes had an overall positive effect on my learning experience. | 4.00 | 4 |
| Literature quiz questions helped me to understand the purpose of reading the articles. | 3.88 | 4 |

References

Articles used for quizzes:

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