Digitization of the IPFW Herbarium and Use in Field Botany and Dendrology Courses

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Project Description

Course Descriptions and Rationale

Field Botany (BIOL 50100), the study of plants in a landscape context, is an upper-division biology course that is included as an approved elective for both the General Biology major and the Ecology and Evolutionary Biology major. Additionally, it is also included in many graduate student plans-of-study. I teach the course on alternating Fall semesters and focus on plant ecology and biogeography. During the lab section of the course, the students and I design a field based survey study of plant communities in Allen County. The last two times I have taught the class with this practical lab experience, the students' project has resulted in a paper in a peer-reviewed botanical journal with all students as authors.

In preparation for the field project, I teach the students 100 key botanical terms and 37 common plant families. Mastery of the terms and families provides the students with skills necessary to identify the plant species they encounter in the field project. Terms and families are the focus of quizzes during the beginning few weeks of the lab section. Development of a digitized herbarium for Fall 2016 provided me a tool that I used for instruction of both terms and families, and also a resource to develop online quizzes the students used to study. My hope was that such a tool would strengthen the field project's output and help the students reach the first learning objective for the course (Develop basic knowledge of plant taxonomy and ecology and use it to identify plant species and their habitats).

Dendrology (FNR 22500), field identification and taxonomy of trees and shrubs, is an approved elective for both the General Biology major and the Ecology and Evolutionary Biology major. As 200-level course, Dendrology is taught specifically for undergraduate students. My focus in the course is on the lab section and the skills of field identification of trees and shrubs. Quizzes and the lab practical make up half of the points available in the course. The lecture provides habitat and ecology context for those species identified in lab.

Much like Field Botany, the students enrolled in dendrology are required to learn 51 key botanical terms and 121 tree and shrub species. Weekly lab quizzes test the students' abilities to in-field, on-the-spot identify these species. The lab practical is an 80 species exam, including wood, fruit, and cone identification. As with Field Botany, my hope is that a digitized herbarium and online quiz tool will strengthen the students' abilities to learn, as well as help the students reach the first learning objective for the course (Understand tree and shrub diagnostic and identification skills related to leaf, bud, twig, bark, flower, and fruit characteristics). While this course was not offered in Fall 2016, the products produced from Field Botany will be applicable to Dendrology.

Because these two courses require specific identification skills that many of these students have never gained or used, I wanted to provide them with as many tools as possible. In both courses, the students are outside the classroom as we cover terms and families/species. They have the opportunity to see, touch, smell, and, in some cases, taste the live specimens. However, after that initial exposure to the species, students need continual review of the specimens for further study. While the physical herbarium is available, it is contained in the Department of Biology greenhouse, which is secure and limits student accessibility. By digitizing the herbarium, I have tried to make it easily available to students to study assigned terms and families/species.

Learning Objectives

My learning objectives come from the two courses that this tool will affect. For Field Botany (BIOL 50100) students will develop basic knowledge of plant taxonomy and ecology and use it to identify plant species and their habitats. For Dendrology (FNR 22500) students should gain an understanding of tree and shrub diagnostic and identification skills related to leaf, bud, twig, bark, flower, and fruit characteristics. In Field Botany and Dendrology, my objective is that a digitized herbarium will become an essential study tool to strengthen the students' knowledge and skills, as well as clarify difficult terms, species, and families.

Implementation

The Department of Biology herbarium houses a relatively small collection of plant specimens. There are currently approximately 1,600 specimens, which is a magnitude smaller

than neighboring institutions. I was able to scan 532 specimens, which included the families covered in Field Botany. Those selected were individual samples that provided clear examples of key characteristics (Fig 1).

During the first six weeks of class in Fall 2016, I taught the students important plant families. After each lab, in which we covered 6-8 families, I posted a practice quiz on Blackboard. Questions were in two forms with one displaying an image and asking the student to name the family (fill-in-the-blank, Fig 2). The second form of question displayed three images of plants from the same family and one image of a plant from a different family and asking the student to identify which image was from a different family (multiple choice, Fig 3). Students completed these online practice quizzes and the in-class graded quizzes in Fall 2016 (5 quizzes). Additionally, I used a Qualtrics survey to gain feedback about the use and interest in using the online quizzes.

Project Results

Two students did not attempt the online quizzes. The remaining 13 students completed a range of 1 to 5 quizzes online as practice. All 15 students completed the five in-class graded lab quizzes. There was a significant positive relationship between the number of online quizzes completed and mean lab quiz grade (Fig 4). Ten of the students completed the Qualtrics survey at the end of the course. Six of the 10, found the online quizzes to have little to no impact on their lab quizzes (Fig 5). Additionally, there was not a clear pattern in how the students responded to potential improvements to the online quizzes (Fig 6). While a greater proportion of graduate students did use the online practice quizzes, the number of uses by graduate students was not greater than the overall median ($X^2_1 = 1.11$, $p = 0.292$). There was no significant difference between undergraduate and graduate students in mean quiz grades ($t_{(2),13} = 0.51$, $p = 0.621$). Finally, mean quiz grades between 2014 (when the online quiz was not available) and 2016 were not significantly different (Fig 7; $t_{(2),8} = 0.23$, $p = 0.824$).

Project Conclusions

While there was a pattern of increased quiz grades with increasing use of the online quizzes, this may simply be an artifact that better students will utilize all study aids. Students that perform poorly in courses typically fail to participate and do not tend to access online materials

(Davies and Graff 2005). In Field Botany, students that did not access the online practice quizzes may simply have been students that would have performed poorly no matter what tools I provided.

Undergraduate and graduate students performed similarly on the quizzes. In 2016, the class was 80% graduate students (12 out of 15 students). In previous semesters, this varies with 2014 having only one graduate student out of 14 students enrolled. Since the undergraduate and graduate students did not perform differently in 2016 and the classes as a whole did not perform differently between 2014 and 2016, I concluded that the online practice quizzes had little impact on students regardless of their academic level. While there was a greater proportion of graduate students using the online practice quizzes, that use rate was not greater than the overall median. This supports the general idea that graduate students have greater participation in online study tools (Artino and Stephens 2009). However, this provided little direct impact on improving the students' grades.

My objective for this project was to provide the students with a tool that would aid in studying technical skills associated with plant family identification. There are limitations to the online quiz as a practice tool and may align more with a passive activity, which will have limited impact on historically lower-performing students (Biggs 1999). However, 40% of the students responded that these online practice quizzes had a moderately strong impact on their lab quiz grades. Because some students may have benefited from the online quizzes, I will continue to provide them as a study aid. This also means that 60% saw little to no impact on their quiz grades by using the online practice quizzes. A more active study tool may be necessary to maximize student learning in Field Botany and Dendrology.

Literature Cited

Artino Jr., A.R., and J.M. Stephens. 2009. Academic motivation and self-regulation: a comparative analysis of undergraduate and graduate students learning online. The Internet and Higher Education 12, 146-151.

Biggs, J. 1999. What the student does: teaching for enhanced learning. Higher Education Research & Development 18, 57-75.

Davies, J., and M. Graff. 2005. Performance in e-learning: online participation and student grades. British Journal of Education Technology 36, 657-663.

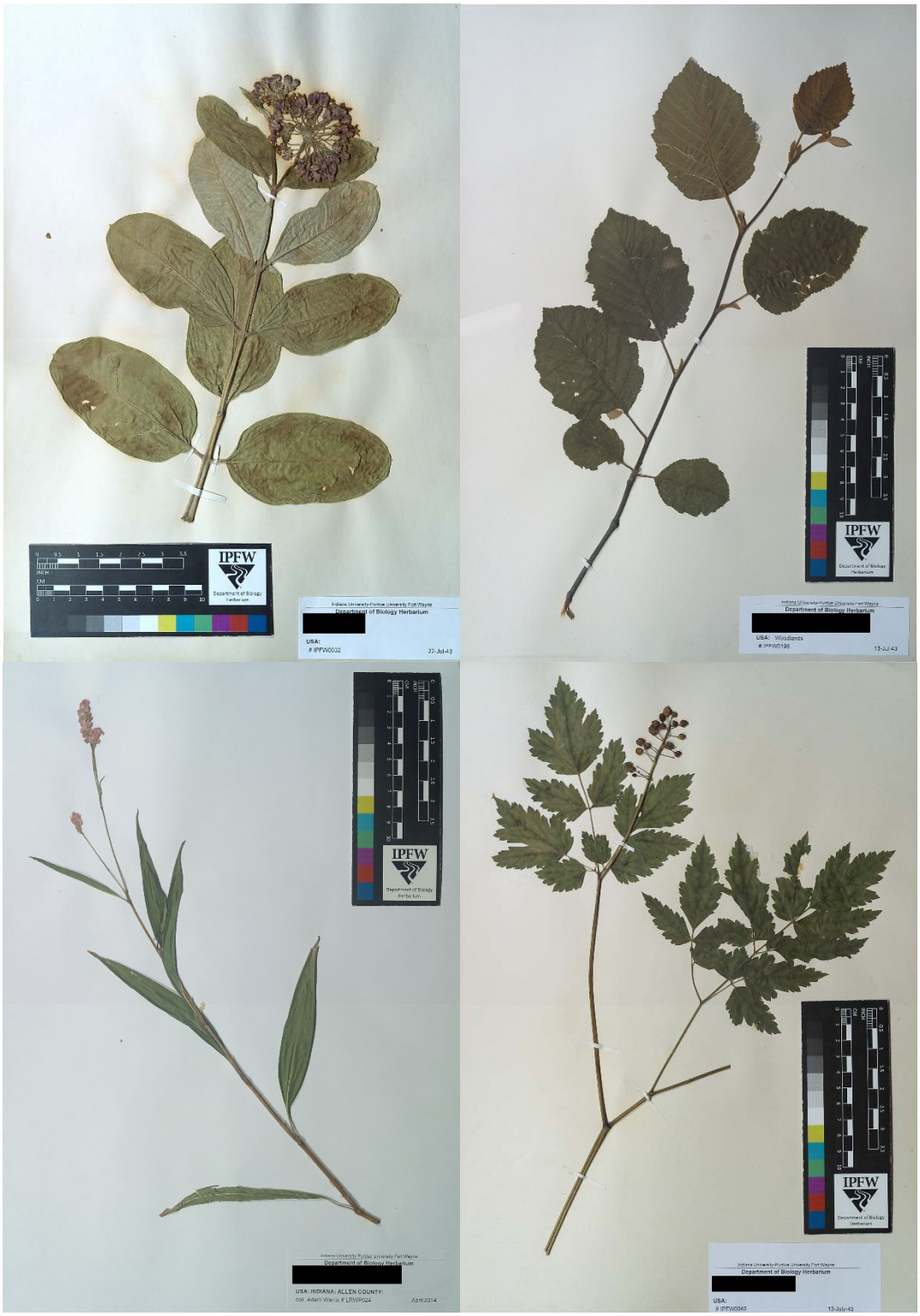

Figure 1. Examples of herbarium specimens used in online practice quizzes in Field Botany (BIOL 50100).

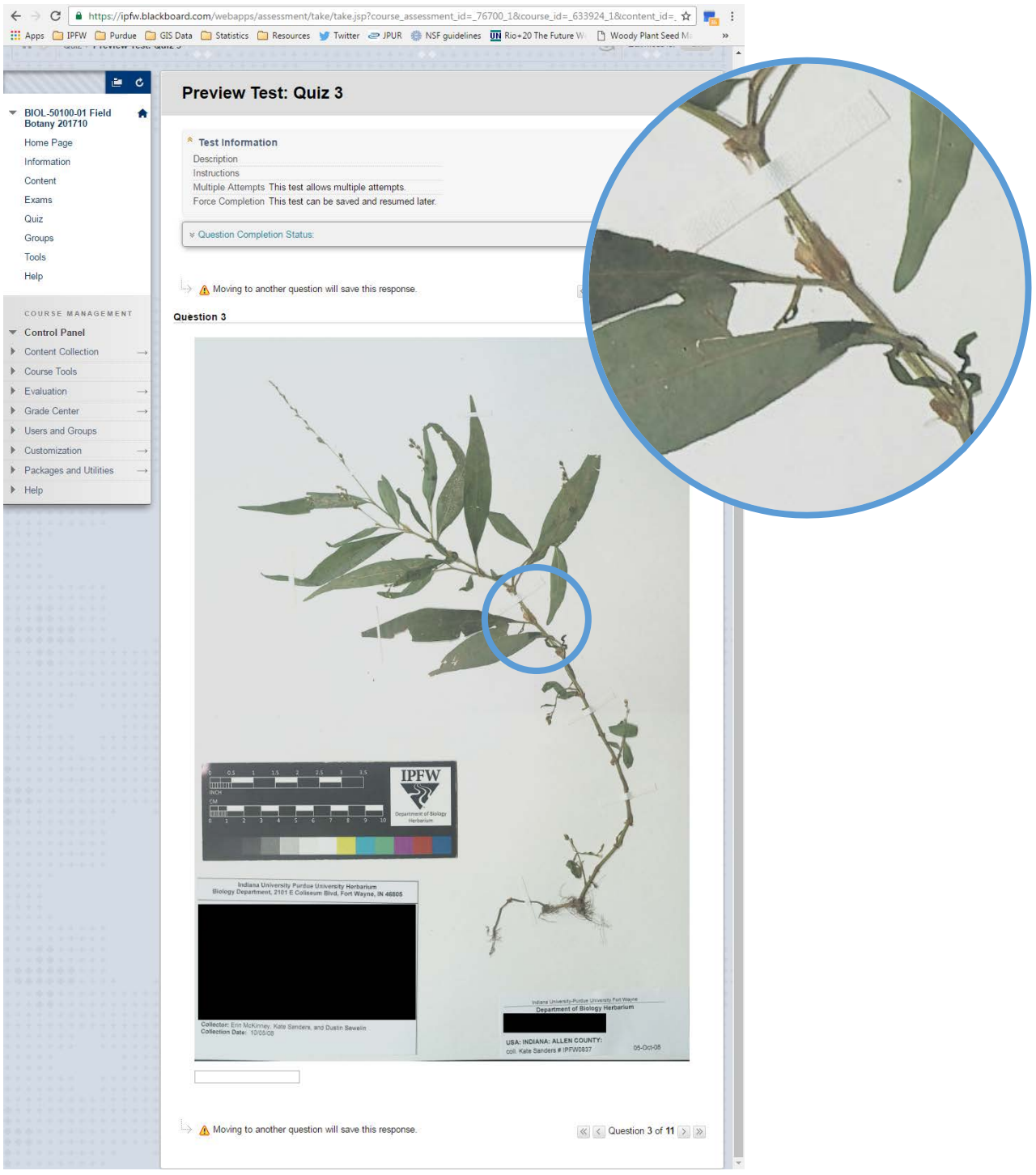

Figure 2. Example of fill-in-the-blank quiz question. Magnified inset provides an example of a key characteristic students would need to use to identify this family (Polygonaceae).

Figure 3. Example of multiple choice quiz question. In this example, students would use fruit and stem shape as the differentiating characteristics. Specimen B is from a different family compared to specimens A, C, and D.

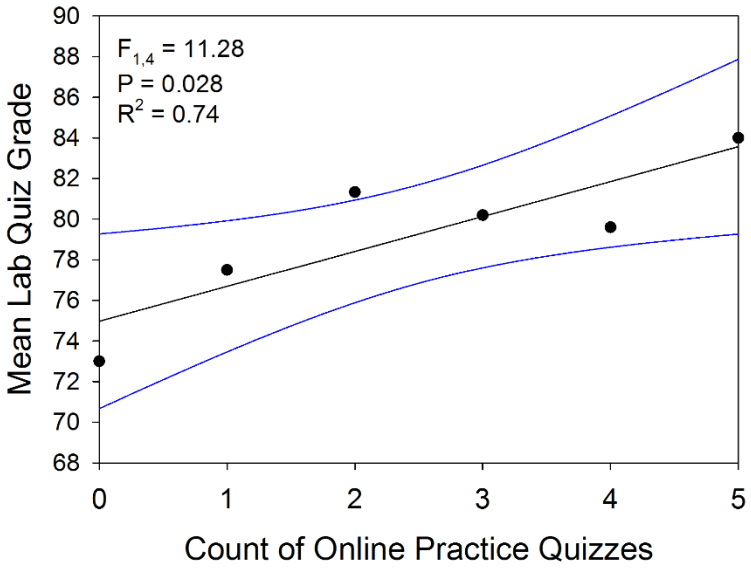

Figure 4. Simple linear regression of mean lab quiz grades and number of online practice quizzes completed. Blue lines represent 95% confidence intervals.

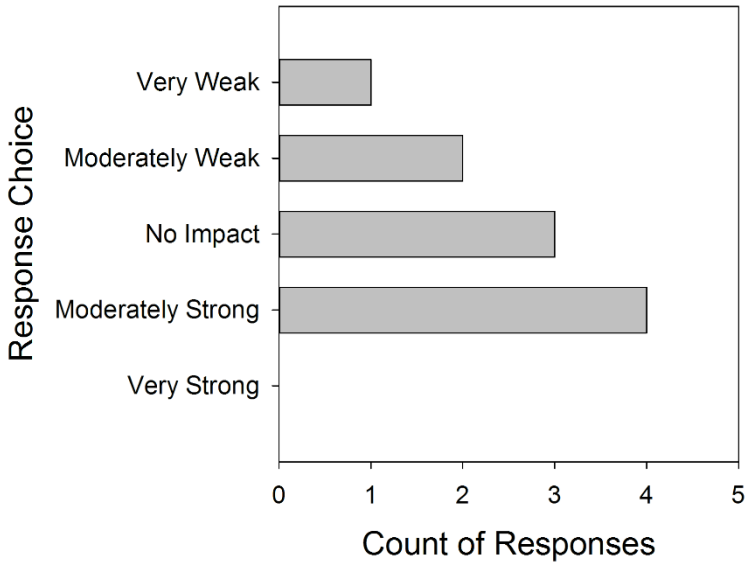

Figure 5. Student perception of the impact the online quizzes had on their lab quiz grade.

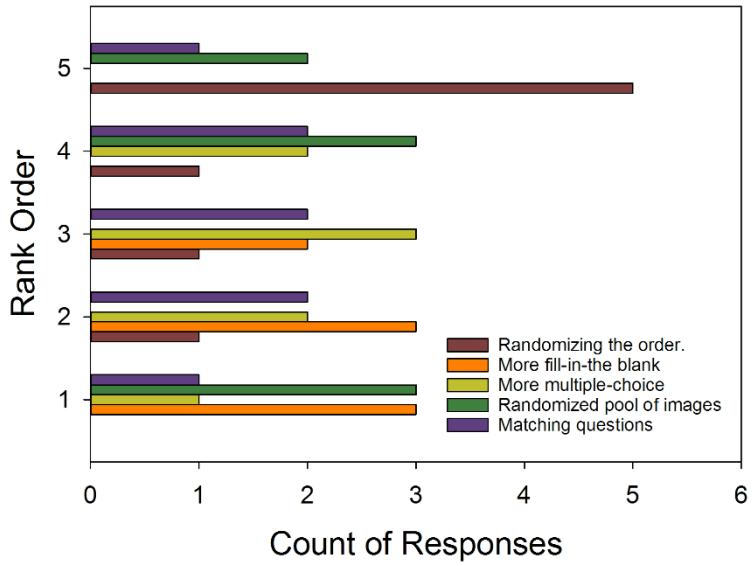

Figure 6. Student ranking of suggested improvements to online quizzes, with 1 as most important and 5 as least important. Options were randomizing the order of questions, more fill-in-the-blank questions identifying families, more multiple-choice questions comparing families, randomized pool of images so quizzes could be recycled, and matching questions of family names to images.

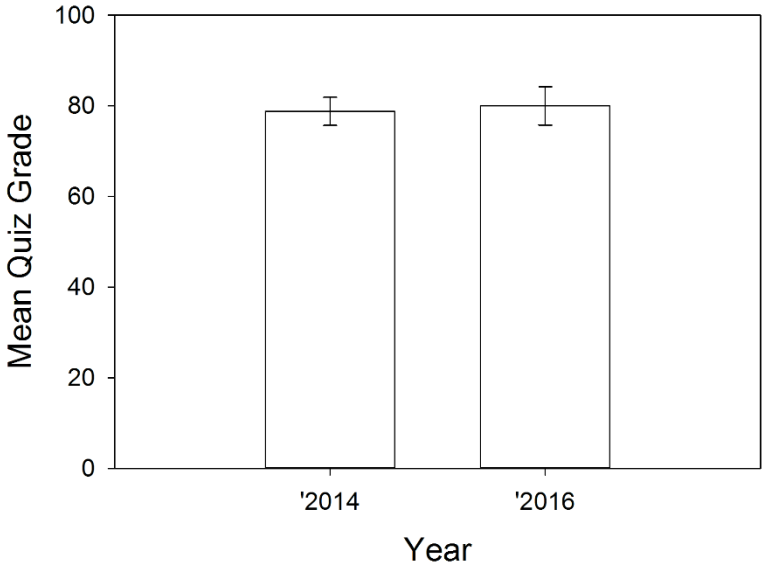

Figure 7. Mean quiz grades for years without (2014) and with (2016) online practice quizzes.