

Encouraging Reflective Learning with End-of-Lab Presentations on iPads

Mariëlle H. Hoefnagels¹ and Mark E. Walvoord²

¹University of Oklahoma, Departments of Biology and Microbiology/Plant Biology, 770 Van Vleet Oval, Rm. 135, Norman OK 73019, USA

²University of Central Oklahoma, 100 N. University Dr., Campus Box 212, Edmond OK 73034, USA
(hoefnagels@ou.edu; mwalvoord@uco.edu)

Presenting results at the end of lab can enhance student understanding and provide opportunities for immediate assessment. When students know they will have to present, they are more likely to reflect on what they're doing, ask questions, and consider how best to communicate their findings. During presentations, the instructor can immediately identify misconceptions and assign grades. With brief training, students can use iPads to videotape, photograph, and/or draw lab procedures, then convey experimental results and conclusions in one concise presentation. During this workshop, attendees learned to use a presentation app, performed a quick lab activity, and created their own presentations.

Keywords: educational technology, critical reflection, phylogeny

Introduction

Since most of our students belong to the generation considered “digital natives,” we wanted to leverage iPads’ functionalities to encourage learning in our biology laboratory. Following the educational theory of constructivism (i.e., students learn by creating their own connections between new material and existing knowledge/experiences), we chose to use iPads to encourage students’ reflection on their experiences with the lab material. Journaling, concept mapping, generative knowledge, peer interviews, and oral presentations are all examples of assignments used to help students reflect upon and voice their understanding of new information.

There is some evidence that reflective learning could be more important in expository (versus inquiry-based) science labs for student learning gains (Schussler et al., 2013). Other studies showed the importance of explicitly stating the learning goals of the reflection activities and giving student specific prompts or rubrics to help the process (Bautista and Schussler, 2010; Kirschner, Sweller, and Clark, 2006). The laboratory exercise that we presented met these criteria.

We developed this activity for use in a nonmajors biology lab course. The class enrolls 30 to 40 students per lab section, and they typically form groups of 2-3 students that work together throughout the 3-hour lab

period. We use iPads frequently for end-of-lab presentations, but the example we used in the mini workshop was from the lab in which students learn to create and interpret evolutionary trees.

Specifically, the lab’s objectives are to learn evolutionary tree “anatomy”; hand-draw a tree to summarize hypothesized evolutionary relationships among living plants in the lab room; and test the hypothesis by entering DNA sequences from the plant species into a website and comparing their hand-drawn tree to the molecular one.

We use iPads throughout the lab. Before examining the living plants, they practice with evolutionary tree terminology by using the Explain Everything app (\$2.99) to draw trees depicting the possible “evolutionary relationships” among 7-8 screws and nails. Each tree must include a photo of the screw or nail at the tip of each branch, hypothesized “nodes,” labels describing the unique character for each branch, and a common ancestor for the whole “clade.”

They present their trees in class, and the instructor immediately identifies and corrects misconceptions. Next, they use the Explain Everything app to take pictures of the plants in the lab and arrange them into trees. Finally, they create molecular trees using the DNA sequences that we provide.

Student Outline

See Appendices.

Notes to the Instructor

Appendix A is a handout with instructions for the Explain Everything iPad app. Appendix B includes the complete instructions for the Screws and Nails activity, including a rubric. Appendix C shows a sample rubric for using iPads to present the methods, results, and conclusions of a student experiment.

When we first started using iPads in the biology lab, data from student post-lab surveys showed that about 41% of students felt the use of iPads in Biology lab for presentations and other activities was too time-consuming and felt like busy-work (17% responded positively to their use, and about 41% were neutral; Walvoord and Hoefnagels, unpublished data). The source of this frustration seemed to be complexity of the presentation app, inability of graduate teaching assistants to troubleshoot technical issues, and students that weren't prepared to use the technology. Also, students knew they were part of a study and perceived that they would have gotten out of lab faster if not for the iPads. (In subsequent semesters, when iPad use was simply a normal lab activity and not part of a study, students were much more welcoming of the technology.) Overall, our feedback emphasizes the importance of: 1) training the students on iPads and specific apps, 2) making sure GTAs have buy-in and understand the goals of using this technology, and 3) training the GTAs to handle technical issues with the iPads, presenting, or the commonly-used apps (Walvoord and Hoefnagels, 2015).

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University of Oklahoma graduate student Krystal Gayler developed the "Screws and Nails" activity used in the mini workshop, and Ingrid ter Steege from OU's University College loaned us iPads and styluses. We are also grateful to the staff of Boston University for their help.

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About the Authors

Mariëlle Hoefnagels has worked at the University of Oklahoma since 1997, the same year she earned her PhD at Oregon State University. She is an associate professor in the departments of Biology and Microbiology/Plant Biology. Her primary responsibility at OU is to teach nonmajors biology, but she regularly teaches courses in mycology and scientific writing as well. She is also the author of *Biology: Concepts and Investigations* and *Biology: The Essentials*, two general biology textbooks published by McGraw-Hill. She also maintains a blog, nonmajorsbiology.wordpress.com, which offers teaching ideas for general biology instructors.

Mark Walvoord received his Bachelor's degree in Biology from Oklahoma Baptist University and his Master's degree in Zoology from the University of Oklahoma (OU). He is currently the assistant director of the Student Transformative Learning Record at the University of Central Oklahoma (UCO), adjunct instructor at UCO, and adjunct Biology instructor at OU. At the time of the presentation, he was the director of Experiential Learning at UCO.

Appendix A

iPads for Lab: Explain Everything App (ver. 2.66)

***Explain Everything** is a versatile whiteboard tool that lets you create presentations using slides you create, plus photos and videos you import from other apps. You will use this app to share your experimental procedures and results with your classmates.*

1. Tap the Explain Everything app on the iPad screen.
2. To create a new presentation:
 - a. Tap the “+” button in the upper left.
 - b. Choose one of the four color templates for your slide.
 - c. A workspace will open.
3. To create a text slide (say, a title slide with the list of student names):
 - a. Tap the “A” (fourth icon from the top along the left side of the workspace)
 - b. Tap the workspace and begin typing
4. To add a new slide (say, a second text slide to list the objectives of your experiment):
 - a. Find the slide counter at the lower left corner of the screen. Tap the plus sign.
 - b. A new slide will appear. In the lower left, it should say “Slide 2 of 2”. You can now use the right and left arrows next to the slide counter to move from slide to slide in your presentation.
5. Draw an image (say, a graph of your results):
 - a. Add a new slide
 - b. Select the pencil tool (second icon from the top along the left side of the workspace)
 - c. Use your finger or a stylus to draw the axes of a graph. Label the axes completely and sketch in your data.
 - d. To add a new line of a different color, click the boxes in the lower left of the screen, then keep drawing.
6. Take a photo from inside Explain Everything:
 - a. Add a new slide
 - b. Tap the “insert an object” tool (fifth icon from the top along the left side of the workspace)
 - c. Tap “New Picture”
 - d. The iPad’s camera app will open.
 - e. Take the picture. You may crop or rotate the image if you’d like, or just tap Done.
 - f. Use your fingers to “pinch” the photo larger or smaller (if desired)
 - g. Use the pencil tool (if desired) to point out features of the photo.
7. Import an existing photo from the iPad’s camera roll:
 - a. Add a new slide
 - b. Tap the “insert an object” tool (fifth icon from the top along the left side of the workspace)
 - c. Tap “Existing photo/video”
 - d. Choose the source treat the photo described in item #6.
8. Take a video from inside Explain Everything:
 - a. Add a new slide
 - b. Tap the “insert an object” tool (fifth icon from the top along the left side of the workspace)
 - c. Tap “New Video”
 - d. A video camera will open. Record your video (file sizes grow rapidly!)
 - e. Resize by pinching (if desired)
9. Import an existing video from the iPad’s camera roll:
 - a. Add a new slide
 - b. Tap the “insert an object” tool (fifth icon from the top along the left side of the workspace)
 - c. Tap “Existing photo/video”
 - d. Select the desired video.
10. Delete a slide:
 - a. Tap the slide counter on the lower left side of the screen
 - b. Touch and hold the slide you wish to delete
 - c. Tap the red “X” to delete the slide

11. Rearrange your slides:
 - a. Tap the slide counter on the lower left side of the screen
 - b. Touch and hold the slide you wish to move
 - c. Drag the slide to its new location in the presentation
12. Save your work:
 - a. Tap the Save icon in the lower right of the screen; it's the second icon from the right and it looks like a little file folder.
 - b. Enter or select the name of the presentation and tap Save
13. Email your presentation to all group members and your TA (note that this will export images only, not video; you can only export video if you "screencast" your presentation, which we won't do in this class):
 - a. Tap the Export movie icon in the lower right of the screen; it's the third icon from the right and looks like a little movie strip
 - b. Select "More..."
 - c. Select PDF near the top of the screen
 - d. Select MORE → mail.

Appendix B
Screws and Nails Activity
 (Based on activity developed by Krystal Gayler)

Objective: Construct a simple “phylogenetic tree” using screws and nails.

Materials required:

- Packets consisting of 7 screws and nails of various sizes (one packet per student group). The packets don’t need to be identical, and the size of each screw/nail isn’t important, but no two items in a given packet should be alike.
- iPads loaded with the Explain Everything app (\$2.99 per iPad)
- VGA adaptor to project iPad images on classroom projector

Student Instructions:

- Observe the similarities and differences in the screws/nails in your kit
- Organize them into a hypothesized evolutionary tree
- Construct your tree in *Explain Everything*. See the rubric pasted below; be sure that your tree has:
 - a photo of each nail and screw in your kit
 - a “root” representing a single common ancestor
 - a nail or screw at the tip of each branch
 - labels on each branch indicating its unique character(s)

Table 1. Rubric for evolutionary tree for screws and nails (from *Explain Everything* app).

Criteria	Meets/exceeds expectations	Unsatisfactory
Photos	Tree includes photo of each nail and screw in your kit	Some or all photos are missing
Common ancestry	Tree is rooted with a single common ancestor	Tree lacks a common ancestor and/or consists of multiple isolated branches
Branch tips	Each nail and screw occupies the tip of its own branch	One or more nails or screws is depicted as an ancestor (implying extinction)
Characters	Each branch is labeled with a brief description of its unique character(s)	One or more branches is not labeled with a character

Appendix C Rubrics

Table 2. Rubric for presenting experimental results using *Explain Everything* app*.

Criteria	Meets/exceeds expectations	Unsatisfactory
Title	Presentation includes title	Presentation does not include title
Names	Presentation includes names of all group members	One or more names of group members are missing
Hypothesis	Experimental hypothesis correctly stated in IF ... AND ... THEN format	Hypothesis incorrectly stated or incorrectly formatted
Experimental design: Independent variable(s)	Presentation correctly identifies one or more independent variables	Independent variable(s) incorrectly identified or missing
Experimental design: Dependent variable(s)	Presentation correctly identifies one or more dependent variables	Dependent variable(s) incorrectly identified or missing
Experimental design: Standardized variable(s)	Presentation correctly identifies one or more standardized variables	Standardized variable(s) incorrectly identified or missing
Experimental design: Control	Presentation correctly identifies control	Control incorrectly identified or missing
Methods: Description	Methods are described in sufficient detail	Methods are described in insufficient detail
Methods: Visual aids	Presentation includes one or more photos and videos depicting experimental methods	Presentation does not include photos and/or videos
Graph: Predicted results	Graph is formatted correctly and includes axis labels (including units) and meaningful treatment labels	Graph is missing, formatted incorrectly, or required components
Graph: Actual results	Graph is formatted correctly and includes axis labels (including units) and meaningful treatment labels	Graph is missing, formatted incorrectly, or required components
Conclusions	Presentation includes reasonable interpretation of results	Interpretation of results is missing or not supported by data

*Not applicable to “Nails and Screws” activity; this is just another example of a way to use the app

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