Do Introductory Biology Students Achieve Deeper Learning After Completing a Learn-by-Teaching Project?

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Abstract

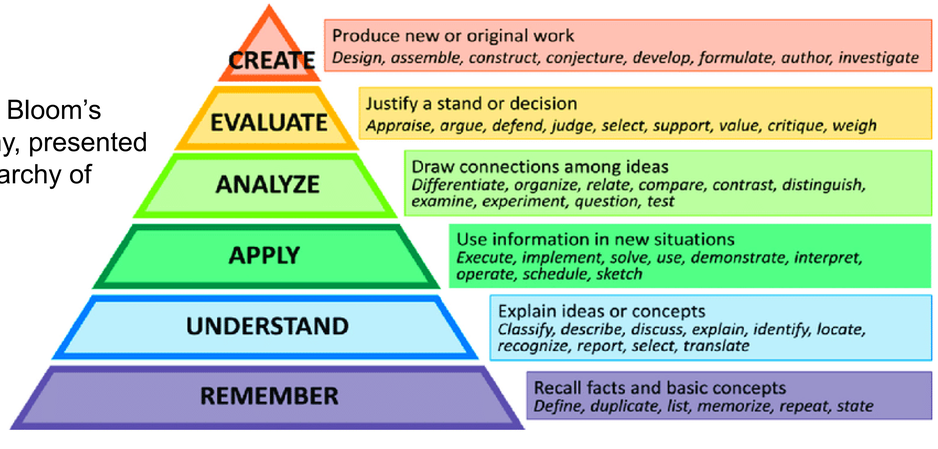
From years of teaching Introductory Biology, I find that students need to be taught how to learn. They often rely on ineffective study habits that do not lead to deeper learning and understanding of concepts. I am interested to learn if students achieve deeper learning by playing the role of a tutor. Students will explain an assigned topic via a short tutorial video and provide a study guide to go with their video. I will assess the students' learning through targeted exam questions on the topic that balance lower-and upper-level Bloom's taxonomy to determine the level of deeper learning achieved. I will survey the students on their experience and perception of whether they feel they achieved a better understanding of the topic.

Introduction

If I want students to learn the course material, beyond memorizing and superficial understanding, I need to teach them how to learn. Students can articulate the difference between **studying** (short term, memorize information for exams, focus on "what") vs **learning** (long term, understand and apply information, focus on "how/why/what if"). However, most students approach course material in **study mode** vs **learn mode**, and they use study habits that aren't effective for them. McGuire (2015) describes 10 metacognitive strategies for students to dramatically improve their learning and performance in any course, including teaching the material. I know from personal experience that teaching requires deeper knowledge and mastery of the material. When students explain material to a real or imagined audience, they begin to consider the topic from multiple perspectives, identifying potential knowledge gaps for others and anticipating questions they might be asked (McGuire 2015).

I want to learn if students achieve deeper learning of a concept when they teach it. Meiosis is a concept that students consistently struggle with in Introductory Biology. I teach it in the last third of the semester, so I have time to introduce students to McGuire's work on metacognition and effective learning strategies, have them practice drawing out and modeling lecture material, and explain the material in small groups. For the teaching project, students play the role of a class tutor who must explain meiosis in a tutorial video. They also will build a study guide with an answer key to go with their video. I predict that students will perform better exam questions about meiosis, particularly those at higher Bloom's taxonomy levels, and that they will report a deeper understanding of meiosis after having to teach it.

Figure 1. Bloom's Taxonomy, presented as a hierarchy of learning



Methods

Participants: Two sections of Intro Bio I (Bio 141, n=86).

Preparation: At the start of the semester I introduced them to metacognition and Bloom's Taxonomy (Figure 1), discussed the difference between studying and learning, and provided low-stakes opportunities for implementing various metacognitive strategies suggested by McGuire (2015) on their own, including learn-by-teaching. Students completed dynamic modeling activities in small groups in lab, where they explained cellular respiration, photosynthesis, mitosis and meiosis (Figure 2).

Project requirements: The video is 15 minutes or less. Students do not have to show their face, they can just record their screen/slides. The worksheet should be 1-2 pages, with at least 5 open-ended, short answer questions and 3 potential exam questions that could be multiple choice, matching, true/false.

Projected Timeline: Exam 3 (April 11-12) contains the meiosis material. Tutorial projects are being graded and exam question data are being compiled. These exam data will be compared to meiosis questions on the cumulative portion of the final exam (May 9 and May 12). Students will complete an anonymous survey during finals week regarding their perception of the project.

Figure 2 a-c

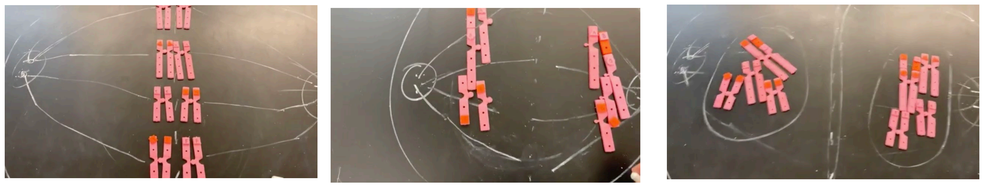


Figure 2 d-f

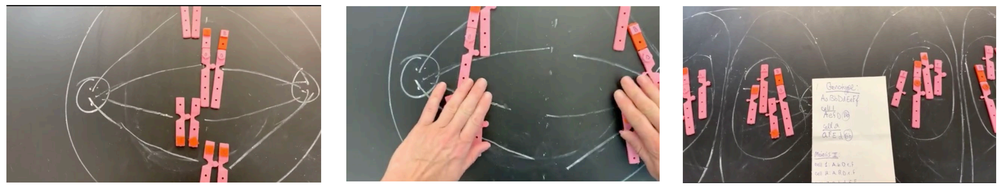


Figure 2 (a-f): Example of meiosis modeling exercise completed in lab. Figures a-c show meiosis I, d-f show meiosis II. Students can replicate this exercise for their tutorial videos.

References

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