Rules of Engagement:

Proceed with Caution when Integrating Multimedia Learning Tools into Existing Course Formats

by

Mary Elizabeth Dawson,Ph.D.

Steven Skinner, Ed.D., and

Arthur Zeitlin, Ed.D.

Department of Biological Sciences

Kingsborough Community College of The City University of New York,

Brooklyn, New York, 11235

Phone: (718)368-5740

E-mail: mdawson@kbcc.cuny.edu

INTRODUCTION

Research indicates that humans have the capability to integrate information from different sensory modalities into a single meaningful experience- such as the way they associate the sound of thunder with the visual image of lightning in the sky. They can also integrate information from verbal and iconic sources into a mental model, such as viewing a video of a process, while listening to a verbal explanation of that process. It therefore becomes the challenge of a successful instructor to choose between different modalities to promote meaningful learning (Moreno & Mayer, 2000).

It has been shown that working memory includes independent auditory and visual working memories (Baddeley, 1986). Furthermore, humans have separate systems for representing verbal and non-verbal information (Paivio, 1986). Finally, meaningful learning occurs when the learner selects relevant information in each memory system, organizes this information, and makes connections between the information in each

system (Mayer, 1997; Moreno & Mayer, 2000). Based on these data, will combining visual and auditory modalities enhance student learning outcomes? Is an effective learning experience one which provides a multimedia approach? Do students learn better when they are presented with traditional laboratory materials in a format which combines a computer enhanced laboratory exercise for visual input, in addition to the traditional hands-on human anatomy and physiology laboratory approach?

In an attempt to address these questions, we conducted a study which compared the learning outcomes of students who had a traditional human anatomy and physiology laboratory experience with those who had, in addition to the traditional approach, free and guided access to a comprehensive human anatomy program, known as A.D.A.M. Briefly, A.D.A.M. is a software tool that utilizes illustrations, x-rays and other images, coupled with on-screen text. Traditionally, human anatomy and physiology laboratories are conducted with some combination of hands-on lab experiences, usually a dissection and the use of slides and models, in conjunction with some lecture component. In the current study, for one cohort we integrated instruction in and laboratory use of a multimedia instructional tool, software known as A.D.A.M,
while the other group simply utilized the existing laboratory exercises.

MATERIALS AND METHODS

Students were randomly selected from a double lecture section of the first semester of a two semester, 4 credit, six hour Human Anatomy and Physiology integrated course. Briefly, the students had the same lecture experience in terms of dates, time of lecture and lecture instructor. One half of the class attended lecture on Monday, from 8:00 – 11:20 am, while the other section attended lab for the same time period on Wednesday.

Students from the Monday lab section (M) and the Wednesday lab section (W) had the same instructor for both the lecture and the laboratory components of the course.

Additionally, labs were conducted in the same format. Basically, the students were introduced to a topic, and then completed a lab exercise using either a model, a dissection, a histological sample, or some combination of the three. Lab quizzes and reports followed the same format for each group. Briefly, laboratory assessments consisted of a minimum of 20 practical items, either on histological or wet preserved specimens, as well as 10 short essay type questions.

In addition to the previously mentioned modalities, the Wednesday lab was given formal instruction in the use of the A.D.A.M. software. Moreover, the instructor provided a guided exercise each week that employed the software, and the students were allowed free access to the software during laboratory session. We then compared the overall performance of each group, as well as their laboratory and lecture grades.

RESULTS

A standard arithmetic mean was calculated for both the Monday and Wednesday lab sections. Separate means were generated for overall course grade (50% lecture + 50% lab), as well as for the laboratory component, and the lecture component alone.

A two-tailed Student's t-test was performed to compare the means for each group, and the results are as follows.

- Lecture averages for the two groups were 80.28 for the group that was using the ADAM software (W,n=18), and 80.44 for those who were not (M,n=17), were not significantly different ($t_{(2,33)}$= 1.67, p>0.01).
- Laboratory averages, 85.35 for the ADAM group (W,n=18), and 92.29 for the traditional group (M, n=17), were significantly different $t_{(2,33)}$=3.62, p<0.01).
- Overall course averages for the ADAM group (W, n=18) for the traditional group (M, n=17), 82.83 and 86.36, respectively, were not significant. $t_{(2,33)}$= 1.55, p>0.01).

TABLE 1.

GROUP	LECTURE AVERAGE	LABORATORY AVERAGE	OVERALL AVERAGE
A.D.A.M.	80.28	85.35*****	82.83
Traditional	80.44	92.29*****	86.36

***** denotes statistically significance

DISCUSSION

We attempted to address the question of whether students would benefit from multiple modality learning. It was hoped that student outcomes would be enhanced if multimedia approaches to learning were introduced into a human anatomy and physiology laboratory course. Much to our surprise, the results were actually the opposite of what we expected.

The group which did not receive any enhanced instruction performed significantly better on assessment outcomes. While these data are contrary to the expected results, there are several logical explanations for these observations. One possibility is that the format in which the narration for the A.D.A.M. visual information was presented was inadequate to produce the expected outcome. Briefly, A.D.A.M. uses on-screen text to describe and define an illustration. It has been suggested that depicting an illustration or animation with a verbal narration is more effective than providing the same explanation as on-screen text (Mayer & Moreno, 1998). Described as the split-attention principle, it appears that students are better able to build referential connections between material when there is corresponding pictorial and verbal representations, since these two representations are in working memory at the same time (Mayer & Moreno, 1998). Since the lab instructor did not provide verbal narration of the A.D.A.M. software, but instead relied on the program's inherent on-screen text, the student's were not utilizing echoic and iconic working memory simultaneously. Perhaps reworking the course to include a

spoken narrative of the A.D.A.M. software might positively influence student outcomes for the A.D.A.M. cohort.

A simpler explanation would be that introducing a new component to the lab portion of the course, without changing the existing time period for the lesson, may have detracted from the time students spent engaging in more traditional laboratory learning modalities, such as dissection and model manipulation. Furthermore, assessment tools, such as practicals and quizzes were not altered to reflect the introduction of a new instructional modality. Therefore, it is highly likely that the existing exam formats were ineffective at assessing student outcomes when presented with a novel learning modality. Finally, one possible explanation is that students simply felt overwhelmed with the addition of the new modality since it required them to learn how to use the new software while integrating it into their lab studies.

Future experiments need to address these issues. It will be interesting to assess if students in the software enhanced group will learn better if the corresponding verbal information is presented auditorially as speech, as opposed to visually as on-screen text (Mayer & Moreno, 1998). Furthermore, if the students are familiarized with the software prior to its utilization in a course setting, prior experience may enable students to employ it more effectively as a way to enhance learning.

In conclusion, the introduction of multimedia tools as a way to enhance student outcomes can be a valuable educational tool. However, instructors should carefully assess the modality and its presentation format before fully integrating it into an existing pedagogical format.

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About the Authors…

Mary Elizabeth Dawson is an Assistant Professor in the Department of Biological Sciences at Kingsborough Community College of The City University of New York (CUNY) in Brooklyn, NY.

Steven Skinner is an Associate Professor in the Department of Biological Sciences at Kingsborough Community College of The City University of New York (CUNY) in Brooklyn, NY.

Arthur Zeitlin is Professor and Chairperson of the Department of Biological Sciences at Kingsborough Community College of The City University of New York (CUNY) in Brooklyn, NY.