

Improving students' comprehension of Biology Labs with Audio-Visual Materials.

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INTRODUCTION

The learning process is complex and it cannot be simply described as a way to incorporate new written knowledge. Human beings elaborate external information through the five senses of the nervous system. The external inputs are processed to build models and patterns of new knowledge in a way that is different for each individual [1]. Audio-visual (AV) materials are very useful to improve general comprehension for the majority of students, especially when delivered before each Biology Lab class.

It is well accepted that the same information should be presented to students in a variety of ways to improve comprehension and learning. The three principles of Universal Design for Learning (UDL) [2] illustrate the importance of presenting class materials in multiple ways to promote students' engagement at different levels of comprehension and stimulate students' interest toward self-learning. Furthermore, the learning process in adults may be more effective when the new concepts retrieve previous background knowledge and/or life experience in each subject [3].

Because of the technological advancements, today's teachers can select interesting AV materials from reliable websites. In this pilot study, educational videos either related to the student's practical laboratory experience or aimed at facilitating comprehension of written scientific topics, were selected for undergraduate biology students belonging to two different level courses. Educational videos last approximately 3 to 15 minutes and could be viewed at any time and location.

Students' response to these preliminary AV Learning [4-5] approaches was evaluated through an anonymous online survey (<http://www.surveymonkey.com/>) [6]. The data revealed that approximately 75% (BIO 2296: 83.4% and BIO 1111: 69.2%) of the students found *Extremely/Very Helpful* the use of educational videos as a method to improve comprehension on a specific subject. The results of this pilot study suggest that AV materials are very useful teaching tools, which should be introduced in Biology Lab class and, perhaps, in all other undergraduate and graduate courses as support to the written material available to students.

REFERENCES

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METHODS

In this pilot study an anonymous survey (<http://www.surveymonkey.com/>) [6] has been freely administered to undergraduate Biology Lab students (individuals are not identifiable). Specifically, the survey that can be completed in approximately 1 to 2 minutes, was sent to two BIO 2296 Genetics (sample size: n=30), and three BIO 1111 *Intro-to-Biology* (sample size: n=60) students at the end of the semester after the final exams. Students were asked to evaluate the usefulness of selected educational videos toward their comprehension of biological concepts and practical Lab activities. They received a Matrix of Choices question/s (One Answer Allowed) and they were asked to rate each item/s based on the following five-point scale: *Extremely Important, Very Important, Moderately Important, Slightly* or *Not Important*. Furthermore, a comment box was also provided to allow students to express their opinion on the selected educational videos.

The AV materials were selected from various reliable online sources including the DNA Learning Center, NASA, YouTube and/or other College/University websites, and could be easily watched by students in 3 to 15 minutes. Moreover, AV material has always been sent on a regular basis before classes thus allowing students to familiarize with the new biological topics and, use it as a studying and reviewing tool before exams.

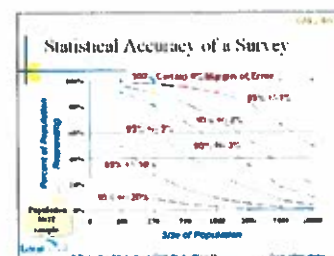
Survey analysis:

Example (Determine Sample Size)
Confidence Level: 95%
Confidence Interval: 25
Population: 250
Sample size needed: 15

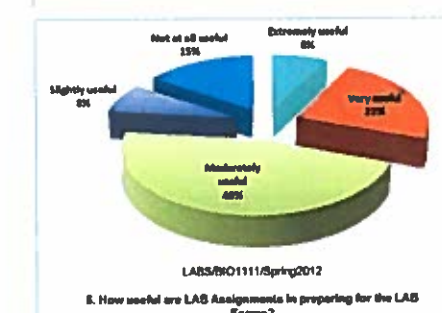
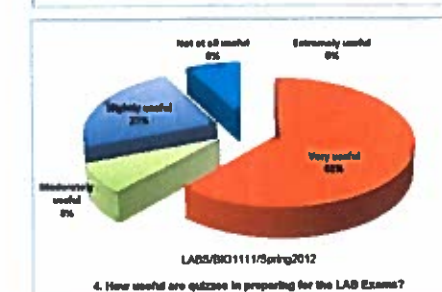
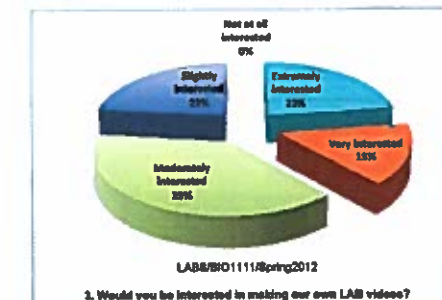
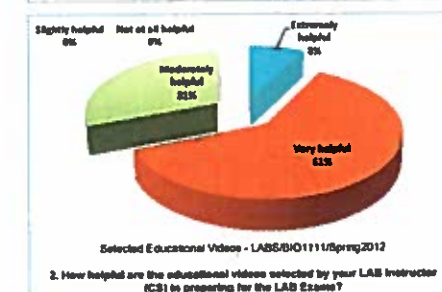
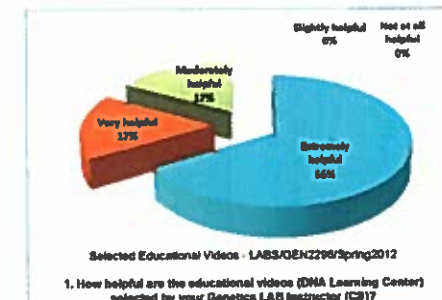
Example (Find Confidence Interval)
Confidence Level: 95%
Sample Size: 15
Population: 250
Percentage: 50 (the worst case percentage)
Confidence Interval: 24.58

The sample size (e.g. n=15) and confidence interval (also called margin of error) has been calculated using the sample size calculator from <http://www.surveysystem.com/sscalc.htm> [7] in order to estimate the number of students needed in each sample that is drawn from a population of few hundred (e.g. n=250) students who usually enroll in those Biology courses. The estimated data are used to evaluate the accuracy of this survey. Furthermore, as previously reported, the test is valid even if the percentage of the students responding to the survey is approximately 5% of the total student population, see table below from Dr. Van Bennekom, *Great Brook, 2010-2011*; http://www.greatbrook.com/survey_statistical_confidence.htm [8].

As the statistical confidence can be estimated using the accuracy chart shown below, the confidence level of this student survey is certain to be of 95% with $\pm 20\%$ accuracy.



RESULTS and DISCUSSION - I



RESULTS and DISCUSSION - II

Anonymous surveys, which can be completed in not more than 1 or 2 minutes, can be very valuable tools to gather useful feedback from students. A survey response rate of 10-20% is considered very common (<http://support2.constantcontact.com/articles/FAQ/2344>) [9] and 20-30% it would be highly successful (<https://www.surveymonkey.com/mp/sample-size/>) [6]. Obviously, responses can vary depending on several factors, which also include the degree of importance given by the student to each specific topic. The response rate (expressed as % of responding students) of this pilot study for both groups (i.e. Genetics and Intro to Biology) is estimated to be very successful as the response rate was ~20%.

The results of the survey for BIO 2296 students are shown in Fig. 1 and 83.4% rated the AV materials as *Extremely/Very Helpful*. Furthermore, I received some very positive comments from the students: 1) "I really thought they helped and every TA should post them" 2) "More videos like these before lab would be a great tool to further conceptualize what we will be doing in lab the next week" 3) "The videos help me to remember the concepts of the lab better. It is also a good introduction to the lab before I start reading about it".

Similar results for BIO 1111 students are presented in Fig. 2 with a rate of 69.2%. Regarding, the BIO 1111 group, I also included in the survey a few extra-questions, asking if students would be interested in making their own videos and how useful were other educational tools used in the course (Quizzes and other Lab Assignments).

I used those extra-questions for comparison on how students rated the usefulness of the AV materials. As shown in Fig. 3, students were not particularly interested in making their own videos, only 38% were *Extremely/Very Interested*. Furthermore, Fig. 4 shows that 61% of the students rated Quizzes *Very Useful* and 0% *Extremely Useful*. Only 30.8% of the students rated the Lab Assignments as *Extremely/Very Useful*, see Fig. 5.

Interestingly, Fig. 4 and Fig. 5 also show that students started to use the *Slightly* or *Not at all* useful choices when rating Quizzes and Lab Assignments, respectively with a percentage of 30.80% and 23.10%. Of note, none of the students (0%) ever used the *Slightly/Not at all* useful choices when rating the questions on AV materials, see Fig. 1 and Fig. 2.

In Conclusion, AV materials may become very useful tools to support scientific written descriptions needed to apply in Biology Lab classes. This pilot study supports the importance of AV Learning [1, 4-5] in consolidating information that is processed through the brain. It also supports the principles of UDL [2] underlying the importance of presenting class materials in multiple ways to promote engagement at different levels of comprehension [3]. Furthermore, a teaching tool that can improve comprehension of the many working college students [10] could bring great benefits in their academic performance. We often teach how we were thought but we can always find new strategies to promote better learning. Introducing new educational tools is also part of informal teaching, which is done by example. Informal teaching can be extremely important in higher education because it could open new doors in the life and career of each student as a valuable member of our society.

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