WORCESTER POLYTECHNIC INSTITUTE

Enhanced Laboratory Learning

Implementing Online Supplemental Material to Increase Student Learning and Retention

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Online supplements to learning are being researched extensively as a technique to aid in student learning. The goal of this project was to generate instructional videos of biology lab techniques. The created videos were posted online, allowing students to access them before, during, or after laboratory sessions. Adobe Premiere CS4 was utilized to create and edit video clips prior to their uploading online. Students were surveyed at the completion of the laboratory to determine if the videos were helpful as a learning aid. Collected survey data were statistically analyzed and suggest addition of online videos as supplements to biology labs increased the knowledge and retention of concepts and techniques. Improved surveys and statistical analysis could be used in future projects to gain an in depth understanding of the benefits of online learning.

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Introduction

With the increased complexity of college biology laboratories, external assistance during the labs could prove helpful. Currently, biology labs focus on mastering intricate and often confusing techniques and skills that enable students to obtain expected result. Many students enter these lab periods without previous knowledge of necessary techniques and/or skills, and therefore must learn them while completing the lab. Adaptive learning can be beneficial for some; however, giving students more opportunity to learn and understand the concepts prior to entering the lab could increase the amount of information learned and retained by the students. There have been a number of studies concluding that interactive or collaborative learning via online pictures or videos, increase the productivity quality of the work. Generally, studies by Suthers et al. (2007), Stahl et al. (2006), and Campos et al. (2003), have concluded that collaborative learning with online resources such as videos increased the success of the students in the lab period.

As no current system is available to the biology lab students at WPI, the goal of this project was to generate instructional videos that will aid in the successful completion of the associated lab. The biology labs at WPI often have a lab background information handout along with a lab protocol that is followed during the lab period. While the protocol explains how to execute each procedure, a student may not completely understand it, therefore, making it difficult to replicate correctly. This textual learning is a common method of teaching, however, better learning is promoted when textual learning is coupled with online collaborative learning, such as with video tutorials (Stahl, 2006). With the addition of videos that show, not tell the student how to complete a procedure, students should have more success during the lab period, and generate more accurate results.

Background

Visual graphics vs. text

Suthers et al. (2007) evaluated the effectiveness of using interactive electronic collaborative learning methods as compared to standard learning from the text. (Suthers, 2007) Their conclusions reinforce the importance of having representational aids as well as dynamic notations, and simulations for individual problem solving to take place (Suthers, 2007). Results of this study suggest that "more knowledge construction takes place when interaction is supported by conceptual representations" (Suthers, 2007).

For example, in a controlled study with two groups, one of which was learning the material via text, while the other group was learning the same material by graphical and visual representation, the graphical group demonstrated substantially better results in all learning categories including the speed at which learning was completed (Suthers, 2007). Students with access only to textual representation of the information recorded the information, even in the absence of full and complete understanding of the material.

On-line/collaborative learning

Collaboration has also been shown to occur the most efficiently with participants who work at the same level to accomplish a common goal. (Campos, 2003) This study concluded that online collaborative learning was substantially more effective than learning via a text. In a study by Koc et al. (2006), surveys were completed by a class of students that were taught material through an online collaborative source. When asked about the usefulness of the learning method, over three-fourths of the students replied that more material was learned and retained via the online method. One useful aspect of having visual information in comparison to textual information is that problem solving can be completed in a smooth and effortless way because the student can gain visual confirmation of data necessary for determining the answer without having to search the entire document for a certain keyword (Larkin, 1987).

A study by Aviv et al. (2003) examined how students build on each other's contributions to the understanding of the material (Aviv, 2003). They concluded that students often work best together when they are not pressured by the instructor. When students are set free to develop cliques within their own group in order to complete a task, the success rate has been shown to be higher (Aviv, 2003).

Another study concludes that when comparing face-to-face learning and online learning, there is a clear difference in the effectiveness between the two. Face-to-face or typical classroom learning was shown to result in less learning than the online collaborative learning because the online learning allowed the students to collaborate with each other, resolving conflicts that arose (Roschelle, 1992). Similarly, Hiltz et al. (2005) concluded that "Face-to-face courses skillfully blended with online learning technologies and methodologies are generally rated by students as significant improvements over traditional face-to-face classes" (Hiltz, 2005). In a computer science course where half of the students were taught via face-to-face learning, while the other half utilized online resources to learn, students concluded that the best method of learning was to first use the online resources, and follow up with face-to-face discussion with the instructor (Figl, 2006).

Riffel et al. (2005) analyzed the differences between a hybrid and traditional biology lab. The hybrid lab encompassed both face-to-face lecture and online-based learning. The traditional lab had no online component. Results from both courses show that the hybrid lab helped students with different knowledge bases become more homogeneous in their knowledge by the end of the lab. The most positive impact involved the inexperienced biology students in the hybrid lab, who demonstrated more information learning and retention, verses the similarly prepared students in the traditional lab (Riffel, 2005).

Online learning does not directly involve the instructor, therefore, the students must rely more on the online sources to compensate for the absence of face-to-face modes of communication. This reliance was shown to force the students to ensure comprehension of the material and resulted in a larger amount of the material being retained (Suthers, 2003).

Evans (2008) describes one instance where college students in the sciences took advantage of the supplemental online resources such as video tutorials and podcasts, Students that used the online resources had more success learning and retaining information than students who did not. Indication was also made that the online learning was completed with more efficiency than similar learning using a textbook, or other written material. Over 70% of the students that took place in this study concluded that the online multimedia method of learning and reviewing was far more useful and successful than similar learning done using conventional textual methods.

Study design

The following studies support our hypothesis that online material, especially material that is presented in a graphical or video format, will increase the amount of information that is learned and retained throughout the lab. The main goal of this project is to determine whether or not students that used the online videos learn and retain more knowledge of the lab techniques than the students that did not use the videos. Our ability to do so is based on the expectation that not all students will view the supplemental videos available online. To test our hypothesis, towards the end of the class data will be collected and analyzed.

To analyze the success rate of the videos, various surveys will be given to the students in the lab course. Initially, these surveys will ask the students whether or not they viewed/used the online videos to aid with the completion of the lab techniques. By grouping the students into two groups, (who did and didn't use the videos) it will then be possible to compare and analyze their responses to survey questions designed to determine the relative ease with which the lab was completed, along with other questions designed to determine the educational success of the videos. This assessment plan will be described in detail in the methods section, and will be used to determine the usefulness of the online video tutorials.

Materials and Methods

Materials:

1. Lab Manuel Human Anatomy and Physiology: **A Dissection Guide & Atlas to the Fetal Pig 2nd Edition** by David G. Smith & Michael P. Schenk.
2. Adobe Premier Video Editing Software Creative Suite Version 4.
3. Digital Video Camcorder, capable of digital upload and editing: CAMERA USED:
4. All necessary laboratory equipment for setting up, completing, and cleaning all lab experiments.
5. One 80GB External Hard Drive.
6. Access to a suitable laboratory to complete experiments.
7. Necessary cables and hardware for transferring data from the video recorder to the computer, and, once the video is completed, online or to a disk.
8. CD's for coping the video.
9. All equipment located inside WPI's Edit Suite.

Methods:

1. Prior to the start of filming of each lab, the camera, tripod, docking station, and necessary cables were obtained from WPI's Academic Technology Center (ATC).
2. All necessary preparations were made for the filming of the lab: the camera system and all other necessary equipment for completing the lab were set up.
3. The camera recorded video clips of many lab procedures which comprised the entirety of the lab, these lab procedures were completed by an expert.
4. When the filming was complete, the files saved on the camcorder were transferred to an external Hard Drive.
5. Prior to transferring the video files onto Adobe Premiere Creative Suite Version 4, a software tutorial workshop was completed with ATC employee Jim Monaco. This allowed the group to understand how to use the Adobe editing software.
6. Laboratory video files were transferred to the computer equipped with the Adobe software via USB cables and the camcorder's docking station.
7. The files were uploaded into the software's editing studio chronologically.
8. The editing process:
    a. Video clips were organized chronologically in the editing software.
    b. As the original clips were often lengthy and included unnecessary footage, the unnecessary or lengthy parts were removed.
    c. Between different clips, a blurring transition piece was added, to best mimic professional videos.
    d. When necessary, labels were added to point out important parts of the clip.
    e. When the editing was complete, narration was added to the video. The narration was added using the microphone available in the WPI edit suite. The Adobe Premier software was used to add narration to the videos. This narration guides the viewer through the video, pointing out certain strategies and tips that aid in the completion of the lab.
9. Once the final product was complete on the Adobe software, the file was converted to two file formats; .wmv and .mp4 and posted on a server on WPI's website so that they can be accessed by students.
10. A CD of the video was also created, such that a hard copy could be retained by the professor.
11. Students registered for labs with available videos were encouraged to view the available videos.
12. At the end of the class, the students were surveyed about the helpfulness of the videos. A sample survey is seen below in Figure 4. The results of the survey will allow for conclusions to be drawn as to whether or not the videos benefited the students. The survey contained 15 multiple-choice questions each with 4 possible responses; "strongly agree", "agree", "disagree", and "strongly disagree".
13. For each question, a Chi Squared Test was completed. A Chi Square Test determines the statistical significance of actual data compared to normal data. The responses to each survey question are the actual data that was used in the Chi Square Test. Normal data was considered to be data that had no trend. In the case of "Question 1" (See below in Figure 1) there were 86 total responses. Completely random or normal data would result in each of the four responses receiving 21.5 votes (obviously, this isn't possible; however, the number is simply a statistical place holder, not actual data). This number is known as the theoretical frequency. A Chi Square

Test comparing the actual values and the theoretical frequency value result in a P-value. If the P-value is less than 0.05, the two sets of data are considered statistically different. If the theoretical frequency data has zero trends, then the actual data must have trend, if the P-value is less than 0.05. Another assumption made during the analysis is that there are 3 degrees of freedom in the Chi Square calculation. This is calculated by totaling the number of possible responses (4) and subtracting 1, as a certain response must fall in one of the four categories. Therefore, there are 3 degrees of freedom in the calculation. The resulting Chi Square P-values with 3 degrees of freedom were calculated in the results section above for each of the survey questions.

14. The students were offered compensation in the form of candy bars for answering the questionnaire.

The videos were edited in Adobe Premiere Creative Suite Version 4 software. An example, seen below in Figure 1 depicts a typical screen of the screen shot of the editing software. In this figure, the bottom box depicts the panel that contains the sequences of clips with the necessary video timelines. The small box to the bottom right of the screen consisted of all editing tools needed to compile the final video that was then distributed to the students

Figure 1 – A screenshot of the pig dissection video project in an Adobe CS4 window.

Seen below in Figure 2, is a screen shot of a labeled instance of a pig dissection video from BB2903. The labeling was completed with a tool built into the Adobe software, and then integrated into the timeline as appropriate. This labeling appropriately exemplifies the important parts of the videos for the students. Finally, Figure3 shows a screenshot from the cricket lab for BB 2904, and the label is shown to highlight the difference between a male and a female cricket.

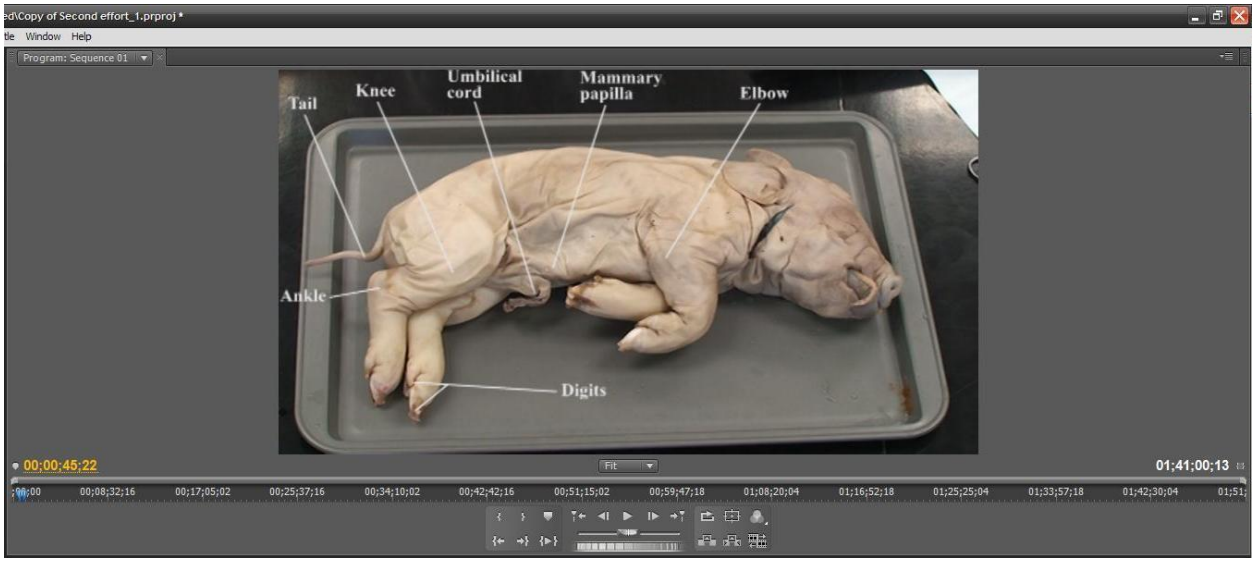


Figure 2 – An Adobe Premiere CS4 screenshot of a labeled fetal pig.

Finally, Figure 3 below shows a screenshot from the cricket lab for BB 2904, and the label is shown to highlight the difference between a male and a female cricket. Notice the appropriate positioning and color of the label such that it is readable for the student.

Figure 3 – A screenshot of a part of the video for a cricket lab.

Seen below in Figure 4 is the survey that was given to the students at the end of the lab class. The student's responses to this survey will allow for conclusions to be drawn about the effectiveness of the videos.

BB2903 Survey for Videos and Animations

Please indicate whether you strongly agree, agree, disagree, or strongly disagree with the following statements:

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. I watched the videos prior to coming to lab	□	□	□	□
2. I felt that the videos aided me in effectively completing the current lab	□	□	□	□
3. I learned and retained more information about the lab procedures by watching the videos	□	□	□	□
4. I was more comfortable performing in lab after watching the associated videos	□	□	□	□
5. The audio associated with the videos were spoken clearly	□	□	□	□
6. I always attended the lecture	□	□	□	□
7. The appearance of Gompei enhanced my interest in the videos	□	□	□	□
8. The presence of Gompei helped me remember the lab protocol more	□	□	□	□
9. The videos were helpful as a supplement	□	□	□	□
10. The videos were unnecessary	□	□	□	□
11. This video technology should be implemented in other biology labs at WPI	□	□	□	□
12. The background music in the animated Video is distracting	□	□	□	□
13. The computer voice, Alex, is audible/clear.	□	□	□	□
14. The animated videos were easier to watch. Than just video demonstrations	□	□	□	□

15. Have you taken other BB 290X labs? Yes No
    If yes, which ones have you taken? Circle all that apply. 2901 2902 2904
    Did you require less assistance from the TA's after watching the videos than in previous 2900 labs? Yes No

Short-Answer Questions:

1) What did you particularly like about the videos?

2) What did you particularly dislike about the videos?

3) Any suggestions for future videos? Something you would have liked to see?

4) Are there any videos you feel would be better understood as an animated video (or vice versa)

5) What do you think the video helped more; quizzes, laboratory reports, or understanding and retaining material?

6) What grade do you expect to receive in this class?

A B C NR

7) Other Comments?

Figure 4: Survey given to the students who were capable of using the online videos

Results

Seen below are the results of the survey questions that were asked of the BB 2903 class during the final day of the lecture period. Only the questions pertaining to the hypothesis were included below.

For each question, the total responses were tallied for each of the four possible responses. A total number of responses for each survey question are shown below for each question. (In some cases, this number varies from question to question due to student's lack of response to every question.) A simple bar graph was created for each question, displaying the number of responses against the possible responses.

Analysis of all of the questions seen below in Figure 1-17, displays a trend of positive response. Inferring such a conclusion from each graph is possible, however to ensure correct analysis, a Chi Squared Test was completed for each question. A Chi-squared test determines if the responses to each survey question are meaningful, and not just randomly chosen by the students. Random responses would result in each of the 4 possible choices having an equal number of responses.

If the P-value generated from the Chi-Squared test is less than 0.05, then the responses are considered meaningful, and therefore not random. If such a trend in the data exists, inference towards the survey question can be completed.

Question 1:

Question: “I watched the videos prior to coming to lab”

Response:

Strongly agree	Agree	Disagree	Strongly disagree	Total
13	45	18	10	86

Seen below in Figure 1 is a bar graph of the class responses to Question 1 above. The number of students responding to each of the four options is shown below.

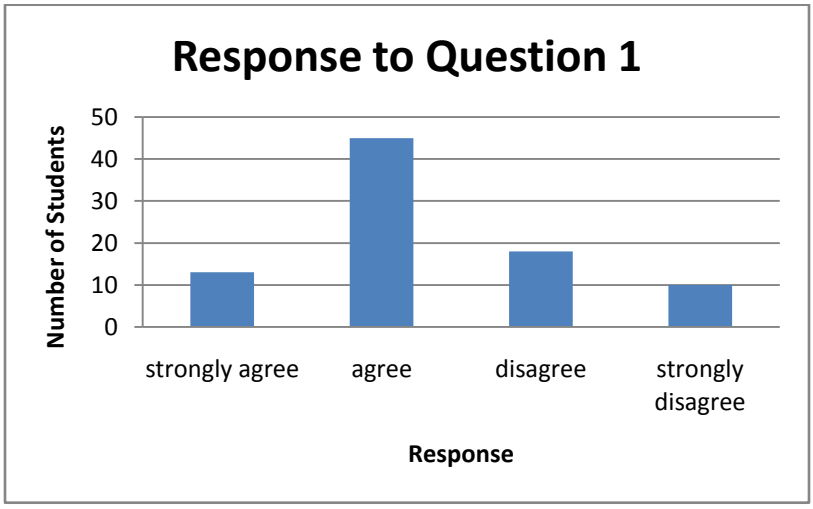


Figure 5: Question 1 Data

Results of Chi Square Test: $P=8.39*10^{-8}$

Seen below in Figure 2 is a bar graph of the combined “strongly agree and agree” and “strongly disagree and disagree” responses of Figure 1 above. The percentage of students responding with an “agree” or “disagree” response is shown below.

Response:

Agree	Disagree
67%	33%

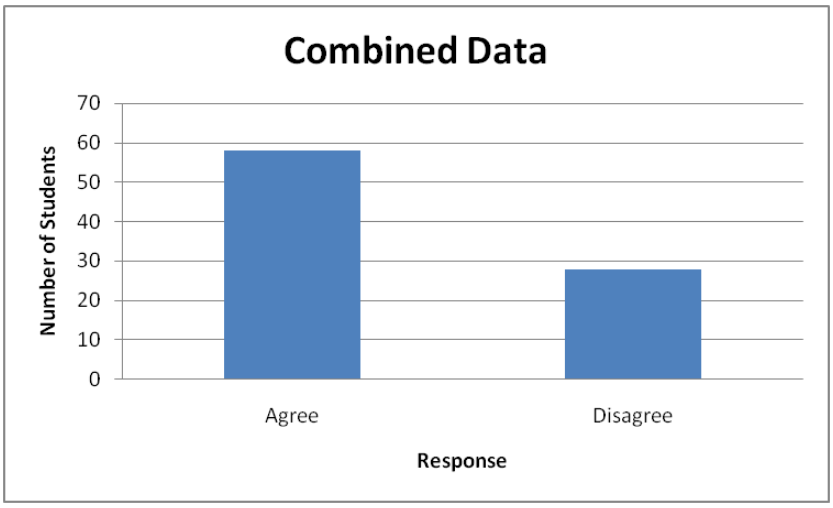


Figure 6: Question 1 Combined Data

Results of Chi Square Test: P=0.00121649

Question 2:

Question: “I felt that the videos aided me in effectively completing the current lab”

Response:

Strongly agree	Agree	Disagree	Strongly disagree	Total
31	44	8	3	86

Seen below in Figure 3 is a bar graph of the class responses to Question 2 above. The number of students responding to each of the four options is shown below.

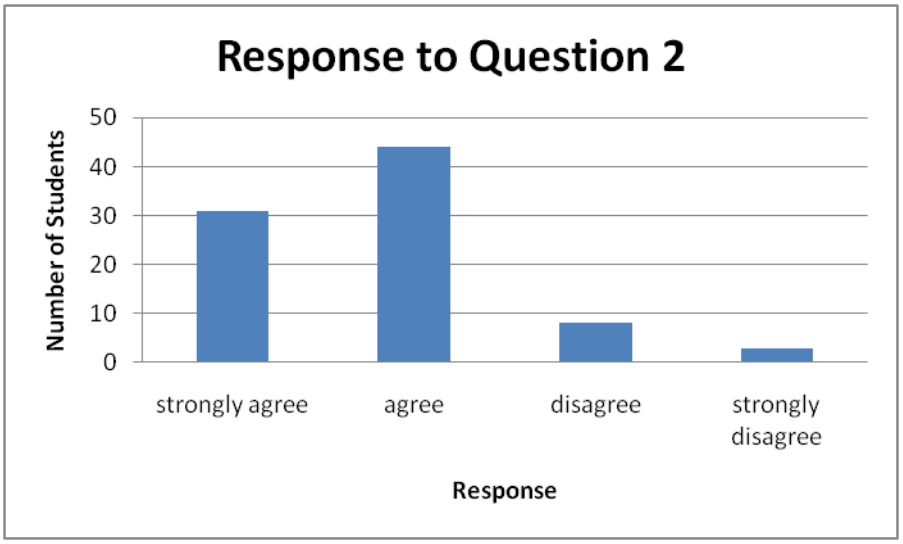


Figure 7: Question 2 Data

Results of Chi Square Test: $P=2.80*10^{-11}$

Seen below in Figure 4 is a bar graph of the combined "strongly agree and agree" and "strongly disagree and disagree" responses of Figure 3 above. The percentage of students responding with an "agree" or "disagree" response is shown below.

Response:

Agree	Disagree
87%	13%

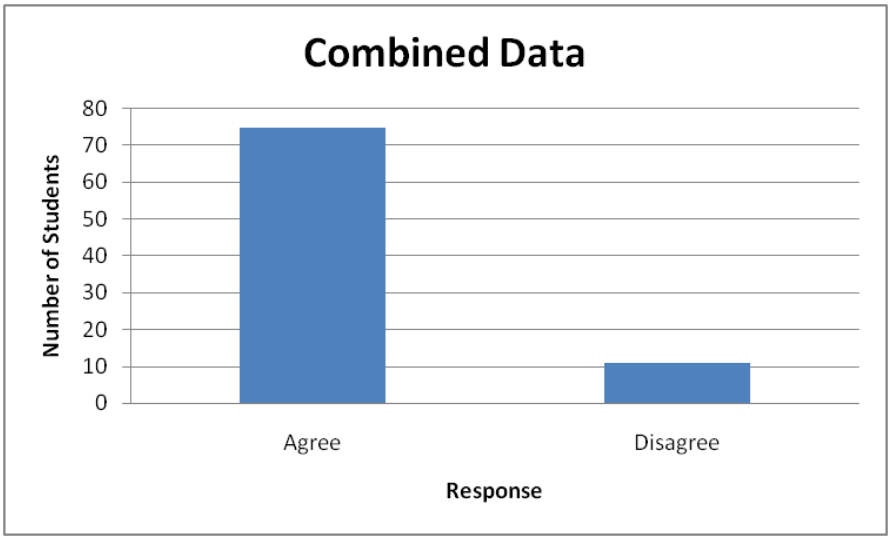


Figure 8: Question 2 Combined Data

Results of Chi Square Test: P=5.15297E-12

Question 3:

Question: “I learned and retained more information about the lab procedures by watching the videos”

Response:

Strongly agree	Agree	Disagree	Strongly disagree	Total:
24	47	15	1	87

Seen below in Figure 4 is a bar graph of the class responses to Question 3 above. The number of students responding to each of the four options is shown below.

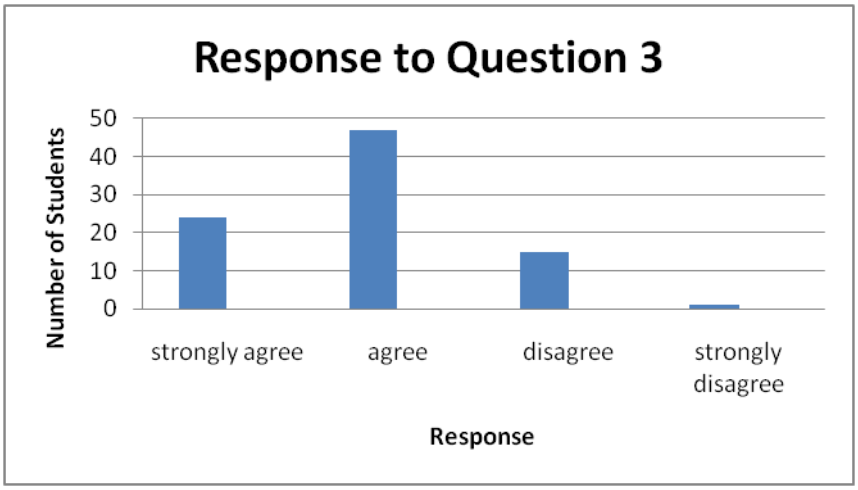


Figure 9: Question 3 Data

Results of Chi Square Test: $P=3.95*10^{-11}$

Seen below in Figure 5 is a bar graph of the combined "strongly agree and agree" and "strongly disagree and disagree" responses of Figure 4 above. The percentage of students responding with an "agree" or "disagree" response is shown below.

Response:

Agree	Disagree
82%	18%

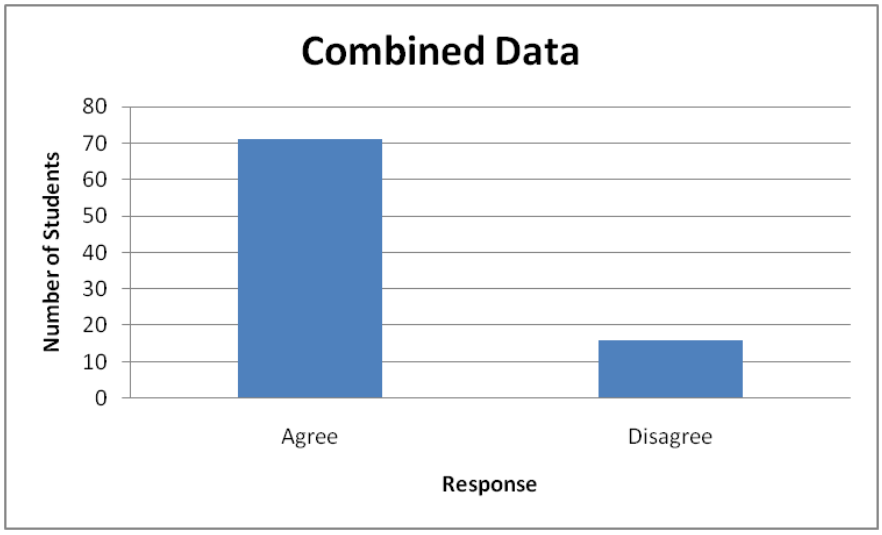


Figure 10: Question 3 Combined Data

Results of Chi Square Test: P=3.71025E-09

Question 4:

Question: "I was more comfortable performing in lab after watching the associated videos"

Response:

Strongly agree	Agree	Disagree	Strongly disagree	Total:
33	38	13	3	87

Seen below in Figure 6 is a bar graph of the class responses to Question 4 above. The number of students responding to each of the four options is shown below.

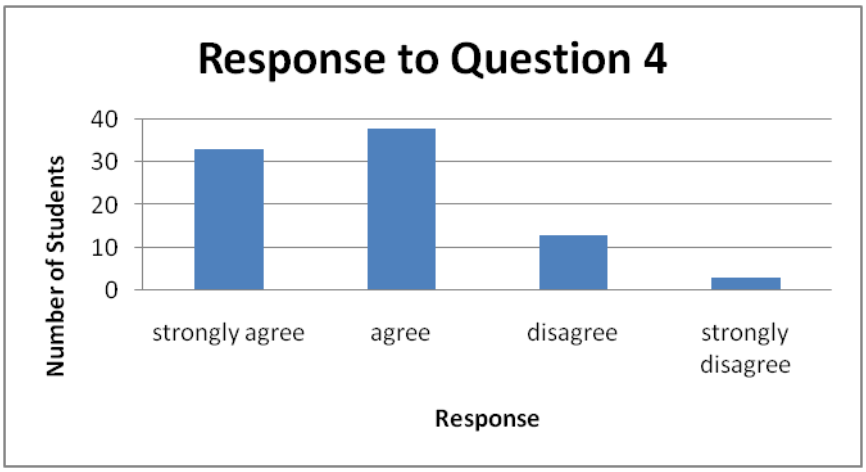


Figure 11: Question 4 Data

Results of Chi Square Test: $P= 3.36*10^{-8}$

Seen below in Figure 7 is a bar graph of the combined "strongly agree and agree" and "strongly disagree and disagree" responses of Figure 6 above. The percentage of students responding with an "agree" or "disagree" response is shown below.

Response:

Agree	Disagree
82%	18%

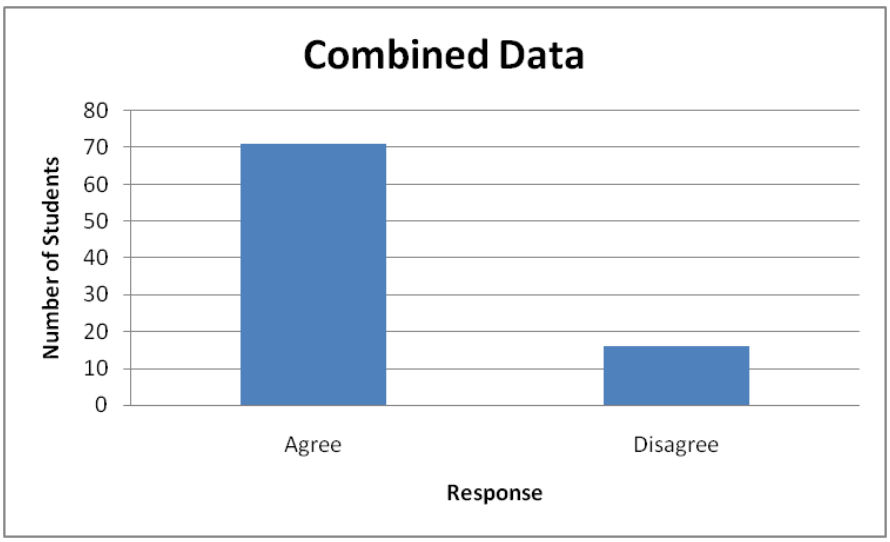


Figure 12: Question 4 combined Data

Results of Chi Square Test: P=3.71025E-09

Question 5:

Question: “The audio associated with the videos were spoken clearly”

Response:

Strongly agree	Agree	Disagree	Strongly disagree	Total:
39	44	4	0	87

Seen below in Figure 8 is a bar graph of the class responses to Question 5 above. The number of students responding to each of the four options is shown below.

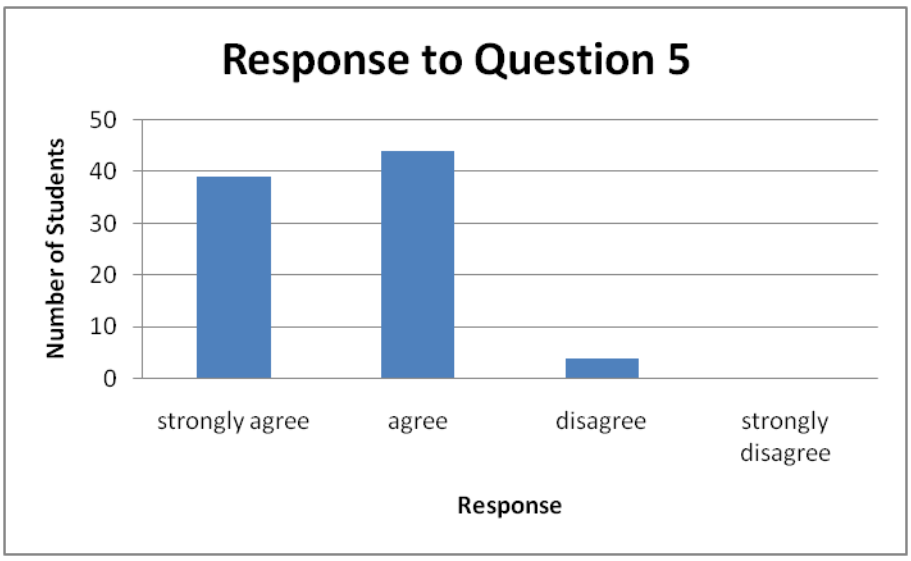


Figure 13: Question 5 Data

Results of Chi Square Test: $P=1.14*10^{-14}$

Seen below in Figure 9 is a bar graph of the combined "strongly agree and agree" and "strongly disagree and disagree" responses of Figure 8 above. The percentage of students responding with an "agree" or "disagree" response is shown below.

Response:

Agree	Disagree
95%	5%

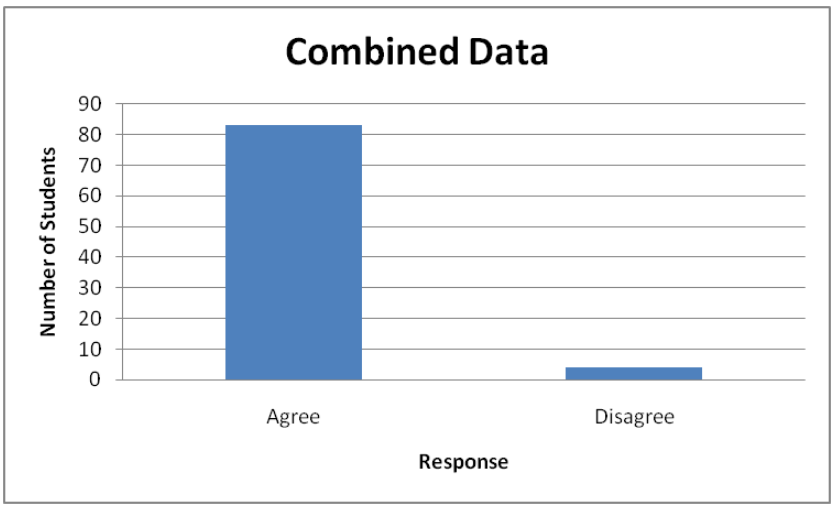


Figure 14: Question 5 Combined Data

Results of Chi Square Test: P=2.46E-17

Question 6:

Question: “I always attended the lecture”

Response:

Strongly agree	Agree	Disagree	Strongly disagree	Total:
37	23	20	7	87

Seen below in Figure 10 is a bar graph of the class responses to Question 6 above. The number of students responding to each of the four options is shown below.

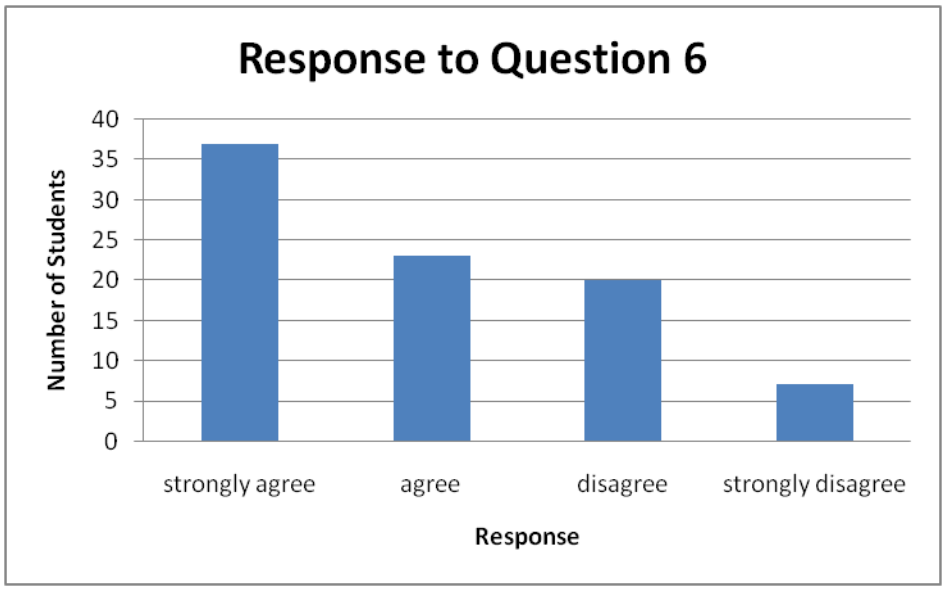


Figure 15: Question 6 Data

Results of Chi Square Test: P=0.0001.

Seen below in Figure 11 is a bar graph of the combined "strongly agree and agree" and "strongly disagree and disagree" responses of Figure 10 above. The percentage of students responding with an "agree" or "disagree" response is shown below.

Response:

Agree	Disagree
69%	31%

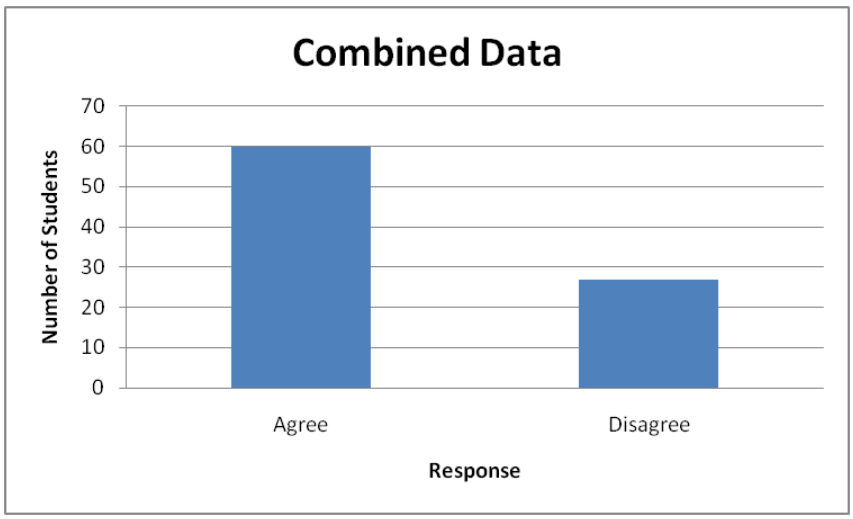


Figure 16: Question 6 combined Data

Results of Chi Square Test: P=0.000403

Question 9:

Question: “The videos were helpful as a supplement”

Response:

Strongly agree	Agree	Disagree	Strongly disagree	Total:
32	48	4	0	84

Seen below in Figure 12 is a bar graph of the class responses to Question 9 above. The number of students responding to each of the four options is shown below.

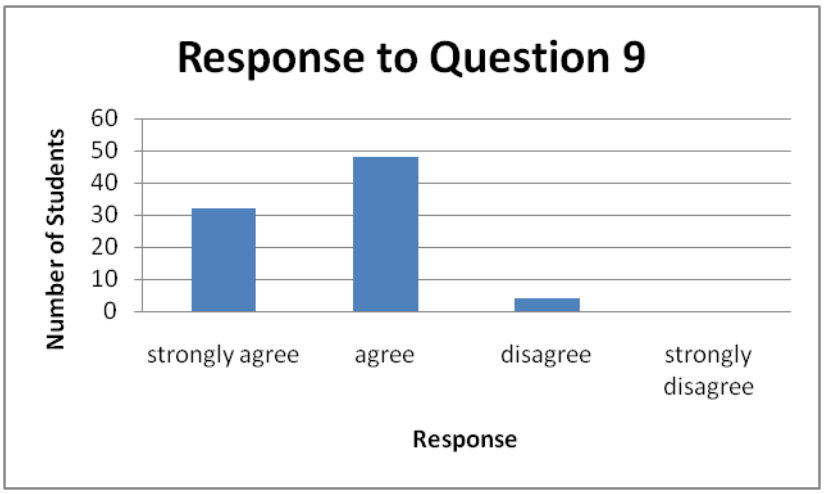


Figure 17: Question 9 Data

Results of Chi Square Test: $P=3.22*10^{-16}$

Seen below in Figure 13 is a bar graph of the combined "strongly agree and agree" and "strongly disagree and disagree" responses of Figure 12 above. The percentage of students responding with an "agree" or "disagree" response is shown below.

Response:

Agree	Disagree
95%	5%

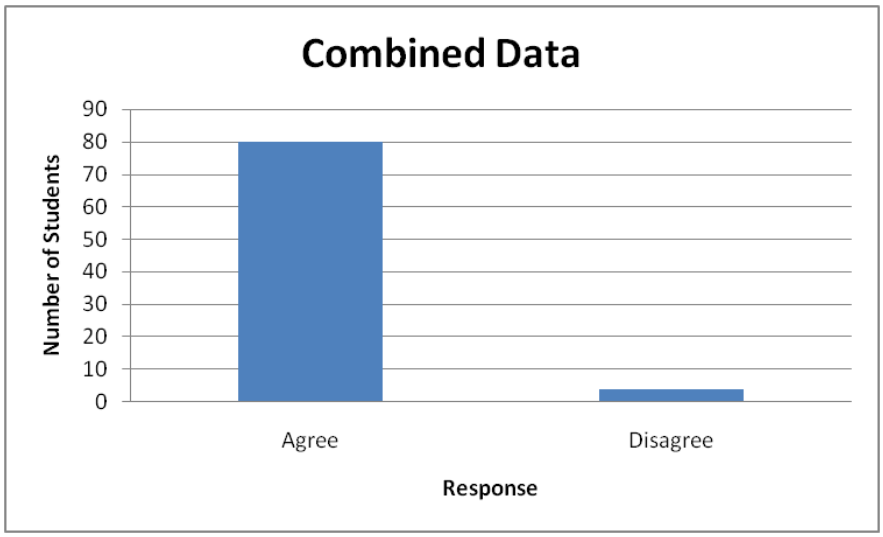


Figure 18: Question 9 combined Data

Results of Chi Square Test: P=1.11098E-16

Question 10:

Question: “The videos were unnecessary”

Response:

Strongly agree	Agree	Disagree	Strongly disagree	Total:
3	10	39	34	86

Seen below in Figure 14 is a bar graph of the class responses to Question 10 above. The number of students responding to each of the four options is shown below.

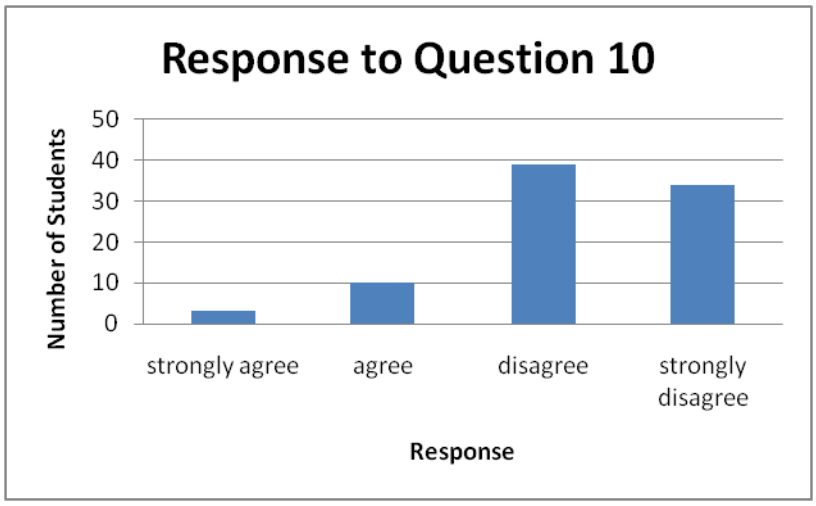


Figure 19: Question 10 Data

Results of Chi Square Test: $P=1.85*10^{-9}$

Seen below in Figure 15 is a bar graph of the combined "strongly agree and agree" and "strongly disagree and disagree" responses of Figure 14 above. The percentage of students responding with an "agree" or "disagree" response is shown below.

Response:

Agree	Disagree
15%	85%

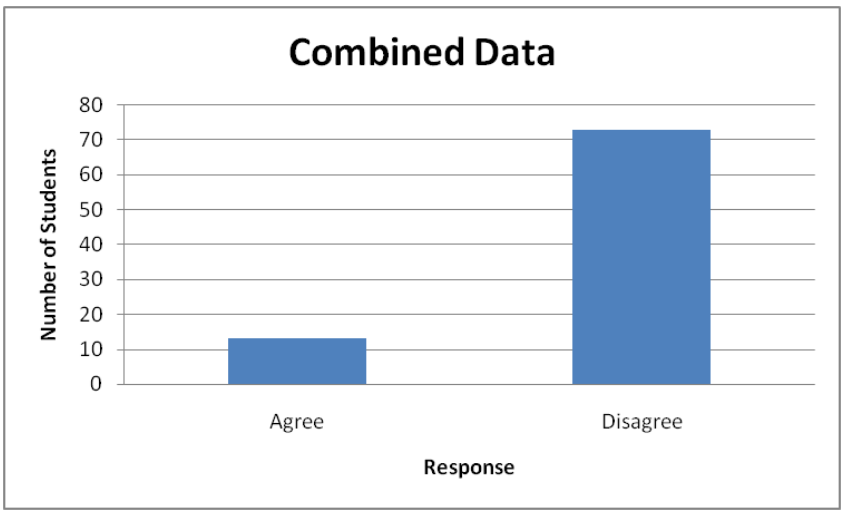


Figure 20: Question 10 Combined Data

Results of Chi Square Test: P=9.80247E-11

Question 11:

Question: “The video technology should be implemented in other biology labs at WPI”

Response:

Strongly agree	Agree	Disagree	Strongly disagree	Total:
26	55	4	1	86

Seen below in Figure 16 is a bar graph of the class responses to Question 11 above. The number of students responding to each of the four options is shown below.

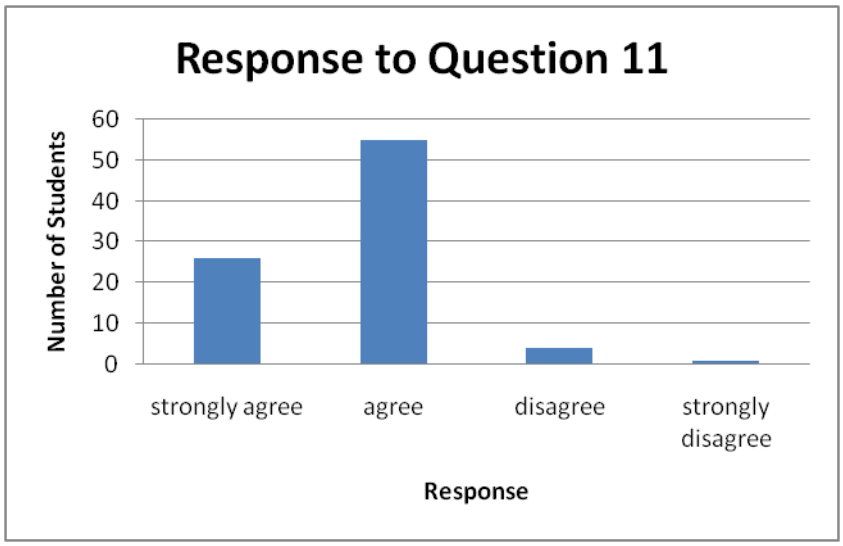


Figure 21: Question 11 Data

Results of Chi Square Test: $P=3.26*10^{-18}$

Seen below in Figure 17 is a bar graph of the combined "strongly agree and agree" and "strongly disagree and disagree" responses of Figure 16 above. The percentage of students responding with an "agree" or "disagree" response is shown below.

Response:

Agree	Disagree
94%	6%

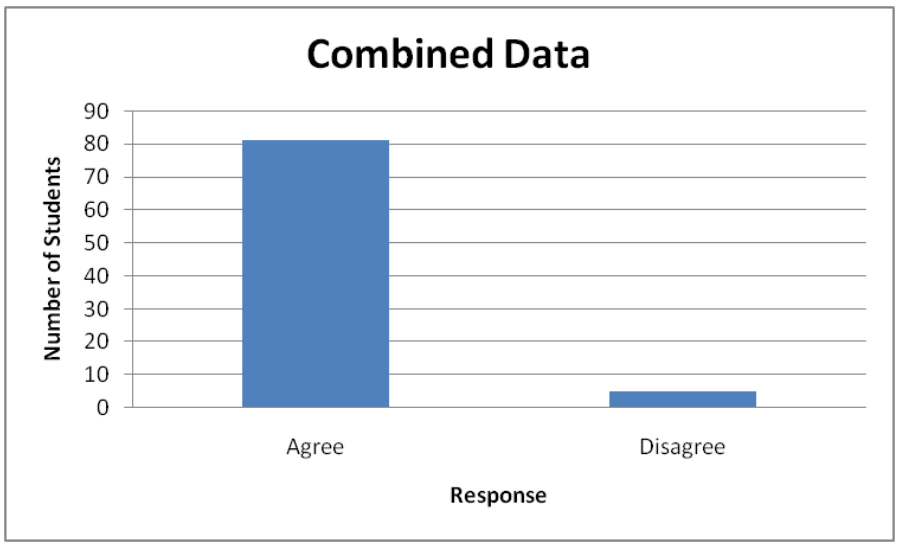


Figure 22: Question 11 combined Data

Results of Chi Square Test: P=2.49988E-16

Grade Data for BB2903

Seen below in Table 1 are the resulting grades for BB 2903 over the past 5 years. The grades are distributed over the 4 possible options, A, B, C, and NR for each year.

Table 1 – Data of grades from past years

	2005*	2006	2007	2008	2009
# of A's	17	23	50	28	43
# of B's	11	26	8	22	26
# of C's	4	5	3	8	15
# of NR's	4	4	5	13	14
Total	36	58	66	71	98

*Note: For the year 2005, there were question marks after some grades, so those were counted to be the grade that that was indicated in the cell and one C/NR was taken as a C.

Seen below in Table 2 are the percentages of the students who received each grade for the past 5 years.

Table 2 – Data of grades from past years in terms of percentage

	2005*	2006	2007	2008	2009
% A's	47%	40%	76%	39%	44%
% B's	31%	45%	12%	31%	27%
% C's	11%	9%	5%	11%	15%
% NR's	11%	7%	8%	18%	14%

Seen below in Figure 18, is a bar graph representing the percent of students who received certain grades over the past five years. The distribution is split up by year, with a particular color representing a certain grade.

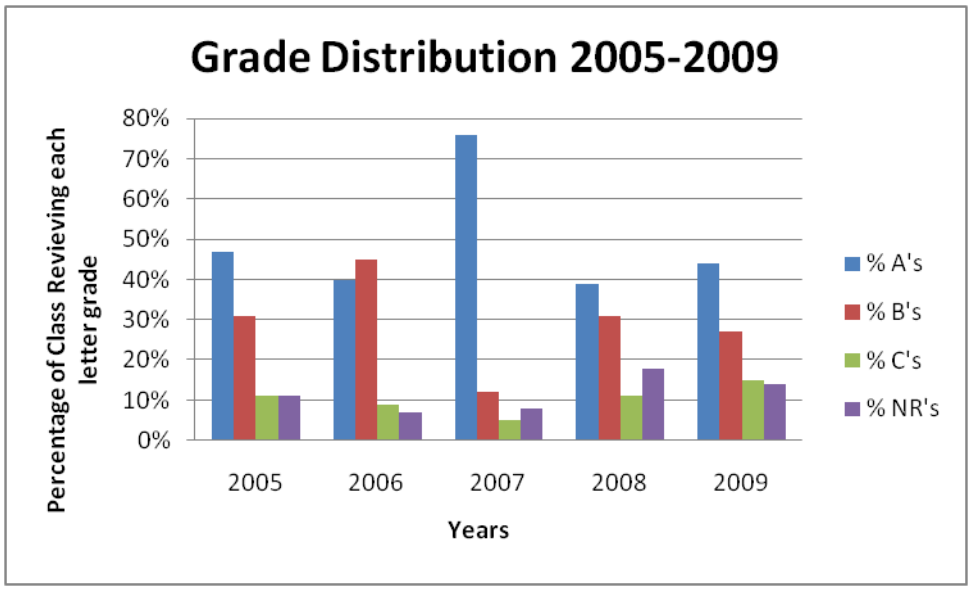
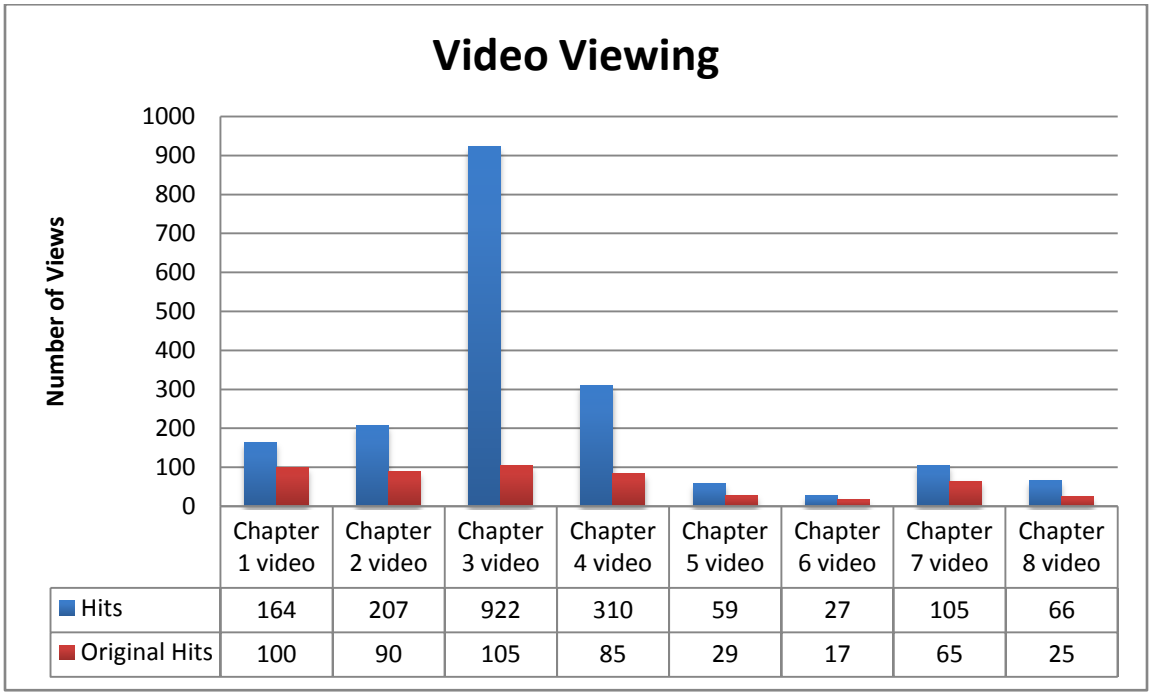


Figure 23: Previous Grades

As can be seen from Table 2, 39% of students received an A in the class in 2008, whereas 44% of the students received an A in the class in 2009. This shows an improvement of 5% from 2008 to 2009. However, it is important to take into consideration that the size of the class has varied from year to year. Also, the teaching assistants and grading rubric have been modified from year to year, meaning that different criteria and grading styles could contribute greatly to the outcome of the grades of the students. Finally, it was concluded that the data from Table 1, Table 2 and Figure 18 might not be the most viable to judge the impact of the videos on the performance of the students. The data, however, does give a trend of grades over the past four years and might help in seeing some improvement in grades due to the videos that can be supported by other data obtained from surveys. External circumstances, such as varying Teaching Assistants, ever-changing protocols and grading rubrics limit the trends seen in this data, however, as a result of the videos; there was a slight improvement of the average grade in the class.

In regards to how many students actually watched the videos, Figure 19 below gives a breakdown of each chapter in the laboratory and how many students viewed the videos. To be completely accurate, the number of original hits was also recorded. This can truly convey how many students viewed the videos, not counting multiple visits from one user.



	Chapter 1 video	Chapter 2 video	Chapter 3 video	Chapter 4 video	Chapter 5 video	Chapter 6 video	Chapter 7 video	Chapter 8 video
Hits	164	207	922	310	59	27	105	66
Original Hits	100	90	105	85	29	17	65	25

Figure 24: Video Viewing Counts

From Figure 19 it is clear that the Chapter 3 video was viewed the most. From this fact it can be assumed that this Chapter was the most difficult in regard to laboratory techniques. Even though out of 922 views there were only 105 individual users, which further proves that it was difficult, because even after seeing the video once the students had to return to the video and view it again. On the other end of the spectrum Chapter 6 is assumed to be the easiest chapter in terms of laboratory techniques because it had the least amount of total views as well as original views. On a whole though, the videos were actually utilized by the students, some more that another's, but all were watched. In terms of the data collected, that means that the students could accurately answer the survey questions since that had viewed the videos.

Seen below are the hyperlinks necessary for accessing all of the videos that were created during this project. The videos created for the pig dissection lab were lengthy; therefore, they were split up into the chapters that the dissection guide follows. Dividing the large video also made it easier for the students to view only one specific component of the dissection at a time.

The link format used to put all the lab videos on the server was:

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2903/NAME OF FILE HERE

Links of the video chapters for the pig dissection lab in BB2903:

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2903/Pig_dissection_Chapter1.wmv

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2903/Pig_dissection_Chapter2.wmv

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2903/Pig_dissection_Chapter3.wmv

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2903/Pig_dissection_Chapter4.wmv

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2903/Pig_dissection_Chapter5.wmv

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2903/Pig_dissection_Chapter6.wmv

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2903/Pig_dissection_Chapter7.wmv

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2903/Pig_dissection_Chapter8.wmv

Links for lab videos for BB 2904:

http://media.wpi.edu/Academics/Depts/Bio/ConnectedLab/BB2904/Crickets_Lab.wmv

Discussion

The P-values for each of the survey questions in the results section were below the cutoff of 0.05. Therefore, there is a statistical trend in each of the survey questions. It is possible to infer conclusions about these trends by analyzing the bar graphs which show the response distribution for each question. This analysis and inference of the collected survey responses are explained in depth below.

The first question, “I watched the videos prior to coming to lab”, was designed to find out whether the students made use of the videos outside of lab. It was noted that the majority of the students “Agreed”, meaning that they watched the videos prior to lab almost every time. It was assumed that the students who “Agreed” to the question watched the videos prior to lab at least 50% of the time and students who “Strongly Agreed” watched the videos often, prior to lab. It was observed that out of the 86 responses, 13 students “Agreed” and 45 students “Strongly Agreed” to the question. This may suggest that 67% (“Agreed” and “Strongly Agreed” responses grouped) of the students found the videos helpful and hence found it beneficial to watch the videos prior to almost all labs. Inferences can be generated from the responses of question 1, discussed above. Since 66% of the students admitted that they watched the videos prior to coming to lab, having a visual demonstration of the techniques and procedures of the lab contributed to their success and efficiency during the lab.

The second question, “I felt that the videos aided me in effectively completing the current lab”, was intended to ask students whether the videos helped the students in completing labs in a more efficient manner. It was assumed that the students answered this question by comparing the use of the videos in this lab with their experience in other labs they have taken in the past. Out of the 86 responses, 31 students “Strongly Agreed” and 44 students “Agreed” to the question. If the “Strongly Agreed” responses and “Agreed” responses are clumped together, this shows that 87% of the students that responded to this question found that the videos helped them in completing the labs effectively.

Inferences can be generated from the responses of question 2, discussed above. A large majority, 87% of the students felt that the videos helped them complete the lab. Once again, watching the demonstration of the lab allowed the students to understand how to best complete the lab procedures. Furthermore, these procedures could be completed at a faster rate, while students who did not watch the videos may have struggled with grasping the technique or strategy best used for completing the lab.

The third question, “I learned and retained more information about the lab procedures by watching the videos”, was formulated to understand whether the videos helped students gain more knowledge with the videos compared to labs that provide only procedure handouts. Again, it was assumed that the students compared this year’s lab experience with the amount of knowledge they gained from past labs, or from labs in other academic departments that did not provide them with videos. It was noted that out of the total of 87 responses, 24 students “Strongly Agreed” and 47

"Agreed". Again, if the two responses are clustered together, it can be seen that approximately 82% of the students learned more by using the provided videos for the labs. This shows a strongly positive response to the use of media in a learning environment such as the labs for this course.

Inferences can be produced from the responses of question 3, seen above. Over 80% of the students admitted that they learned more information about the lab by watching the videos. This may have occurred because they were able to experience the lab more than one time. After viewing the experiment online, the process of completing the lab becomes easier. When time came to actually complete the lab, students knew what to expect, because they had already been exposed to the procedure. If the outcomes were different from those in the video(s), the students could compare procedural differences made accidently or intentionally during the lab. Ideally, these students can then learn how changing the procedure affects the outcome of results. Recognizing how changes affect results is a vital aspect to learning and understanding biology labs, and the online videos greatly helped students recognize this notion.

The responses of question 4, "I was more comfortable performing in lab after watching the associated videos", display a common trend compared with responses from questions 2 and 3. The questions were purposely created in a similar fashion to find a common trend without bias. The difference between this question and questions 2 and 3 is that question 4 specifically focuses on the performance of students, if they watched the videos prior to lab. A striking 82% of the class agreed with the statement, claiming that if they watched the videos before completing the lab, eventually completing the lab proved easier.

Inferences about question 4 discussed above, can therefore be created. Students who watched the videos before completing the lab, had a good idea of the general practices of that lab, and could work more quickly and efficiently than students who did not watch the videos. The students who watched the videos were also more likely to be aware of the anticipated results of each experiment and would be more prone to recognize a mistake, should the resulting data appear drastically different than that of the videos. As a result, these students would recognize a mistake and correct it, rather than complete the entire lab incorrectly, as some students who did not watch the videos may do.

A recent study was done at the University of California aimed to interpret the effect of web-based technology enhancements in both classes and laboratories. These results found that there was very little difference in attendance of control groups with no web-based information compared to test groups which had online-technology enhancements. The rate of attendance was actually heavily influenced by the time of day, and the style of the lecture. (Educause Quarterly, 2003) This study helps us further make sense of our results.

With regards to question 5, "The audio associated with the videos were spoken clearly", Figure 9 shows a strong correlation that clarity was present. This strong agreement implies that poor clarity in the narrators had little significance in dislike for the project. However, viewing Figure 8, (the categorized responses to the question) it can also be inferred that the videos have room for improvement. There are

39 who strongly agree while there are 44 who only agree with the statement that the videos are clear. Future implications of louder and/or clearer audio may make a better learning environment. Also, it can be noted that several students of different genders took part in the voiceover of audio. One person should do all voiceovers to control for differences, and for professionalism. Further inference can be made involving language barriers as a result of cultural differences. It is possible that the narrator spoke a different primary language from the student, making it difficult for the student to completely understand the narrator.

With regards to question 6, "I always attended lecture", one can extract interpretations that deviate from one another. This is largely due to an inadequate wording of the survey question because it implies either a yes or no answer, yet there are four options to answer. For this, Figures 10 and 11 do not give concrete results to interpret. In a different perspective, Figure 10 may show that the videos were in fact effective in helping students complete the laboratory. Due to access to the videos online, students may feel substantially informed about upcoming labs, and thus not feel the need to go to lecture. Referring to Figure 10, the two most concrete results are that 37 students strongly agreed in always attending lecture, while 7 strongly disagreed. However, the 23 who solely agreed and the 20 who solely disagreed may be interpreted in different ways. To help make sense of this, we can assume that students who answered these responses attended lecture 50% of the time and did not attend the other 50% of the time. From that, one could infer that these students either attended because they enjoyed the lecture, or because the videos were not helpful. One caveat to lecture attendance involves the exams. There were seven total lectures, and two of them had exams during the class time, forcing all students to attend those sessions. Therefore the results of this question may be slightly skewed, as students were forced to attend two lectures to complete the exam. Outside of the two exam lectures, students may not have attended because they disliked lecture, or because the videos were enough of a supplement to make the lectures obsolete. If the latter statement is true, then the availability of the videos online resulted in students watching the videos and becoming so comfortable with the current laboratory, that they believed that attending lecture was not necessary.

Question 9 of the survey asked the students if "The videos were helpful as a supplement." Almost identical responses were obtained from the students, only the majority of the students (80/84) agreed with the statement. The conclusions that can be drawn from the responses to both of these questions are clear. A large majority of the students felt that the videos were necessary and helpful to the laboratory. There were very few people that did not believe that the videos were necessary. Possibly, these people did not watch the videos, as there were 28 students who disagreed with the question asking if the videos were watched prior to lab. Therefore, these people who disagreed with question 10 may have not watched the videos, therefore, never recognized the benefits that the videos had to the students that did watch them.

Question 10 on the survey asked the class to respond to the following; "The videos were unnecessary." There was a clear trend in the responses of the 86 people, (see Figure 15) Only a total of 13 people, agreed with the statement, and only 3 of them expressed strong agreement with the statement, (see Figure 14). 73 of the 86 people disagreed with the question, claiming that the videos in

fact were necessary. There was a rather even distribution in the disagreement category as 39 students disagreed while 34 strongly disagreed. The students' feelings towards the videos, via their responses to question 10 mimic their feelings to a similar statement. Question 9 of the survey asked the students if "The videos were helpful as a supplement." Almost identical responses were obtained from the students, only the majority of the students (80/84) agreed with the statement. There were very few people that did not believe that the videos were necessary.

The inferences that can be drawn from the responses to both of these questions are clear. Firstly, the students who claimed that the videos were unnecessary possibly never watched any videos. If this was the case, those students never got the opportunity to recognize the benefits of the videos. Furthermore, by claiming that the videos were in fact necessary, the students confirm positive feelings towards the videos helping students in future lab classes.

Question 11 on the survey asked students if the videos technology should be implemented in other biology lab courses at WPI. A vast majority of the students (81 out of 86) agreed with the question, stating that the videos should be used in other biology lab courses. Once again, it is possible to believe that the 5 students that disagreed with the question may have done so because they did not watch the videos at all, therefore did not understand the benefits that the videos may have had. The conclusions that can be drawn from this question include the possibility of implementing similar videos in other biology labs. Over 90% of the students who were subjected to these videos felt that the videos would be helpful in other lab courses. Students enjoyed the availability of the videos to aid them in the completion of the lab courses, and therefore feel that similar videos in other biology lab courses would be a helpful tool to aid in learning. Believing that these videos will benefit fellow students as well infers that the current students benefited in many ways from the availability of these videos.

There are some future recommendations that could be implemented. Better survey methods could be carried out. These methods include more precise questions and possibly separating students into two groups depending on if they watched the videos. Separate surveys could be administered for each group to gain a better understanding of the resulting effects of video watching. A comparative approach could then be completed between the two groups, resulting in more powerful statistical analysis, and more insight towards future improvements.

In conclusion the purpose of this IQP was to create video tutorials of laboratory procedures. Students taking the laboratory classes were given the opportunity to view these videos prior to completing the lab, therefore, allow for increased knowledge and material retention for the lab. The goal of this IQP was to determine if these online videos and supplemental material increased the learning and retention of the students. Conducted surveys explicitly asked whether or not students watched the videos, and were asked a series of questions about the usefulness of the videos in allowing them to learn and retain information in and outside of lab. Results explicitly concluded that the students that did use the videos prior to coming to the lab did learn and retain more skill and knowledge about the lab. This data concurs with the formulated hypothesis and the numerous studies that were reviewed

in the introduction section of this report. This IQP was successful in determining how online course materials increase the learning and retention of the students who used them.

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