Effects of Visual Media on Achievement and Attitude

in a Secondary Biology Classroom

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Abstract

Technology can be very beneficial to students’ learning, yet it is not used enough by teachers in the classroom. Many forms of technology can be beneficial, including visual media. In this study at a rural high school, sophomore biology students were shown short, informational video clips, in addition to direct instruction, to determine if there was an effect on achievement and/or attitude towards the subject studied, and the use of videos as a learning aid. The sample was divided into two treatment groups and two control groups, where the treatment group was shown videos, and the control group was provided with the same instruction without videos during a unit on biological diversity. Assessment tests were used to measure achievement, and pre and post surveys, as well as interviews, were used to determine the effect of videos on attitude. After analysis with an independent t-test, it was found that there was no statistically significant difference in achievement, though the treatment group showed slightly higher gains. The surveys showed no significant change in attitude towards video use or the content studied, however, the surveys as well as the interviews indicated that students felt positively about the use of videos in the classroom. If students like videos and find them useful, then over time it is possible that achievement would follow. Improving the way that videos are shown in the classroom could lead to higher gains in achievement.
Chapter 1: Introduction

Importance of Technology Use in Schools

Technology in many forms is expanding rapidly in our nation and there is a push for schools and businesses to keep up with this technology, which includes computers, digital media, and scientific tools. It is becoming increasingly important to expose K-12 students to technology, to prepare them for life in the real world. Technological literacy is a skill that employers seek and many jobs will require the use of computers or other technological equipment, and so students will need to be prepared to use them and should be familiar with them. By introducing more technology into schools, students can be better prepared for adult life. Furthermore, American students lag behind students in other developed nations in math and science (National Center for Education Statistics, 2012). If technology helps students learn, then they may be able to catch up to students in other countries.

Benefits to Using Technology in the Classroom

Not only will students likely use technology in their careers, using technology in the classroom can offer new, creative and engaging ways to teach. Digital technology in particular can be useful when teaching. Learning can be enhanced with images, video and sound. For example, direct instruction can feature videos of processes or situations. Projects and experiments can involve graphic representations of data and more efficient data collection and analysis, especially in math and science classrooms. Different types of learners can be reached through the use of technology. For example, those who prefer hands-on learning would benefit through modeling data or using an interactive computer simulation. If used effectively, technology can greatly enhance learning.
One benefit to using technology in schools is that learning can be enhanced with images, video and sound. Using videos in the classroom is a step in the right direction towards implementing and taking advantage of the available technology, and offer an additional visual for student learning. Many people may need visual aids to help them learn (The Institute for the Advancement of Research in Education, 2003). This means they learn best by seeing drawings or pictures to represent concepts. Showing videos is a method for visually representing information, and a form of technology, that can be used to illustrate concepts. Using videos to help students understand concepts could improve academic achievement, and even attitude towards the subject in the classroom. Visual media use can strengthen understanding, especially of abstract processes that are hard for one to envision in their mind. For example, in biology there are many molecular processes that occur, which cannot be seen by the naked eye. If students can see an animation of the process, they may be able to learn it more easily than just seeing drawings. Previous studies have supported the idea that visual media along with traditional methods of teaching can increase student performance, indicating that students learned more with the visual media (Harwood and McMahon, 1997; Eick and King 2012; Kay and Kletskin, 2012). Studies also show that students’ attitudes towards a subject can be improved by using visual media (Eick and King, 2012). Improvement in attitude can in turn improve achievement. Although studies have been done on the effects of visual media, few have been done specifically in a secondary science classroom. Given the variance in grade level and subject with previous studies, additional research can support the use of videos in science classrooms.

If additional studies support the idea that using visual media can improve student achievement and motivation, particularly in science classrooms, then teachers could become more motivated to implement this teaching strategy. Connecting to students’ activities outside of
class, such as watching YouTube videos, can also help engage students and keep them interested. Students today use technology frequently outside the classroom, such as with cell phones, video games, iPods, computers, etc. Any way to connect to their life outside the classroom can increase students’ motivation. The graphics and sound used in videos may keep students more engaged than they would be in a typical lecture.

**Problems with Technology Usage**

Although there is a push for students to use technology, many schools and classrooms do not implement it. According to the U.S. Department of Education’s National Center for Education Statistics, while 97% of teachers have access to computers for their students, only 40% use them often (National Center for Education Statistics, 2012). There could be several reasons teachers don’t use more technology. One reason is likely that there is a lack of funding to provide students with technology. The average ratio of students to computers in a classroom is 5.3:1, meaning there are not enough computers for every student to have one (U.S. Department of Education, 2009). Furthermore, less than half of teachers have a projector available to use. Without resources to implement technology, teachers are stuck to using older methods of teaching. Another reason technology is not implemented as much as it could be is that the teacher does not know how to use new technology, or does not know how to implement it (Petko, 2012). A teacher cannot implement technology if they do not have the knowledge to do so. A third reason for a lack of technology use could simply be stubbornness. Some teachers, particularly those who have been teaching for many years, may be used to using paper and pencil all the time, and may be unwilling to do anything different. If a teacher is unwilling to learn how to use new technology or create activities that use technology, then students are unlikely to encounter it.
With the reasons for the lack of technology use in schools, it is necessary for teachers to learn to use technology and implement it in the classroom. It is also important for schools to receive the funding they need to catch up to the rest of society. Even if the technology usage is as simple as showing a computer animation, it can improve student learning.

**Research Question and Statement of Purpose**

The purpose of this study is to determine if 10\textsuperscript{th} grade biology students, at a moderately sized rural high school in Southeast Ohio, will benefit from being shown visual media with lecture material and direct instruction. Also, the study will determine if these students are more engaged and more interested in the content when shown videos. If students indicate that their interest or attitude is improved, and their test scores are significantly higher, then this study would support using visual media as a teaching tool. The question this study aims to answer is, can presentation of videos with direct instruction improve test performance and attitude toward biology class?

**Definition of Terms**

**Technology**

In this study, technology refers to digital technology such as computers, video, scientific tools, graphing software, etc.

**Direct instruction**

A general term for the explicit teaching of a skill-set using lectures or demonstrations of the material

**Visual media**

Videos with image and sound
Chapter 2: Literature Review

Introduction

Technology is important to use in the classroom due to the need to prepare learners for the adult world and the potential to enhance the learning process. Visual media is a form of technology that could improve comprehension of concepts in a science classroom. Many concepts are abstract and may need additional visual representation for students to understand, thus a video would aid in comprehension.

Currently, there is not extensive research that has been done specifically on the use of video and instruction in secondary classrooms. Related research on interactive computer games, computer-based learning, or interactive video is more common. With the lack of extensive research done specifically on the use of video with instruction, this study aims to discover whether or not there is evidence for using video as a useful teaching tool in the biological sciences.

This chapter explores the current level of technology used by educators, how teachers use visuals and graphics, and how attitudes affect technology usage. Then it reviews research that supports different forms of instruction that includes visual media. Research supports video use to improve achievement and/or motivation in elementary, secondary, and post-secondary classrooms, as well as in teacher training. Finally, the literature review explores research on the best practices to using videos in the classroom.

Current Level of Technology Use

Why is there a lack of studies on the use of video with direct instruction? It could be that many instructors do not even use technology to begin with, so not much research has been done on it. Some research has been done however on the reasons for whether or not teachers are
using technology. In one study, researchers examined how teachers’ beliefs influenced their use of digital media in the classroom (Petko 2012). The main purpose was to find out what affected the frequency of use of computer based learning by teachers. Researchers surveyed secondary teachers in Switzerland through an online questionnaire. Teachers were asked questions about the school environment, frequency of use of computer technology in class, and personal competency with computers. The findings of this study were that teachers who felt competent in computer technology, had easy access to computers, who felt computers helped students learn, and who used the constructivist model of teaching, were more likely to use interactive computer technology.

Whether or not technology is available in the classroom had the most significant impact on teachers’ use of technology with students. Since there are not enough computers in most schools for each student to have one, and not all teachers have projectors in their classroom, it makes it difficult for these teachers to implement technology. If teachers do not have a computer and projector, they use methods such as visual media to aid instruction. The findings in the article make sense. If a teacher does not feel comfortable using computers or other technology, or does not feel that they are useful in teaching, then they are less likely to use them. Access to computers also makes sense as a factor in the frequency of computer use. When there is a limited time in the day, teachers may not want to have to use the time it takes to walk to the computer lab, and if there are not even enough computers to use, then many teachers would not bother to even use them. This article is useful in providing insight into some of the reasons for how often technology is used in the classroom. The more technology is used, the more we will know how helpful it is to students.
Resource availability, course content, and student characteristics are important factors in how teachers select visual representations to use in class (Cook, 2011). Research shows that the way visuals are represented can affect student comprehension, and that visuals with verbal or written explanations are best. Simple diagrams are better for understanding than realistic pictures, and short explanations have found to be better than longer explanations. As far as student characteristics, those “with less prior knowledge of content are helped more by illustrations than students with more prior knowledge” (Cook, 2011). With this information, one researcher performed a case study to find out how teachers select visual representations. In an observation study of seven high school science teachers, the researcher found that there were many factors affecting how visuals were chosen. Teachers of different subjects preferred different kinds of pictures, for example, realistic vs. cartoon drawing. Relevant to the particular study discussed in this paper, biology teachers more frequently use simple diagrams and animations of processes to represent content (Cook, 2011). Since course content, student ability, and resource availability are all taken into consideration, it may be best to choose visual representations that seem helpful to specific content areas.

**Support of Visual Media Usage**

Research involving visual media and education supports its use to increase both learner attitude and achievement. Previous research most relevant to this study supports video use as a teaching tool (Harwood and McMahon, 1997). In a study by Harwood and McMahon, high school chemistry students were shown a video series throughout the academic year in addition to their regular instruction. Students in the treatment group not only showed higher scores on standardized measures of achievement, but also rated higher on a chemistry attitude instrument.
Previous studies before this one also support this method (Enger 1976; McNeil and Nelson 1991).

Not only is there evidence for achievement, but also evidence for improvement in attitude. Another study was done with college students in an introductory science course who were non-science majors, which investigated the students’ attitudes towards the use of YouTube videos embedded in lecture Powerpoint presentations (Eick and King, 2012). In this study, a significant proportion of students felt the videos were useful and entertaining. This study only surveyed students’ opinions and did not investigate whether there was an effect on exam scores. A similar study was done at another college in an environmental science class for non-science college majors. In this study, small group activities, inquiry labs, and visual media were used to increase student engagement (Gill 2011). The researcher found that students were most engaged in lecture during small group activities and video presentations. When students were surveyed on what they found most valuable, however, a majority reported that the lecture and video presentations were most valuable to their learning, so their perceived achievement was greater. Other studies done with college students support video use with instruction as well, for both achievement and especially engagement (Pearson and Litchfield, 2011; Adams, 2010; Tobolowsky, 2007). Although these studies were done with college students, the findings could be applied to the secondary level. These studies support the integration of visual media into direct instruction methods.

Some studies have been done on the use of technology in math classes in addition to those done with science classes. In one study, researchers used video podcasts in a college calculus class (Kay and Kletskin, 2012). Students had the opportunity to view podcasts online that demonstrated how to work different calculus problems. A majority of students who used the
podcasts found them useful and found that the podcasts increased their achievement in the class. Although the use of podcasts is different than using video clips with lecture material, it does involve students watching videos to learn.

One study done by researchers in Taiwan measured the difference in achievement and emotional state between 5th grade students identified as either verbal or visual learners (Chen and Sun, 2012). The study used three different multimedia materials: static text and image based multimedia materials, video-based multimedia materials, and interactive multimedia material for a unit on energy. Results of the statistical test on performance showed that verbal learners’ scores improved significantly with video based multimedia as opposed to animated or image based multimedia. For the visual learners, their scores improved significantly with both the video based and interactive multimedia, but not significantly with the image based multimedia. The emotional state of all learners decreased during the learning experience, as measured by a heart rate variability monitor, indicating that testing is not a stimulating experience for these particular students.

These studies mentioned all support the use of video as a tool for student learning. Video use is supported in various age groups and situations, from middle school through college students, and even teacher education (Coles, 2011). The research shows that visual representations can be effective in promoting student achievement and increasing positive attitudes towards content.

Though many studies that involve video use support it as a teaching tool, not all studies support video use. In a college psychology class, researchers were interested in how to get students to apply what they learned to real life situations when shown a video involving the concept (Luyben and Warden, 2008). The purpose of the study was to see if an instructional
strategy that involves video is more effective than one that does not in the identification and application of a concept within a video. Students in the study were alternately assigned to do a tutorial on a computer that was either text only, or included video and text. The results of the study were that scores between the groups were not statistically significant. Researchers concluded that since neither group scored well on the test associated with the tutorial, the task was too difficult, and so the results may not have been truly valid. This research shows that the context in which videos are used should be considered, and in some contexts, videos may not always aid significantly in comprehension. Additional supports may be needed in these situations.

**Best Practices**

The research presented in this literature review shows that visual media use can be beneficial to students. What then, is the best way to use videos? There is not extensive research on the best practices for video usage. One case study on this can provide some insight however. An upper-elementary school teacher in a small, rural school district in Missouri wanted to find out when showing videos was most effective for her students. The teacher taught three different units in science and tried showing videos at the beginning of the unit, the middle, and the end of the unit. The teacher used a constructivist approach, following a learning process that involved explore, engage, consolidate, and assess. What the teacher found was that video usage was most effective when shown at the end of a unit (Drury, 2006). Students asked more effective questions about the video and were better able to respond to questions related to content in the video. The students had learned the content and had time to process it. The videos then reinforced and extended their understanding of the content in that unit. This case study can provide insight for
when to use videos when teaching science. It seems it is best to explain information first, and then show a video afterwards.

**Summary**

In summary of the literature review, the way teachers use technology and visuals to represent information is determined by a number of factors. Resource availability is an important factor for both. Teachers’ knowledge of how to use technology can influence how much it is used. When choosing visual representations, this could come into play, as technology is often used to create and show visual representations. Student characteristics and content learned are other important factors. Much research indicates that visual media can be both beneficial and motivating to students, and can increase test performance and comprehension. This benefit is best achieved when showing videos at the end of a chapter unit of instruction. Previous research can be used to decide how and when to implement visual media in the classroom.
Chapter 3: Methods

Introduction

In this study, the focus is to determine if visual media improves attitude and increases achievement in a high school biology classroom. The visual media used is in the form of educational video clips from YouTube or other educational sources, and were shown to students in addition to direct instruction. This study used two chapters of learning as part of a unit on biological diversity. Videos could possibly make classes more interesting for students which would increase positive attitude towards the subject being studied, which may in turn result in greater achievement. Videos are visual resources that may help students understand concepts better. Some concepts in biology are abstract and hard to picture in one’s mind. A video may help students visualize the concepts. The more resources and visuals students have, the more achievement should increase.

Assessment tools, such as course exams, were used to measure achievement. Students were given a pre assessment at the start of the unit and post assessment at the end to measure differences between preexisting knowledge and knowledge obtained, and to measure differences between the control and treatment groups. Surveys and interviews were used to measure students’ attitudes and perceptions of how well the videos helped them learn. Surveys were given to all students before and after the study and were measured with a Likert scale system. Interviews were face-to-face consisting of open ended questions.

Participants

Four different biology classes at a moderately sized high school in rural Southeast Ohio were used for this study. There were two honors biology classes and two general biology classes used, who were both studying and learning about identical content. The 2nd period honors class
consisted of 23 students, and the 7th period honors class consisted of 24 students. There were 20 students in the 3rd period general biology class, and 22 students in the 4th period general biology class. Both morning and afternoon classes were used, and both general and honors classes were used to control as many factors as possible. The two general classes and the two honors classes were used to have fairly equal control and treatment groups. The students were of a range of socioeconomic backgrounds, but about half of students were considered economically disadvantaged (data from 2010-2011 school report card). All of the students participating in this study were Caucasian, with the exception of one biracial student in the 7th period honors biology class. The students were age 15-16 at the time of the study. In the 3rd period class, there are three students with an individual education plan (IEP). In the 4th period there are four students with an IEP. In the two honors classes, there are no students with IEP’s.

Setting

The high school used in this study was located in rural Southeast Ohio. The area contains many forested areas and a large State Park. The school had recently been rebuilt and contained many modern amenities. The biology prep room was well stocked with supplies and updated laboratory equipment. The classroom was arranged in 3 rows of 4 tables, with one side of the classroom with 2 tables. These tables accommodated 2 students each. The school was large, bright, and temperature controlled. Students could choose from a variety of classes to take such as vocational agriculture, biomedical science, forensic science, woodshop, and weight training, to name a few. This study was conducted in the spring of 2013. The 2nd, 3rd, and 4th period classes took place in the morning, between about 8:25-10:38 am. The 7th period class took place in the afternoon between about 12:15-12:56 pm.
**Instruments**

Surveys, interviews, and test scores on an exam were used to measure the effects of the study. Surveys were paper surveys given to the students and consisted of 13 questions in which students rated their response with a Likert scale. Interviews were in face to face format and responses were recorded on paper. The interviews consisted of 8 questions and students were asked to elaborate on their responses. See appendix for instruments used.

**Survey**

The survey used for this study was a Likert scale survey. It was used to measure students’ attitudes towards the use of visual media and whether or not they felt it helped them learn. The survey was administered to all students in the study and consisted of 13 questions. The survey was administered before and after the start of the study. Students’ responses were compiled per question, and the average response for each question was calculated. Students’ attitudes and perceptions of biology and use of visual media were assessed at the conclusion of the study to note any changes. See Appendix for survey.

**Interview**

Selected students were interviewed for this study to further delve into their ideas about the use of visual media in the classroom. One student from each class was selected for an interview, based on which students were available and wanted to volunteer to be interviewed. Students did not know the content of the interview questions prior to the interview. Students were asked a series of questions that pertained to their attitudes about video use in class, how they learn best, and whether or not they feel videos shown helped them understand content or made class more engaging. They were asked to elaborate on these open ended questions and
provide as much detail as possible. The interviews were recorded by writing the students’ verbal responses on paper. See Appendix B for interview questions.

**Pre-assessment**

At the start of each unit used for the study, each class was given a pre-assessment to measure existing knowledge. The pre-assessment consisted of 10 questions where some were multiple choice and some were short-answer. These same 10 questions were used on the students’ post assessment to measure achievement. The 10 questions were compared between classes to determine if there was a difference in achievement between classes shown videos and classes not shown videos. See Appendix C for all pre and post assessments.

**Post-assessment**

An assessment was given at the end of the unit to test for comprehension and content mastery. The exam consisted of multiple choice, true/false, short answer, and extended response questions. Test scores on the post unit test were compared between the classes who were exposed to visual media and those who were not. These scores were used to determine if the videos had a significant impact on achievement.

**Procedures**

Video clips were shown as the treatment for this study. In the study, two classes were shown video clips with lecture while two classes were not shown any video clips (the control group). Two book chapters were used in this study as part of a unit on biological diversity. The classes that were the treatment group for the first chapter studied were 7th period honors biology and 4th period general biology. The control group for this chapter consisted of 3rd period general and 2nd period honors. In the second chapter studied, the treatment and control group were switched, so as not to disadvantage students from possible benefits of being shown videos, and to
gain additional data. For the second chapter used, 2\textsuperscript{nd} and 3\textsuperscript{rd} period were shown videos and 4\textsuperscript{th} and 7\textsuperscript{th} period were not. The chapters studied were from the book and consisted of chapter 18: Viruses and Prokaryotes, and chapter 19: Protists and Fungi.

The video clips shown with direct instruction were related to content being learned in direct instruction. They were used to reinforce processes and content learned and to add interest and engagement. In chapter 18, a video from NPR was shown to reinforce the process of viral replication in a eukaryotic cell (Krulwich). Another video was shown to reinforce the difference between the lytic and lysogenic viral cycles in a prokaryotic cell. This video was from the CD that came with the AP biology textbook (Campbell, Reece & et al, 2008). I taught the process of each in direct instruction with a diagram, and then for students in the treatment group, I showed the video clips. Students in the control group did not watch any videos but had the same direct instruction. In this chapter I also showed a Youtube video that summarized information about bacteria (BillNyeRulz, 2009). This video was both informational and meant to add interest.

In chapter 19, there were four videos shown to the treatment group. One video depicted a time lapse of fungal growth, to promote interest (BBC, 2013). A video depicting microscopy videos of protist pond life was shown to promote interest and engagement (Nikon). A video from Youtube depicting the malaria cycle was shown to reinforce the process (Darby communications, 2012). A video from Youtube depicting a time lapse of slime mold growth was shown to promote interest and engagement (Ms Grim Dog, 2009). The videos ranged from a few seconds in length to up to 10 minutes. The videos were obtained from YouTube, resources from a textbook and an educational website (see appendix for further information). These videos were delivered via a projector connected to a computer. Videos were explained as necessary, and were meant to reinforce concepts. The videos served as another visual aid for the students.
The setup for which classes received treatment or were the control for each chapter is as follows:

Honors classes were randomly selected to be control or treatment, and general classes were randomly selected to be control or treatment

Honors Biology
2nd period: chapter 18- control, chapter 19- treatment
7th period: chapter 18- treatment, chapter 19-control

General Biology
3rd period: chapter 18- control, chapter 19- treatment
4th period: chapter 18- treatment, chapter 19- control

Data Collection

Test scores and responses to surveys and interviews were the source of data for this study. The test scores from chapter exams were used to measure achievement. The average scores on post-assessment questions for each class were compared between the classes in the treatment group and the classes in the control group and a paired T-test was used to determine significant difference between the scores. The pre and post-assessment scores for each class were compared as well to determine the difference in achievement between the start of the chapter and the end of the chapter. For the surveys, the data was compiled from the responses on the Likert scale. The score for each question was averaged and compared between the pre-survey scores and post-survey scores.

Summary

In summary, surveys and interviews were used to assess engagement and attitude towards biology. A post assessment was used to determine if there was a difference in achievement when
using visual media. If videos help students understand concepts, then there should be a significant difference, as shown in a statistical T-test, in chapter test scores between the control and treatment groups. If videos increase engagement, attitude, and interest towards biology, or the content being learned specifically, then there should be a significant difference in the survey scores. If attitude and achievement are improved, then video use in classrooms, particularly science classrooms, would be supported.
Chapter 4: Results

To analyze results, the post assessment scores were compared for each chapter studied between the control and treatment groups. The scores for the general classes were compared to each other and the scores for the honors classes were compared. The pre and post survey scores were also compared. The average score for each question was compared from the pre-survey and post-survey. See Appendix for survey, interview, and assessment instruments.

Achievement

For chapter 18, 4th period general biology and 7th period honors biology served as the treatment group. The 7th period honors biology class’s average post assessment score was slightly higher than the average score for 2nd period honors. The 7th period class scored an average of 86.23% of questions right on the post assessment questions, while 2nd period scored an average of 85.31%. The 4th period general biology class, however, scored lower than the 3rd period class. Fourth period scored an average of 59.62% while 3rd period scored an average of 74.92%. When comparing the average raw score for each class, I found there was no significant difference between test scores for the honors classes. An independent t-test was used to test for significance of the data. When comparing the post assessment scores between 2nd and 7th period, p=0.791, with a significance level of 0.05. Since p>0.05, I fail to reject the null hypothesis, and there is no significant difference. When comparing scores for 3rd and 4th period, there was a significant difference, where p=0.0049 with a significance level of 0.05. Since p<0.05, the data is found to be statistically significant. Although the means are significantly different, 3rd period, the control, had the higher mean score, rather than 4th period, the treatment group.
For chapter 19, 2nd period honors and 3rd period general served as the treatment group while 4th and 7th period were the control groups. The 2nd period class scored slightly higher than 7th period, with an average score of 91.33% as compared to 90.87% for 7th period. The 3rd period class scored higher than 4th period, with an average score of 77.87% compared to 71.86% for 4th period. Again I found no significant difference in mean score for the honors classes or the general classes. For honors classes, p=0.869 and p>0.05. For the general classes, p=0.391 and p>0.05. Again, I fail to reject the null hypothesis, and the data are not statistically significant.
The survey was used to determine how videos affected the attitudes of students towards the content learned and to see if the students felt the videos were useful. There were 13 questions on the survey, which was given before the start of the study to all students, and given again at the conclusion of the study to the same students. Students were asked to rate how much they agreed with each statement by circling a number 1-5, a Likert scale, where a 1 is strongly disagree and a 5 is strongly agree. Each student’s responses were recorded, and the average score for each question was calculated. The average scores for each question were compared for each class from before and after the study. The last two questions on the post survey were compared between control and treatment groups to see if there was a significant difference in attitude after being shown videos. The results can be seen in table 1. For many of the questions, the average score was higher at the conclusion of the study. Students agreed more with statements that referred to videos making class more interesting, engaging, or helpful to learning. Though there

<table>
<thead>
<tr>
<th>Class Period</th>
<th>Per 2 pre assessment</th>
<th>Per 2 post assessment</th>
<th>Per 7 pre assessment</th>
<th>Per 7 post assessment</th>
<th>Per 3 pre assessment</th>
<th>Per 3 post assessment</th>
<th>Per 4 pre assessment</th>
<th>Per 4 post assessment</th>
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<td>2</td>
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<td>28.33</td>
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</tbody>
</table>
were increases in average score for each question, again there is no significant difference in the data.

Table 3. Comparison of average score per question for pre and post surveys

<table>
<thead>
<tr>
<th>Question #</th>
<th>Per 2 before</th>
<th>Per 2 after</th>
<th>Per 7 before</th>
<th>Per 7 after</th>
<th>Per 3 before</th>
<th>Per 3 after</th>
<th>Per 4 before</th>
<th>Per 4 after</th>
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<td>1 I am a visual learner.</td>
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<td>4.05</td>
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<td>4.1</td>
<td>3.41</td>
<td>3.94</td>
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<td>3.64</td>
<td>3.91</td>
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<td>3.88</td>
<td>4.17</td>
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<td>4.14</td>
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<td>4.17</td>
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<td>4.54</td>
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<td>9 I enjoy class more when videos are shown.</td>
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<td>3.95</td>
<td>4.00</td>
<td>4.12</td>
<td>3.94</td>
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<td>3.25</td>
<td>2.94</td>
<td>2.69</td>
<td>3.15</td>
</tr>
<tr>
<td>13 I think learning about protists and fungi is interesting.</td>
<td>2.90</td>
<td>2.90</td>
<td>3.00</td>
<td>3.21</td>
<td>2.94</td>
<td>2.88</td>
<td>2.38</td>
<td>3.00</td>
</tr>
</tbody>
</table>

Interviews

Interviews were given during this study to four students, one from each class period, to find out students’ perceptions of video use in a more in depth manner. Interview questions can be found in the appendix, and below. The interview was given at the conclusion of the study, after all students had been exposed to the treatment, and had seen videos in class with direct instruction. The answers to each question varied. Answers to each question are summarized from what students discussed with me.
1. How do you feel you learn best in the classroom?

   Student 1, 2nd period: visually, watching demonstrations and then doing it myself
   Student 2, 3rd period: hands-on learning, being involved, not just listening,
   Student 3: 4th period: visually- videos, diagrams, and charts
   Student 4: 7th period: hands-on activities and labs, visual aids such as diagrams

From this question, three of the students indicated that they learn visually. Three of the students also indicated that they also learn through hands-on activities.

2. What are some things you like to do in class (take notes, reading assignments, group work, experiments or activities, watch movies, etc.)?

   Student 1, 2nd period: I hate reading; I prefer taking notes, watching videos, hands-on labs.
   Student 2, 3rd period: labs and notes sometimes
   Student 3, 4th period: group work, labs and hands-on activities
   Student 4, 7th period: watching videos, labs, group work, notes; I hate reading

All four students like doing hands-on labs, and three of the four students like taking notes to help them learn. Two of the students indicated that they like watching videos.

3. What have we done in class so far this year that you feel has best helped you learn?

   Student 1: labs
   Student 2: review after the notes and before tests because it ties it all together
   Student 3: the labs because they help me remember more
   Student 4: guided notes because they provide the most information, and class reviews

The students indicate that they feel the labs and reviews have been most helpful.

4. How do you feel about watching instructional videos?
Student 1: It depends on if it’s boring or incorporates interesting things or real life stuff.

Student 2: It’s fun, if it’s not a boring video. Sometimes the voices are boring.

Student 3: It helps and makes class more entertaining.

Student 4: I like animations because you can see things moving.

Two of the four students indicated they like videos, but two of the four said it depended on if it was boring or not.

5. Would your perceptions of class change if instructional videos were shown more?
   
   Student 1: Not sure, depends on subject matter. It would be worse if it was cellular stuff, but better with video clips during lecture.
   
   Student 2: No, I’m used to videos with notes. Other teachers use them- English, History, Spanish teachers.
   
   Student 3: Yes, it would help me pay attention more.
   
   Student 4: No it wouldn’t change.
   
   Two of the four said their perceptions wouldn’t change. One said it would change positively, and one said they were not sure.

6. Do you feel you learn more from watching videos?
   
   Student 1: I feel like it’s equal since videos aren’t shown much in class.
   
   Student 2: Yes, if it’s connected to the notes.
   
   Student 3: Yes.
   
   Student 4: Yes, because they help you think about it in another way and reinforce ideas and concepts.
   
   Three of the four feel they learn more from watching videos. One student didn’t feel that they were significant to her learning.
7. If you were shown videos in this class, do you think it would help you learn better?

   Student 1: To a point, but I would need instruction too.
   Student 2: Yes.
   Student 3: Yes.
   Student 4: Yes, because you can’t see some things in biology so it helps you picture it better, especially microscopic stuff.

   Three of the four indicated videos may help them learn better. One felt it may help some, but she would not solely be able to learn from videos.

8. Do you feel like watching videos during lecture (in this class) helped you learn the concepts better, or did it make class more interesting for you?

   Student 1: Yes, it helped in learning and made it more interesting.
   Student 2: Yes, it helped and was more interesting.
   Student 3: No difference in learning, but it made it more interesting.
   Student 4: For learning, yes, it was less work for my brain to try and understand concepts when videos are being shown. It made class more interesting because it was different than normal and it adds a different aspect to class.

   Three of the four felt the videos that were specifically shown during the study helped them learn concepts. All four felt the videos made class more interesting.

Summary

In summary, there was no significant difference in post assessment scores between the control and treatment groups or survey scores. Students indicated in the interviews, however, that videos were at times useful and made class more interesting.
Chapter 5: Discussion

There are three things to discuss with regards to the results of the study- the assessment data, the survey data, and the responses to the interview questions. When comparing post assessment scores between the control and treatment groups, I found that treatment groups for each chapter studied generally scored slightly higher, but the difference was not statistically significant. The reason for this could be that the content of the videos was not informative enough to the students. The information in the video was used to reinforce what was already presented in direct instruction, so it could be possible that this reinforcement didn’t make much of a difference. It could also be possible that the short time viewing the video did not make a difference in their knowledge retention. The video clips were only a few minutes in length and were shown during the same class period as the direct instruction related to content in the video. Since learning involves practice and repetition, it may have been more helpful if students had access to the videos to study on their own. If students had been able to watch the video more than once and maybe towards the end of the time spent on the chapters, it could have made more of a difference.

The only significant difference in mean scores was between the general biology classes for chapter 18 on bacteria and viruses. The 3rd period class scored higher than 4th period, even though 4th period was the treatment group and was expected to have a higher mean score. The reason for this could be class environment. Students in the 3rd period class were generally more studious than the 4th period class. Third period tended to work quietly on assignments and paid more attention during direct instruction, while 4th period needed more prompting to work on assignments and pay attention. The 4th period class is also right before lunch, so it is possible that
the students are antsy and ready for lunch, and less willing to study for an exam or pay attention during direct instruction.

When analyzing data for the student surveys, there was no statistically significant difference found in mean score between the pre and post survey for any questions. The reason there was no statistically significant difference could be that many of the scores were already above 3, many between 4 and 5, indicating that they already felt positively about the use of videos. If they already like watching videos in class, then by showing videos, their opinions have not changed, they have only been confirmed. Many teenagers also watch Youtube videos on their own, so they may be used to watching video clips. Since they are used to them, the videos may not have been all that exciting. Many of the scores on the survey were higher, though not significantly so. There may not have been any statistical significance due to the nature of the t-test. When the difference is less than a whole number, and since the survey used a Likert scale of 1-5, the t-test is not likely to give a p value of less than 0.05. The reason for little change in scores for each question could also be that the students may be unwilling to “strongly agree”. They may not want to choose an extreme.

The responses to interview questions were useful in this study. Out of the four students interviewed, all of them seemed to feel positively about the use of videos in class. So, although there was no statistically significant difference in achievement, if students feel positively about watching video clips, then videos could still be used with direct instruction. It did not harm students to watch videos or negatively affect them. In teaching, many strategies can be used. Video use can break up direct instruction and help students pay attention.

Though the data did not show statistically significant results, students in general like watching videos in class. There is a link between attitude and achievement. If students are more
engaged and more motivated to learn, then achievement is likely to increase. This study was done over a short time period. If the study had been extended to a whole school year, the results could be more significant. When students have a more positive attitude towards class and the content learned, then achievement could follow. Showing videos could increase achievement over time.

**Implications**

There are many implications to this study, as would be expected with performing a study in a short amount of time with a limited sample size. The sample size was small and only consisted of four classes at one high school. The study time only lasted a few weeks and consisted of two chapters of study as part of a larger unit. The sample was also homogenous—all students were Caucasian except for one biracial student, and all were from a rural area. The results for the study may be different if the study was done at an urban school, or with a different culture, or different socioeconomic status of students.

The survey had implications as well. The questions on the survey leaned positively towards using videos, with statements such as, “Watching videos related to concepts we are learning in class helps make class more interesting.” It was also difficult to keep track of who did the pre and post survey. The survey was intended to be given before the study and before any direct instruction. If students were absent, the survey, as well as the pre-assessment test, could be skewed. The study was done at the end of the school year, and being a high school in general made for at least a few absent students each day. While performing the study, full time student teaching had also just begun, making it difficult to make sure that each and every student took the pre-assessment and pre and post survey.
With achievement, and scores on post assessments, there are many things that affect achievement and ability to pay attention. For the surveys and interviews, there are many things that affect how much students like a particular class or subject. It is impossible to eliminate all confounding variables when studying human beings in an educational setting, especially since education involves many aspects. Therefore, it can be difficult in a limited study such as this to determine if a teaching method has a significant impact.

**Recommendations**

This study could be improved for future use. A larger and more diverse sample and a longer term of study could produce more reliable and valid results. The better the sample, the more reliable the data are. In the future, students should be tracked to make sure each student is taking the surveys and pre-assessments, as well as post assessments. In this study, all students took the post assessment as part of a grade for the unit.

To see if achievement can be affected positively by videos, it may be better to provide students with access to the videos to watch and study on their own. It may also be better to show the videos more than once and/or later in teaching the chapter. Videos could be more useful to students after they have had time to process the information. Videos could help them comprehend and tie together information in a way that would be easier than when first learning the information. This recommendation is supported by the study done by Drury, mentioned previously in the literature review (Drury 2006).

**Conclusions**

Showing videos with direct instruction may not produce significant gains in achievement for students in secondary science classrooms. Additional and improved studies could aid in determining whether or not achievement can be increased with videos. Students in general, feel
positively about the use of videos with direct instruction, though watching videos does not seem to greatly affect their opinions, especially of the content itself. What videos could do is keep students engaged and paying attention. If students can pay attention and focus better in class, then videos could be a positive and useful teaching strategy. When students pay attention more, they can learn more.
References


The Institute for the Advancement of Research in Education. (2003). Graphic Organizers: A Review of Scientifically Based Research. *The Institute for the Advancement of Research in Education at AEL*


Appendix A.

Student Survey

Survey Instrument:

This survey is intended to see how you feel about watching informational videos in class. Please use the following scale to rate each statement below.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tr>
<td>Strongly Disagree</td>
<td>Somewhat Disagree</td>
<td>Undecided</td>
<td>Somewhat Agree</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

1. I am a visual learner.
   1 2 3 4 5

2. I remember things I see more than things I read.
   1 2 3 4 5

3. Pictures help me understand concepts.
   1 2 3 4 5

4. Watching informational videos and animations in class is engaging.
   1 2 3 4 5

5. Watching a video or animation about a concept I am learning about helps me to understand that concept.
   1 2 3 4 5

6. Shorter videos in class are better than longer videos.
   1 2 3 4 5

7. Watching videos related to concepts we are learning in class helps make class more interesting.
   1 2 3 4 5

8. Watching videos in class helps me pay attention more.
9. I enjoy class more when videos are shown.

10. I would like to see more informational videos in this class.

11. I currently like biology class.

12. I think learning about bacteria and viruses is interesting.

13. I think learning about protists and fungi is interesting
Appendix B.

Interview

Student Interview

Please answer the following questions as completely and thoughtfully as possible.

1. How do you feel you learn best in the classroom?

2. What are some things you like to do in class (take notes, reading assignments, group work, do experiments or activities, watch movies, etc.)?

3. What have we done in class so far this year that you feel has best helped you learn?

4. How do you feel about watching instructional videos?

5. Would your perceptions of class change if instructional videos were shown more?

6. Do you feel you learn more from watching videos?

7. If you were shown videos in this class, do you think it would help you learn better?

8. Do you feel like watching videos during lecture helped you learn the concepts better, or did it make class more interesting for you?
Appendix C.

Ch 18 Pre-Assessment

1. Which of the following is a prokaryote?
   a. Virus
   b. Viroid
   c. Prion
   d. Bacteria

2. Viruses can infect
   a. Animals
   b. Plants
   c. Bacteria
   d. All of the above

3. What happens to the host cell in a lytic infection of the viral life cycle?
   a. It bursts and releases new viruses.
   b. It becomes a prophage.
   c. It enters a lysogenic cycle and copies the prophage for many generations.
   d. It produces proviruses.

4. In a lysogenic infection, once the DNA of the virus is incorporated into the bacterial DNA, the DNA is called a:
   a. Prion
   b. Viroid
   c. Prophage
   d. Plasmid

5. Antibiotics are used to fight:
   a. Viral infections
   b. Fungal infections
   c. HIV infections
   d. Bacterial infections

Circle true or false for the following statements.

6. True    False            Bacteria are always bad.

7. True    False            Viruses are considered living organisms.
8. What are 2 things you can do to prevent the spread of illness?

9. Describe the overall process of the viral life cycle.

10. Give one example of a bacterial disease.
Chapter 18 Test- 40 points

Multiple Choice (1 pt. each)

1. Which of the following is a prokaryote?
   - e. Virus
   - f. Viroid
   - g. Prion
   - h. Bacteria

2. Viruses can infect
   - e. Animals
   - f. Plants
   - g. Bacteria
   - h. All of the above

3. What happens to the host cell in a lytic infection of the viral life cycle?
   - e. It bursts and releases new viruses.
   - f. It becomes a prophage.
   - g. It enters a lysogenic cycle and copies the prophage for many generations.
   - h. It produces proviruses.

4. What is a vaccine?
   - a. a medicine that kills a pathogen when it enters the body
   - b. a pathogen that has had its surface proteins removed to make it harmless
   - c. a substance that cures a disease
   - d. a weakened pathogen or pathogen part that stimulates an immune response against that particular pathogen

5. How does HIV cause AIDS?
   - a. HIV destroys red blood cells so the host cannot get enough oxygen.
   - b. HIV causes the host's DNA to mutate at a high rate.
   - c. HIV kills the intestinal microorganisms that provide needed nutrients to the host.
   - d. HIV destroys white blood cells so the host's immune system cannot fight disease.

6. Which of the following structures are NOT found in bacteria?
   - a. Cell wall
   - b. Flagella
   - c. Plasma membrane
d. Nucleus

7. The genetic material of a virus consists of

   a. DNA only
   b. Capsids
   c. Surface proteins
   d. RNA or DNA

8. Prions are infectious particles composed of

   a. DNA
   b. Protein
   c. RNA
   d. DNA and protein

9. A viral capsid is composed of:

   a. Lipids
   b. DNA
   c. Carbohydrates
   d. Proteins

10. In a lysogenic infection, once the DNA of the virus is incorporated into the bacterial DNA, the DNA is called a:

    e. Prion
    f. Viroid
    g. Prophage
    h. Plasmid

11. The enzyme that the HIV virus uses to copy RNA into DNA is

    a. Reverse transcriptase
    b. Peptidoglycan
    c. Bacilli
    d. Cyanobacteria

12. In the bacterium below, what is the structure labeled B?

    a. Pili
    b. DNA
    c. Plasmid
13. Bioremediation uses microbes to
   a. Produce carbohydrates
   b. Clean up pollutants
   c. Convert atmospheric nitrogen
   d. Break down food

14. Antibiotics are used to fight:
   e. Viral infections
   f. Fungal infections
   g. HIV infections
   h. Bacterial infections

15. Which of the following organisms are capable of living in extreme environments?
   a. Obligate aerobes
   b. Archaea
   c. Facultative aerobes
   d. Viroids

16. Bacteria that are able to fix atmospheric nitrogen are important to the environment because:
   a. Atmospheric nitrogen is toxic
   b. They make nitrogen available to plants in a usable form
   c. Bioremediation would not be possible without them
   d. Their niche would otherwise be filled with pathogens

True/False (1 pt. each)
Answer the following questions by circling true or false.

17. True  False   Bacteria are always bad.

18. True  False   Viruses are considered living organisms.
19. True  False  Antibiotics can be taken to cure a viral infection.

20. True  False  Vaccines can be used cure an illness.

21. True  False  Bacteria can exchange genes with other bacteria.

Short Answer

22. Describe one way bacteria can help people. (1 pt.)

23. Give one example of a virus that causes disease. (1 pt.)

24. Give one example of a bacterial disease. (1 pt.)

25. What are 2 things you can do to prevent the spread of illness? (2 pts.)

Use the diagram below to answer questions 27-31.

26. The figure above depicts two types of viral infection. Name the two types. (2 pts.)
27. Which side shows a lytic infection? (1 pt.)

28. How do you know that side shows a lytic infection? (1 pt.)

29. How does a lytic infection differ from a lysogenic infection? (2 pts.)

30. Describe the overall process of the viral life cycle (what is happening in the pictures?). (3 pts.)

31. Antibiotic resistant bacteria are a serious public health concern. Many bacteria have become resistant to many antibiotics over the years. What has contributed to this problem? In your answer:
   - Explain how the misuse of antibiotics can increase the number of resistant bacteria
   - Explain how natural selection favors this resistance. (5 pts.)
1. Malaria is transmitted by
   a. Bacteria
   b. Flies
   c. Mosquitoes
   d. Virus

2. A protist is a
   a. Eukaryote
   b. Prokaryote
   c. Fungus
   d. Plant

3. An amoeba is an example of a
   a. Plant-like protist
   b. Animal-like protist
   c. Fungus-like protist
   d. Bacteria-like protist

4. What is not a structure protists can use to move?
   a. Flagella
   b. Cilia
   c. Pseudopod
   d. Pili

5. Fungi reproduce with
   a. Seeds
   b. Binary fission
   c. Spores
   d. Leaves

6. Fungi use photosynthesis
   a. True
   b. False

7. Give an example of a fungus.

8. How can fungi be beneficial to plants?

9. Give an example of a disease caused by a fungus.
10. Describe the malarial life cycle.

Chapter 19 Test- 30 points

Multiple choice (1 point each)

1. Malaria is transmitted by
   e. Bacteria
   f. Flies
   g. Mosquitoes
   h. Virus

2. A protist is a
   e. Eukaryote
   f. Prokaryote
   g. Fungus
   h. Plant

3. You discover an unknown protist in the soil that appears to be breaking down decaying matter. Which type of protist would you classify it as?
   a. Plant-like protist
   b. Animal-like protist
   c. Fungus-like protist
   d. Bacteria-like protist

4. On what basis are protozoa classified?
   a. What they eat
   b. Where they live
   c. How they move
   d. What organelles they contain

5. Why aren't green algae considered to be plants?
   a. They don't have roots, stems, and leaves.
   b. They don't have the same kinds of chlorophyll as plants.
   c. They don't have carotenoids.
   d. Their cell walls don't contain cellulose.
6. Which of the following fungus-like protists forms parasitic relationships with other organisms?
   a. Water mold
   b. Cellular slime mold
   c. Plasmodial slime mold
   d. Bread mold

7. An amoeba is an example of a(n)
   e. Plant-like protist
   f. Animal-like protist
   g. Fungus-like protist
   h. Bacteria-like protist

8. What is not a structure protists can use to move?
   e. Flagella
   f. Cilia
   g. Pseudopod
   h. Pili

9. Fungi reproduce with
   e. Seeds
   f. Binary fission
   g. Spores
   h. Leaves

10. How are fungi different from plants?
    a. Plant cell walls are made of chitin; fungal cell walls contain cellulose.
    b. Plants reproduce asexually by hyphae.
    c. Plants are autotrophic; fungi are not.
    d. Plants get food by absorbing it from their environment.

11. The reproductive structure of a fungus that grows above ground is called the:
    a. Mycelium
    b. Mycorrhizae
    c. Fruiting body
    d. Hyphae

12. Many people like to eat mushrooms. Mushrooms are in which group?
    a. Bread molds
    b. Primitive fungi
    c. Sac fungi
    d. Club fungi
13. What are the components of a lichen?
   a. a fungus and algae or cyanobacteria
   b. a fungus and a plant
   c. a fungus and a diatom
   d. a fungus and a protozoan
   e.

14. How are fungi important in an ecosystem?
   a. They release spores.
   b. They decompose decaying matter and return nutrients to the soil.
   c. They are producers.
   d. They are not important.

Answer the following questions by circling true or false. (1 point each)

15. True  False  Fungi use photosynthesis
16. True  False  Protists can be single celled or multicellular
17. True  False  Yeast is a type of fungus.
18. True  False  Some protists are more closely related to animals than they are to other protists.
19. True  False  Parasitic protists that infect humans are usually funguslike protists.

Short answer

20. Give an example of a fungus. (1 pt.)

21. How can fungi be beneficial to plants? (2 points)

22. Give an example of a disease caused by a fungus. (1 pt.)

23. Give an example of a disease caused by a protist. (1 pt.)

24. Which type of protist do we use in foods? (1 pt.)
Extended Response

25. Malaria is a disease that kills millions of people each year. Describe the malarial life cycle. In your answer, include the following:

- what organism **transmits** malaria
- what type of organism actually **causes** the disease
- which organs and cell types malaria infects
- the steps of the life cycle
  (5 pts.)
Grammarly feedback:

**139 writing issues and 39 enhancement suggestions**

Score: 69 of 100 (weak, needs revision)

### Plagiarism
- The text in this document is original

### Contextual Spelling Check
- **19 issues**
  - Spelling (13)
  - Commonly confused words (6)
  - Ignored words
  - Unknown words

### Grammar
- **84 issues**
  - Use of articles (11)
  - Use of nouns (1)
  - Incorrect use of prepositions (1)
  - Pronoun agreement (9)
  - Use of adjectives and adverbs (2)

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**Use of articles**

Mistakes made when using articles, and how articles relate to nouns:

<table>
<thead>
<tr>
<th>Use of nouns</th>
<th>Incorrect use of prepositions</th>
<th>Pronoun agreement</th>
<th>Use of adjectives and adverbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
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