

Integrating Digital Storytelling into an Engineering Design Course

Richard O. Mines, Jr.¹ and Beth P. Mines²

Abstract – This paper discusses the use of multimedia in a digital storytelling format for communicating the design of unit operations and unit processes involved in water treatment. Students were required to create a design module on their specific water treatment process by making a digital video. The objectives were to communicate the design of a specific process through video clips, PowerPoint slides, design equations, and case histories; and to include a design example and photos of actual equipment. Pre- and post-surveys of student attitudes were conducted and the results are presented. Overall, the students had a positive experience in creating their digital stories and indicated they would recommend this type of assignment in other courses in lieu of a term paper.

Keywords: video, movie-making, design, storytelling, water treatment

INTRODUCTION

In recent years, multimedia and technology have been hailed as educational tools used to engage students in the classroom, hopefully leading to enhanced student performance. The author, over a period of years, has used a variety of teaching assignments to appeal to various learning styles [4] and used PowerPoint presentations [5] to facilitate the ease of presenting complex equations and principles in the classroom. This paper focuses on integrating digital storytelling into a 400 level engineering design course.

The objectives of this paper are as follow:

1. To provide background information and theory on using digital storytelling in the classroom.
2. Describe how digital storytelling was integrated into an engineering design course on water treatment systems.
3. Assess the effectiveness of using digital storytelling by presenting and discussing the results of pre- and post-surveys conducted in the course.

DIGITAL STORYTELLING

What is digital story telling? A general definition of storytelling is that it is the art of using digital multimedia such as audio, video, and images to convey a story to a specific audience. Digital stories are primarily categorized into

¹ Mercer University, 1400 Coleman Avenue, Macon, GA, and mines_ro@mercer.edu

² Wells Elementary School, 101 Mattie Wells Dr, Macon, GA, and bmines@jones.k12.ga.us

personal stories, historical documentaries, and instructional stories [7]. There are seven key elements to consider when working with digital stories. Table 1 presents these elements and what each element means.

Table 1. Seven Elements of Digital Storytelling (Center for Digital Storytelling, Berkley)

Element	Meaning
1. Point of View	What is the main point of the story and what is the author's perspective?
2. A Dramatic Question	A key question must be asked to keep the viewer's attention and will be answered by the end of the story.
3. Emotional Content	Provide serious issues that come alive in a personal and powerful way and connect the story to the audience.
4. The Gift of Your Voice	This personalizes the story and helps the audience to understand the context.
5. The Power of the Soundtrack	Music and sound that support and embellish the storyline.
6. Economy	Use enough content to tell the story without overloading the viewer.
7. Pacing	Related to economy but relates to the rhythm of the story; how slowly or quickly the story progresses.

According to Clark [1], research on cognitive learning and different media technologies has shown that no specific media is inherently more effective than another. Using a video in lieu of a lecture or some alternative learning exercise is unlikely to be more effective; however, Denning [3] indicates that video can be an important media for motivating students.

Why Use A Video in the Classroom?

From a pedagogical view, teachers using instructional videos report that students are more enthusiastic about what they are learning, understand concepts more rapidly, and retain more information [6].

Listed below are four major reasons why teachers use videos in the classroom.

1. Can present complex material using images, video, and animations.
2. Bring experiments into the classroom to reinforce theory.
3. Allows students to go on a virtual field trip which bridges theory with practical applications.
4. Using video with sound appeals to students with different learning styles.

To be effective however, instructional videos must be used in conjunction with other learning and instructional strategies. Strategies and pedagogy should be embedded into videos to engage students. Students learn best when they are physically or intellectually engaged in a learning activity. Denning [2] states that video should be integrated into a three-part approach to instruction. A pre- and post-activity should occur before the video is presented.

Digital storytelling can be an effective learning tool for students who create their own stories [7]. This allows students to use their ingenuity and creative talents when conducting research for the video and while making the video. Brown et al. [2] indicate that digital storytelling increases their digital, global, technology, visual, and information literacy. As students conduct research, organize, design, create, and present their digital stories, all of these literacy skills are enhanced.

ENGINEERING DESIGN COURSE

EVE 406, Design and Analysis of Water Treatment Systems, is a required course in the Environmental Engineering Specialization at Mercer University in Macon, Georgia. In past course offerings, students were placed in teams of two or three to work on the process design of a water treatment plant. Each group selects and designs the appropriate unit operations and unit processes for either a ground water or surface water source. The treated water has to meet Primary and Secondary Water Treatment Standards. The project is turned in at the end of the semester along with a detailed technical report documenting the design, specifications, and equipment required for each process. This is quite an overwhelming task, however, students comment on how pleased they are to come up with a final product that can be shown to prospective employers. On more than one occasion, student teams have not been able to put forth the level of effort necessary to achieve the required outcome of a functional process design.

During the fall 2010 semester, the design project was dropped from being a course requirement and replaced with a digital storytelling project. Rather than work collaboratively on a team, each student was required to prepare a design module on some specific unit operation or unit process used for treating drinking water. The design module must use multimedia in a digital storytelling format. Students were required to complete their projects by the end of the semester and turn in a digital copy of their work which should be approximately 5 to 10 minutes in length. The main objectives were to get students excited about their projects and to be able to communicate the design of a specific process by presenting a design example and a case history using video clips, PowerPoint slides, design equations, and photos of actual equipment.

Traditional Project Assignment

Traditionally, students are required to come up with a conceptual design of the unit operations and processes necessary to treat specific source water as one of the requirements for EVE 406. The design must be documented in a 15 to 20 page report accompanied by appendices with sample calculations and equipment cut sheets. On past occasions, students generally dislike going through the process, but once completed they took pride in what they had designed and have something to show prospective employers.

Digital Story Assignment

This semester I decided to change the rules a little and allow the students to be more creative. The traditional team design project as mentioned above was replaced with each student preparing a design module. On the first day of class, a list of topics that I developed was distributed and students were asked to choose one of them or submit an alternative topic. Unbelievably, each student had selected their topic by the end of the class. The list of proposed topics for the design modules is presented in Table 2.

Table 2. Design Modules Selected by Students

1. Continuous Flow Activated Carbon Adsorption
2. Advanced Oxidation Processes
3. UV Disinfection
4. Electrodialysis
5. Reverse Osmosis
6. Air Stripping
7. Ion Exchange

Each design module was to be presented as a digital story, i.e. video. Students were told that they must explain the design of their unit operation or unit process by using video, audio, slides, pictures, PowerPoints, etc. in 5 to 10 minutes. No rubric or checklist was given to them to follow. I wanted students to be creative and approach the project with ingenuity.

The specific requirements for student design modules as taken from the course syllabus are described in the following paragraph.

You are required to prepare a 5- to 10-minute, narrated design module using digital storytelling for a specific unit operation or unit process used for treating drinking water. This will take a considerable amount of time to accomplish and will represent 30% of your final grade in this course. A list of potential unit operations and processes will be provided. Each student will have a different unit operation or unit process to work on. The digital story will explain how to design the specific process and illustrating the steps and equations that must be solved to properly design the systems. The equations must be properly cited by providing a list of all reference used. Photos and schematics of the unit operation or unit process should also be included. Appropriate design criteria shall be provided in tables and a list of manufacturers should be supplied as well. A minimum of one case history should be included in the project to show typical operating data for the selected unit operation or unit process. The completed digital storytelling project shall be burned on to a CD and turned in at the beginning of class on December 9, 2010.

RESULTS AND DISCUSSION

Pre-Survey

A pre-survey was taken before the students started developing their digital stories. Table 3 shows the questions on the survey and Table 4 are the responses.

The results of the pre-survey indicated that only one student had previously made a digital video and that most students considered their digital photography/movie making skill to be at the novice level. Students appeared to be anxious about making the digital story however, they thought that the assignment would an effective way to demonstrate their knowledge of the material. It was good to learn that the students had a high level of interest in preparing a digital video as indicated by the average rating of 3.21.

Table 3. Questions on Pre-Survey

1.	How many digital videos have you already made?
2.	What is your level of interest in preparing a digital video? Rate from 1 to 5 with 5 being very interested and 1 being no interest at all.
3.	How effective do you think this assignment will be in demonstrating your knowledge? Rate from 1 to 5 with 5 being the very effective and 1 being not effective.
4.	What do you consider your skill level in digital photography/movie making? N-Novice, I-Intermediate, or A-Advanced
5.	How anxious are you in completing this assignment? Rate from 1 to 5 with 5 being very anxious to 1 being not anxious at all.

Table 4. Student Responses to Pre-Survey

Student: Question	#1	#2	#3	#4	#5	#6	#7	Mean	Standard Deviation
1	0	1	0	0	0	0	0	0.14	0.46
2	3	3	3.5	4	4	2	3	3.21	0.78
3	4	4	5	5	4	3	4	4.14	0.76
4	N	I	I	N	N	N	N	N.A.	N.A.
5	3	3	3.5	3	5	4	3	3.5	0.88

To help relieve some of the uncertainty of making a digital movie, a 1-hour session on digital storytelling was scheduled with an instructor from Academic Technology. The hands-on session involved learning the fundamentals of using Movie Maker and Audacity software. A handout prepared by one of the authors was distributed to students to assist them in preparing their videos. It was entitled “Movie-Making Magic” and was presented at the GSCA Annual Conference on November 4, 2010. The handout listed several websites that provide background information on research and theory of why educators use digital videos in the classroom and described several “lessons learned” to aid new movie-makers.

Discussion of Post-Survey

A post-survey was taken after students had completed and submitted their digital stories for grading. Table 5 shows the questions on the post-survey and Table 6 provides the responses.

Students spent from 5 to 72 hours working on their digital movie with an average time of between 21 and 22 hours. This seems low since they had the entire semester to create the video. The software used most often was Movie Maker and Audacity. Only two of the 7 students used Imovie. Making the movie was an effective way to demonstrate students’ knowledge as indicated by an average rating of 3.71. Students’ also indicate they would be interested in making a movie in the future versus preparing a paper. After making this video, 4 students rated themselves at the intermediate

skill level and 2 at the novice level for making digital photography/movie making. The level of difficulty was ranked relatively high with an average of 3.71. Most students' did experience some anxiety during the movie making experience. Some of the comments indicated they had difficulty with different versions of the software they were using and recording the voice-overs. All but one of the students' said that they would recommend this kind of project as an assignment in the future.

Table 5. Questions on Post-Survey

1. How much time do you estimate that it took to make the digital movie? _____
2. Which software did you use to make the movie? Circle those that you used: Movie Maker (MM), IMovie (IM), Audacity (A), Other:_____
3. Now that you have made a digital movie, do you feel that this is an effective way to demonstrate your knowledge? Rate from 1 to 5 with 5 being very effective and 1 being not effective.
4. What is your level of interest in preparing a digital movie in a future course versus preparing a traditional design project and report? Rate from 1 to 5 with 5 being the very interested and 1 being not interested.
5. What do you consider your skill level in digital photography/movie making now that you have completed this assignment? Novice Intermediate Advanced
6. Rate the level of difficulty that your experienced making the digital movie? Rate from 1 to 5 with 5 being very difficult to 1 being very easy.
7. What was the level of anxiety that you experienced while making the movie? Explain.
8. Would you recommend this kind of project be assigned in the future? Yes or No

Discussion of Videos

From a holistic perspective, the quality of the videos prepared by my class exceeded my expectations. This is the first time trying this type of venue, and I am encouraged to use it again in this course and other engineering courses that I teach.

Most of the design modules were prepared using Movie Maker software that comes with PCs. A combination of slides with images, background music, and narration was used in the majority of the videos. In some instances, the music detracted from the main goal of the video which was to convey the design of a unit operation or process used in water treatment. Sometimes the music was too loud or an inappropriate selection was used.

I know students spent a lot of time learning to work with Movie Maker and Audacity and as a result, they sometimes lose their focus on the main objective which is design. The major complaint with the videos is that none of the students actually presented an example illustrating the proper sequence and the steps necessary to design their individual unit operation or process. One student did present the equations and sequence but they were not illustrated with a specific design flow or design in mind. Students tended to present the facts, e.g. tables with design criteria, images or photos of the process, and design equations.

Table 6. Student Responses to Post-Survey

Student: Question	#1	#2	#3	#4	#5	#6	#7	Mean	Standard Deviation
1	72 h	12-15h	10 h	24 h	20+ h	6 h	5 h	N.A.	N.A.
2	MM, A	MM	MM, A	M	IM	MM, A	IM	N.A.	N.A.
3	3	4	4	4	4	3	4	3.71	0.52
4	3	3	4	4	5	4	5	4.00	0.76
5	I	N	I	I	I	N	I	N.A.	N.A.
6	4	3	4	3	3	5	4	3.71	1.07
7	Not much	Some	Medium	A lot	High	High	High	N.A.	N.A.
8	Depends	Y	Y	Y	Y	Y	Y	N.A.	N.A.

SUMMARY AND CONCLUSIONS

Students in my undergraduate Water Treatment Systems design course were required to make a design module using digital storytelling in which they were to illustrate how a specific unit operation or unit process is designed. The digital video was assigned rather than a traditional design project and report that they have done in the past. The objective of having students prepare a video was to increase enthusiasm for the course material and allow them to communicate their knowledge using a multi-media venue. The major conclusions of this study are listed below.

1. All students were successful in making a digital video and they all were completed and turned in on-time.
2. Students felt like this was an effective way to demonstrate their level of knowledge of the material.
3. Most students experienced a mild level of anxiety while making the videos, however, 6 of the 7 students recommended that it should be used in future courses rather than a traditional project and term paper.
4. When I have students make a digital video in future courses, I will provide them with more guidance and a grading rubric to delineate the various areas in which they should focus their efforts to be successful.

REFERENCES

- [1] Clark, R.E., "Reconsidering Research on Learning from Media," *Review of Educational Research*, 1983, 53(4), 445-460.
- [2] Brown, June, Bryan, Jan, and Brown, Ted. "Twenty-first Century Literacy and Technology in K-8 Classrooms," http://www.innovateonline.info/pdf/vol1_issue3/Twenty-first_Century_Literacy_and_Technology_in_K-8_Classrooms.pdf, retrieved December 1, 2010.

- [3] Denning, David, "Video in Theory and Practice: Issues for Classroom Use and Teacher Video Evaluation," <http://www.ebiomedia.com/downloads/VidPM.pdf> , retrieved December 1, 2010.
- [4] Mines, Jr., Richard O. Mines, "Strategies for Enhancing Learning in the Classroom", *Proceedings of the ASEE Southeastern Section Annual Conference*, April 7-9, 2002, Gainesville, FL.
- [5] Mines, Jr., Richard. O., "Do PowerPoint Presentations Really Work?" *Proceedings of the National ASEE Conference*, June 23-27, 2001, Albuquerque, NM.
- [6] National Teaching Training Institute, "Video Strategies," <http://www.thirteen.org/edonline/ntti/resources/video1.html>, retrieved 12/1/2010.
- [7] Robin, Bernard R., "The Educational Uses of Digital Storytelling," <http://digitalliteracyintheclassroom.pbworks.com/f/Educ-Uses-DS.pdf>, retrieved 12/1/10.
- [8] Robin, Bernard R. and Pierson, Melissa E., "A Multilevel Approach to Using Digital storytelling in the Classroom," <http://discovery.coe.uh.edu/7358-f07/class1/multilevel-approach.htm>, retrieved 12/1/10.

Richard O. Mines, Jr.

Dr. Mines is Director of MSE/MS Programs and Professor of Environmental Engineering at Mercer University. He is a graduate of the Virginia Military Institute with a BS in Civil Engineering, a Masters in Civil Engineering from the University of Virginia, and a PhD in Civil Engineering from Virginia Tech. Dr. Mines has over six years of experience with CH₂M Hill and BLACK & VEATCH consultants and twenty-two years of teaching experience. He is a registered Professional Engineer in New Mexico. Dr. Mines has authored/co-authored over 100 technical and educational papers. He is the primary author of *Introduction to Environmental Engineering* published by Prentice-Hall. His research interests lie in water and wastewater treatment, modeling of bionutrient removal systems, and enhancing learning in the classroom. Dr. Mines is an active member of ASEE and ASCE.

Beth P. Mines

Ms. Mines is the School Counselor at Wells Elementary School in Macon, Georgia. She is a graduate of the University of Tennessee Knoxville with a BS in Communications and has a Masters and Specialist in Education in Counseling from the University of Florida in Gainesville. Ms. Mines has made over 20 movies for and with elementary students in areas of character education, academic motivation, classroom guidance, small groups, Black History month, bus safety, new-student orientation, and other school wide programs. In 2010, a movie entitled "Rocket to Success" won three awards at a local film festival, including Best Picture for grades K-2. She and Dr. Mines have been married for 19 years.