AC 2010-1012: PROMOTING TECHNOLOGICAL LITERACY BY UTILIZING PICTURES AND RECREATED ARTIFACTS

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Promoting Technological Literacy by Utilizing Pictures and Recreated Artifacts

Abstract

Today's students study and understand today's technologies. Few look back into history to study and understand the technologies from the past. Current engineering and engineering technology students study how to use modern tools to solve modern problems. Little do they realize that engineers and technologists from the past did the very same thing. The only difference was the type, variety, and number of tools they had to work with. Typically, they were far less sophisticated and complex. In many cases, they were actually quite crude. However, they served their purpose and worked. Problems were solved, ideas were turned into inventions, and dreams became innovations. Ironically, we struggle with many of the same problems today that were actually solved in the past. It is the understanding of past technologies and connecting them to current ones, that is important. To address this issue, a junior level interdisciplinary course has been created that explores a historical perspective of the development of technology and its impact on society in a global context. Within this framework lies the dilemma of how to make the subject interesting. Just offering lectures and discussion sessions does not do the subject justice. There had to be a better way to engage and capture the student's interest and curiosity. With this objective in mind, a project was initiated to accumulate or recreate technological artifacts from the past for the students to examine, touch, and even use. Then, in order to enhance the lectures, pictures, graphic images, and short videos were extensively used. Combining these techniques, the student's have become more engaged in the subject of technological literacy. The focus of this paper is to describe the methods undertaken to collect and recreate technologies from the past. The new artifacts were made using the tools and techniques from the past, just as engineers from generations ago did. Currently six collections representing a variety of technologies from different time periods exist and are used in the classroom. Future plans include adding more collections with additional artifacts obtained either through donation or recreation. The intention was to enhance and extend the student's understanding of past technological issues in order to better prepare them to solve the technological challenges they will encounter in the future.

Introduction

Early humans were keenly aware of their limitations. Their ability to see, hear, and smell was inferior to many other creatures. They also could not run very fast or fly. They were at a distinct disadvantage when compared to other animals. However, it was their ability to overcome these deficiencies that set them apart. By using their brain to visualize and then build devices to extend their capabilities early tools emerged. At first, they were quite simple and very basic. However, as time marched on, they were refined and improved. This inventive process has been repeated countless times since then.

Even today, there are numerous opportunities to make life easier, safer, produce more food, create shelters, clean up the environment, and meet a host of other challenges. These problems

and many others require solutions that may utilize technologies in novel and innovative ways. The search for a solution usually begins by looking at new and emerging technologies. Few people look at past technologies for present day solutions.

Students rarely have the opportunity to look back into history and study how engineers and technologists from the past solved the critical problems of their time. They concentrate instead on using today's technologies in proven or new ways. To address this issue of technological literacy, a course was developed to broaden the student's perspective of past technologies and how they were discovered and used. This junior level course, (TECH 393), titled Technology in World Civilization (Loendorf[8], 2004) has two main objectives. First, promote awareness of technological development, and second provide an understanding of the social, political, economic, and cultural impact of technologies.

The content of the course begins by exploring ancient technologies, progresses through history to modern technologies, and even looks into future technologies and their continual impact on society. Initially the course was lecture and discussion based with a few videos included for variety. It soon became apparent that the method of delivery for the course material had to be enhanced. With this objective in mind, a project was started to accumulate or recreate technological artifacts from the past for the students to examine, touch, and even use. Then in order to enhance the lectures pictures, graphic images, and short videos were extensively used. Combining these techniques, the students have become more engaged in the subject of technological literacy.

Theoretical or Conceptual Support

"As technology has become increasingly important in our lives, it has receded from view. Americans are poorly equipped to recognize, ... ponder or address, the challenges technology poses or the problems it could solve. And the mismatch is growing" (Pearson & Young[13], 2002). Most people's connection to technology is through finished consumer goods. They have very limited practical connection to the actual technology. "They do not build the devices they use, tinker with them to improve their performance, or repair them when they break. Because of this lack of engagement, people today learn relatively little about technologies through direct experience" (Pearson & Young[13], 2002).

Numerous definitions of technological literacy exist. "Technological literacy requires the ability of an individual to code and encode technological messages.... It means being able to understand and use words and their meaning" (Waetjen[17], 1993). "Technological literacy can be thought of a comprising three interrelated dimensions that help describe the characteristics of a technologically literate person... (1) knowledge; (2) ways of thinking and acting; and (3) capabilities" (National Academy of Engineering[11], 2008). "Technological literacy is the ability to use, manage, assess, and understand technology" (International Technology Educational Association[7], 2007). All of these definitions point to the knowledge and understanding of technologies.

"Common elements of technological literacy include knowledge about individual technologies, the process of technology development, the historical and cultural aspects of technology, and

adaptability based on creative thinking" (Loendorf & Geyer[10], 2009). Four competencies are required: "(a) accommodate and cope with rapid and continuous technological change, (b) generate creative and innovative solutions for technological problems, (c) act through technological knowledge both effectively and efficiently, and (d) assess technology and its involvement with the human life world judiciously" (Wonacott[20], 2001). This project was conceived and driven with these objectives for technical literacy in mind (Loendorf & Geyer[9], 2008).

One way to increase the practical connection to technologies is through a hands-on approach that implements some aspects of active learning. Active learning has been defined as "anything that involves students in doing things and thinking about the things they are doing" (Bonwell & Eison[2], 1991, p. 2). Through active learning, students become connected with the subject they are studying (Crawford, Saul, Mathews, & Makinster[4], 2005). Allen[1] (2002) and Tileston[15] (2007) have stated that this can be accomplished through application, demonstration, interaction, or discussion. Many positive learning outcomes resulting from using active learning techniques in the classroom have been reported by Bonwell and Eison[2] (1991), Davis[5] (1993), Sousa[14] (1995), and Weimer[18] (1991).

Pictures, Graphics, and Videos

"Humans have created images to convey meaning for thousands of years, but the idea of educating people for visual literacy developed over the past century concurrently with new communications technologies" (Felten[6], 2008). The use of pictures and other forms of graphics have been used for centuries to record events and transfer information. This process evolved into using the chalkboard for drawing images in classrooms. With the advent and utilization of modern presentation tools, like PowerPoint, this trend continues.

Today's educational system is creating a generation of students that learn visually. They are "intuitive visual communicators" and "more visually literate than previous generations" (Oblinger and Oblinger[12], 2005). However, "seeing is not simply a process of passive stimuli but also involves active construction of meaning" (Felten[6], 2008). Using PowerPoint slides containing pictures and other forms of graphics can promote an atmosphere of active learning (University of Minnesota's Center for Teaching and Learning[16], 2009). When used properly, PowerPoint is a beneficial learning tool. Unfortunately, PowerPoint is often overused and misused, with too many slides offering too much detail and text.

Initially this course was lecture and discussion based. However, describing a technology to someone that has never seen or experienced it is a difficult task. This is especially true for many retro and ancient technologies. In order to overcome this dilemma, a variety of pictures and graphic images depicting aspects of technology have been integrated into the lectures. By using a number of pictures in sequence, they create a storyline or storyboard that shows how a technology was developed and utilized. Each slide with a picture or graphic also contains a short textual description. Just a few words are included that offer an explanation while not diverting attention from the images.

In addition, selective videos are used to trace the historical evolution of technologies. They allow students to view the technology in action while it is actually being used. The videos used vary in length from a few minutes to an entire class session (50 minutes). The short videos are the latest addition to the presentation materials. These videos are incorporated seamlessly right into the lecture and discussion. In a few minutes, the students can see catapults, trebuchets, iron smelting, flintlock muskets, steam engines, assembly lines, and other technologies in operation. As a result, they acquire an added appreciation for the size and scope of many retro and ancient technologies.

The use of pictures, graphics, and videos has added a new dimension to the course. Rather than trying to describe how a technology functioned, the students can actually see it in action. They gain a better understanding for why a particular technology was invented along with how it was developed. The students become active observers of the creation and evolution of technologies through visual images enhancing their technological literacy.

Recreating and Collecting Artifacts

Technological artifacts were also either recreated or collected for use during the class sessions. Most of the recreated artifacts were technologies from ancient times. The processes used to recreate and replicate technologies from the past duplicated those used by early humans. The reproductions were made using tools and techniques from their historical period to insure the accuracy of the replicas. The recreated artifacts became not only exhibits for display during class sessions but also examples of the processes utilized to make them.

Collecting other type of artifacts offered further challenges. Most of these technologies were from the past two centuries, with others from more modern times. Many of these items were found in old barns, sheds, flea markets, and antique shops. Since there was no funding allocated to this project, only low cost items were purchased. Because of this constraint, the focus shifted to seeking donations of items for the collections. After some word of mouth advertising, this approach worked and many items were received.

One additional problem remained to be solved. The storage location for these collections was on a different floor and at the opposite end of the classroom building. How can all of these recreated and collected artifacts be transported easily to and from the classrooms? An outdated technology came to the rescue. While searching through the university's surplus building some old audio-visual (AV) carts were discovered. After some cleaning and decorating they became the perfect vehicle to transport the collections. In fact, they were called "Educational Delivery Vehicles" or "EDVs" to express the purpose of the old AV carts. Currently six are in use with two more undergoing repair and refurbishing. Even an old grocery cart has been called into service to transport one of the newest collections.

Recreating Historical Artifacts

This part of the project began by researching past hand held instruments and devices that could be recreated using the same tools and methods originally used. Ancient technology, in contrast to modern technology, is short on its documentation. As a result, one cannot just pull an ancient

period book from the shelf and read about the "then" current technology from 10 to 20 thousand years ago. However, there are two prominent people, who have studied the history of the stone tool period and learned how to recreate the artifacts of that period. By using the reference material researched and produced by Donald E. Crabtree[3] (1972), and John C. Whittaker[19] (1994), the process of building of a collection of Stone Age tools (Figure 1) was accomplished.

Figure 1. Stone Age Tools.

The first step was the creation of a basic set of what is referred to as flintknapping tools. Then, using this tool set, the creation of the rest of the stone and bone items included in the Stone Age tool collection was completed. This tool set turned out to be surprisingly sharp, so to help insure the safety of the students, all of the Stone Age tools were purposely dulled. Beyond the basic tools, this collection also includes: stone choppers, sinkers, digging stones, arrowheads, hand axe and axe head, animal hide pouch, bone awl, obsidian, and flint samples. The creation process on this part of the project was long, requiring seven months before the implementation date.

Collecting Historical Artifacts

Some historical technology still exists; the challenge is finding it at a reasonable cost. After a great deal of searching, the process of building of an exhibit of Pioneer Days technology was begun (Figure 2). The barbed wire used in this project was bought from sources in Texas, some dating to the late 1870's. Other items like the glass insulators were purchased locally or donated by students and staff.

Figure 2. Pioneer Days Technology.

All items required cleaning, with special attention given those made from metal – they were sandblasted and painted with a rust-inhibitor. This collection also includes: railroad spikes, animal traps, hay hook, various sized horseshoes, scythe, plow shears, porcelain-enamel pots, and oil lamps. To be able to deliver and display these artifacts in context, an AV cart was modified, by attaching two weathered wooden posts to the front of the cart. Barbed wire was then nailed to the posts. Additional posts were attached to the rear of the cart to display the glass insulators.

Collecting Modern Artifacts

More modern artifacts are found in relative abundance. A collection of plastic based technology was a relatively low cost endeavor. By searching through local second-hand stores the process of building a collection of Plastic's technology (Figure 3) proceeded. As the collection grew, the focus shifted to two areas; items that could be found in the food isles of grocery stores and items that were non-food related.

Figure 3. Plastic's Technology.

To help deliver and display these items in their proper context, a plastic coated grocery cart was acquired and modified. This collection includes recyclable-labeled products, numbered 1 through 7, and items that show a wide variety of different manufacturing processes. The pros and cons for each of the plastic type are discussed in class along with their environmental ramifications.

Lessons Learned

Several lessons have been learned while integrating recreated artifacts, collected retro technologies, graphic images, pictures, and videos of varying lengths into the class sessions. All of these lessons learned have been implemented, in one form or another, right into the classroom experience. As a result, what began as purely lecture sessions have been transformed into lecture, discussion, demonstration, and hands-on activity periods.

The addition of collected or recreated artifacts has expanded the students learning experience from that of a passive observer to an engaged involved participant. They can now examine, handle, and pretend to use the artifacts whether they were technologies used as a tool, weapon, armor, or for a host of other purposes. Not only do the students understand how and why the devices were used, but they also understand how they were made including the time and effort involved.

The use of graphics, pictures, and videos, has made it easy for students to experience visually exactly how retro and ancient technologies were utilized. The uses of ancient and old technologies are no longer left solely to their imagination. Instead, they can see them in action. The technologies are brought to life in ways that words alone could never accomplish. The graphic images and pictures also added variety to the lectures. However, it was the videos that

really displayed the capabilities of old and ancient technologies. Regardless of the length of the video, they depicted through reenactments exactly how technologies were operated and worked.

Overall, the students were more enthusiastic and positive about the learning experience. They became more involved and engaged in the learning process. As a result, they derived more from the course than was possible prior to the integration of actual artifacts, graphics, pictures, and videos. Incorporating a visual and hands-on component to the lectures fostered very interactive results in terms of questions and more in-depth discussions. Although not totally unexpected or unanticipated, it was still encouraging to realize this outcome. This aspect of the project, by itself, has made it a worthwhile and rewarding experience. By using a variety of different presentation styles, more students were able to relate directly to the material and learn from it.

This was also reflected in the course and faculty student evaluations completed during the last class session of the term. Their comments were always very positive and favorable. This was exhibited in the enrollment increases for future sections of the course. Students were recommending the course to their friends and encouraging them to take the course. This was a bit of an unanticipated consequence of the project, although well received.

Conclusions, Reflections, and the Future

The study of past technologies utilizing recreated artifacts, collected objects, graphic images, pictures, and videos has enhanced the student's level of technological literacy. The relationship between people and technology is now better understood in terms of its social, cultural, political, and economic aspects. The problem solving ability of previous generations of humans along with their desire to invent and develop new tool, techniques, and processes are also more appreciated. The objective to enhance the student's understanding of past technological issues in order to better prepare them to solve the technological challenges they will encounter in the future has been met.

Reflecting back, the use of artifacts, pictures, and videos has transformed a passive learning experience into an interactive dynamic environment filled with lively questions and discussions. However, this came with a cost. Extensive preparation time was required to recreate the artifacts, pictures, graphic images, and collect videos. However, increased student awareness, interest, and participation in the class resulted, making it a very worthwhile project.

What began over three years ago as an idea has taken on a life of its own. The concept of bringing old technologies to life and allowing students to touch and examine them has added a new dimension to their learning experience. As the years passed new collections were added. And this trend is expected to continue.

Future plans include adding more collections with additional artifacts obtained either through donation or recreation. Artifacts for the new collections are currently being made using the tools and techniques from the past, just as engineers from generations ago did. Donations for other new collections are also being accepted with the items being added to the collections as well. It is clear that the project is by no means complete, but rather just in its beginning stages. There is a lot more that can and will be done using these techniques to promote technological literacy.

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