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Technology and Practice in a Historical Context: Building the Civil War *Submarine* Pioneer

By Dr. Roy Bonnette

Activities that replicate lost historical artifacts provide students with a unique opportunity to explore the origins of present day technology. Understanding the evolution of manufacturing technologies plays an important role in teaching real-world concepts and skills to technology students. Employers are interested in students that have had industrial exposure as well as a depth and breadth of academic experiences. Community outreach projects can be one of the main avenues of student success in this arena. As Dewey (1938) noted, life experiences and knowledge are inseparable. This article focuses on an academic service learning project performed in conjunction with the Lake Pontchartrain Basin Maritime Museum and regional industries. Utilizing historical records from the 19th century provided Southeastern Louisiana University students with the opportunity to use modern technology in the reconstruction of a Civil War submarine (see Figure 1).

Students and faculty from Southeastern along with industrial representatives and museum curators combined their skills and talents to develop a full-size replica of the Civil War submarine, the *Pioneer*, which was originally built in New Orleans in 1862 (Regan, 1999b, p.50). This submarine was a predecessor to the famous Civil War submarine the *Hunley.* The *Pioneer* was designed and financed by Hunley and others living in New Orleans in the early 1860's (Regan, p.86). Because the museum's work is accomplished through community level affiliations and volunteers, it became an appropriate venue for the direct involvement of technology students. Specifically, this project was a form of Southeastern's Problem-Based Service-Learning (PBSL). Projects of this type provide students with an opportunity for stimulating and exciting interdisciplinary learning experiences. In building the submarine, students were required to integrate their knowledge and skills from technology courses along with mathematics, physics, and history while working with master technologists from the local industrial community. Students had a first-hand opportunity to work with the Maritime Museum in developing drawings and taking part in the actual construction of the full-size Civil War submarine replica. Through such experiences, students have the opportunity to contribute to the local community in meaningful ways, gain new skills, and see the concrete results of their contributions.

The Maritime Museum's mission is to "provide an education and research center to collect, interpret, and preserve the maritime and cultural history and artifacts of the Lower Mississippi River Basin for public benefit". Students became part of a regional effort to recreate a historically significant maritime craft. When University students first became involved with the project, builders at the museum were working from artists' reproductions of the *Pioneer* submarine without the benefits of detailed drawings and specifications. Students were able to provide detailed drawings computer models of the *Pioneer* submarine from historical records (Regan, 1999b p.91). Students also participated in the actual fabrication of the submarine.

Historical Perspectives

The *Pioneer*, was originally built in New Orleans in 1862 (Regan, 1999b). James McClintock designed the boat working with Horace L. Hunley and Baxter Watson. McClintock would later write after the war that:

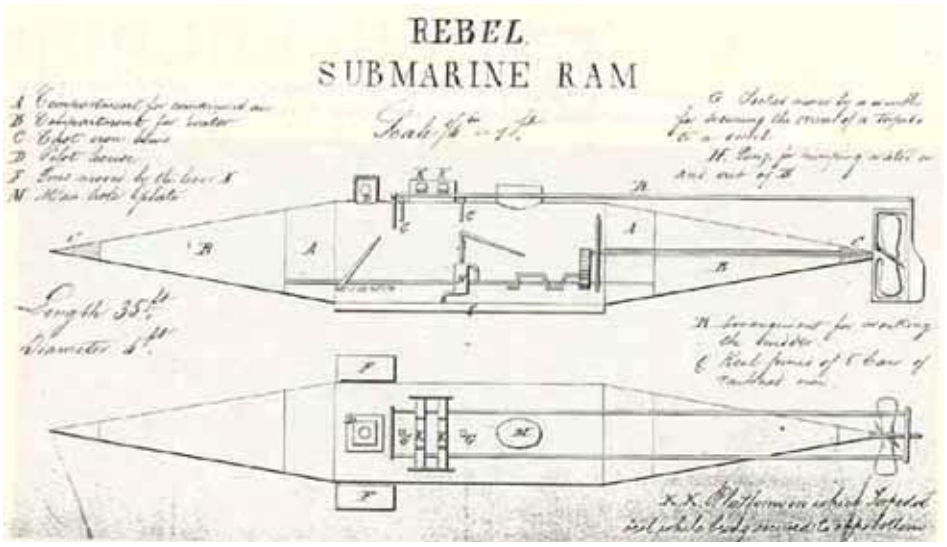
> *"At New Orleans, in 1862, we built the first boat. She was made of iron one-quarter inch thick. The boat was of cigar shape 30 feet long and 4 feet in diameter. This first boat demonstrated to us that we could construct a boat that would move at will in any direction desired, and at any distance from the surface. As we were unable to see objects passing under the water, the first boat was steered by compass." (Regan, p.50).*

The original *Pioneer* submarine was constructed in response to President Abraham Lincoln's Union Blockade at the mouth of the Mississippi and the Atlantic coast. In response, Confederate President Jefferson Davis invited applications for "Letters of Marquee" encouraging that actions be taken against federal ships (McNeill, 2003 p.9, Wills, 2004, para. 7). The submarine was constructed at the Leeds Foundry on the corner of Delord and Constance streets in New Orleans (Williams Research Center, 2004). According to the Louisiana Division of the New Orleans Public Library (2003), Charles J. Leeds, a partner in the foundry, would go on to become the thirty-third Mayor of New Orleans in 1874. It was anticipated that the *Pioneer*, or submarines like her, would help the South break through the blockade and reestablish supply roots with the Atlantic coast (Regan, 1999c).

The *Pioneer* carried a floating mine on top of her hull that would be released and pulled a by rope through the water (Cussler & Dirgo, 1996). Timing would be of the essence as the mine was expected to explode against the side of a targeted ship as the submarine maneuvered safely under and past the ship. The original submarine was put through sea trials in Lake Pontchartrain, and it was reported that the submarine was successful in completing numerous dives, sinking at least one barge, several rafts and a schooner in the lake (Cussler & Dirgo, 1996). Shortly after her sea trials the submarine was intentionally sunk in the New Basin Canal as a result of the impending invasion of the Union army. At an unspecified time the submarine was salvaged from the bottom of the New Basin Canal by the Union Army and placed on its banks where it would remain until sold. On February 15, 1868, *The New Orleans Picayune* reported that the *Pioneer* submarine, still in her original shape, was sold for scrap metal (Regan, 1999c, p.52). Just before the capture of New Orleans, McClintock, Hunley, and Watson escaped to Mobile, Alabama. (Cussler & Dirgo, 1996). Here they would design and build the *Pioneer* II and later the infamous Hunley. Now 142 years later, students used the same plans that Hunley and others detailed to recreate a valuable piece of Civil War and history.

Figure 1

Figure 2



Project Goals for Students

Goals for students involved in the service learning project were as follow:

- Understand the mission of the maritime museum
- Develop an appreciation for community service
- Develop new skills and techniques for drawing marine craft
- Demonstrate problem-solving skills as well as skills in analyzing information
- Work under the guidance of master builders from industry, the museum and faculty
- Historical research on technical literature
- Develop detailed CAD drawings of the *Pioneer* submarine
- Develop CAD solid model of the submarine
- Participate in the actual construction of the submarine

Project Organization

Instructional practice was realigned to facilitate the following:

- Monitoring: Developing an effective means of gathering regular feedback from community partners and students
- Advisory Group: Incorporating multiple perspectives through community advisory groups
- Interdependence: Creating an diverse set of activities that facilitates community members co-teaching
- Transformations of appraisals of outcomes: Developing joint outcomes that meet the needs of both the educational institution and the community partners
- Affirmation: Developing an effective means for affirming the value of the partnership

The above was adapted from "Campus-Community Partnerships: The Terms of Engagement" (Bringle & Hatcher, 2002, p.510-511)

Meetings were held with industrial representatives, the museum's art curator, students, and IT faculty to discuss the project goals and to develop a plan to coordinate activities. The students' involvement began with becoming familiar with the mission of the Maritime Museum through researching and discussing the history and philosophy of the organization's founders. Students visited the museum to develop a more comprehensive understanding of the contributions that the museum makes to preserving local and regional history. Collaboration with the museum and its curator expanded their knowledge of the current state of welding and drafting technology and their origins. These activities provided opportunities for innovative approaches to replicate manufacturing technologies of the past.

Situated in the heart of bayou country, students investigated boiler making and sugar kettle construction techniques of the 19th century to understand how the sections of the submarine may

Figure 3

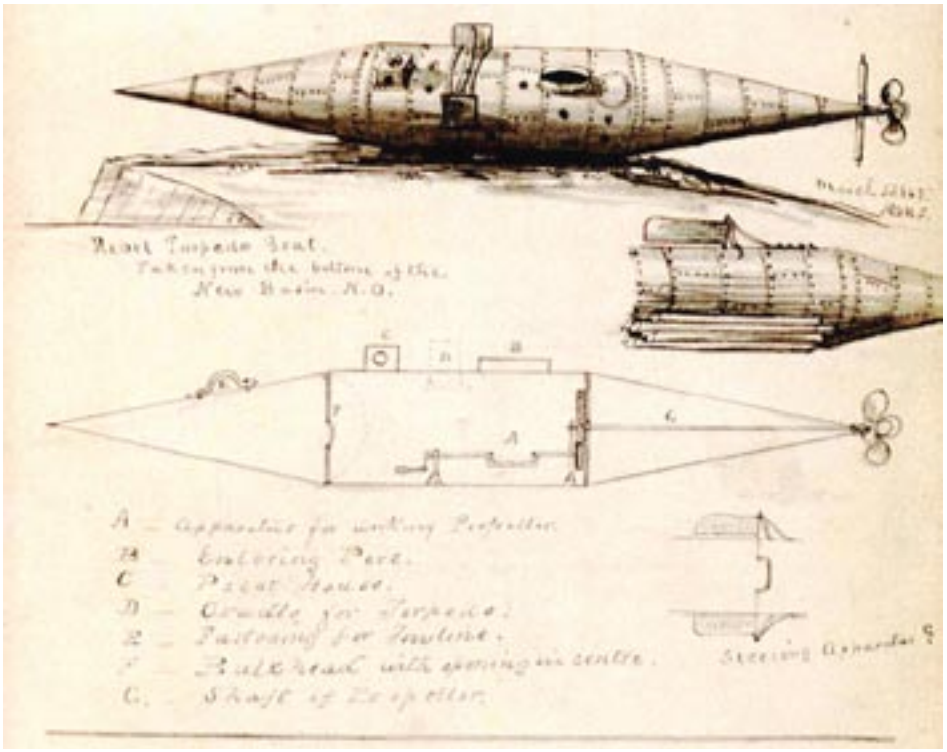
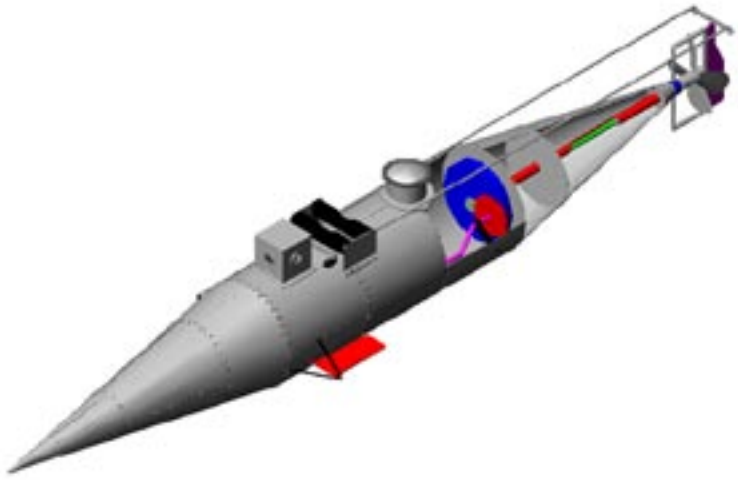


Figure 4



have been fastened together. A truly interdisciplinary study into the history and philosophy of science and technology was an essential component for completing the project. Students were encouraged to consult with faculty from the history, mathematics, and physics departments on campus. Questions were raised and answered regarding the roots of technology, materials, and fabrication techniques needed to replicate one of world's oldest submersible marine vehicles.

Student Participation

While there are no original detailed drawings of the submarine and her fittings, there are some accurate renderings that provided insights into her size and construction details. After the *Pioneer* was removed from her watery grave by the Union Army, William H. Shock, a fleet engineer in the Union Army, completed a scaled set of drawings (see Figure 2). These remain as the only partially detailed drawings of the Confederate craft. The drawings illustrate the interior of the boat as viewed from the top and side. However, besides the overall length and diameter, few dimensions were given (Regan, 1999b). A second drawing, by Ensign David M. Stauffer, was also completed in 1865 (Louisiana State Museum, 2002), (see Figure 3). This rendering gives indications of the ship's lapped hull design and the methods that were employed during her construction. From these illustrations and other written historical records, students were able to reproduce detailed drawings and developments that were needed for the construction of the full-size replica. To enhance the visual aspects of the project, students also developed a solid model of the entire submarine with CAD. This three-dimensional computer model helped in the calculations of weight (displacement), center of gravity, and buoyancy. Students were able to experiment with theoretical balancing of the craft during submersion or surfacing. A 3D prototype was also developed that assisted students in determining the physical constraints of the steering and propulsion systems (see Figure 4).

Students who are members of American Welding Society (AWS) participated in the construction of the submarine's midsection that is 4' in diameter and 11' 2" long. The original midsection of the *Pioneer* was composed of six cylinders. Each cylinder was constructed from three pieces of ¼" steel plate that were most likely, given the technology of the time, heated and bent into shape. The steel plate used in the current project was of identical size and was rolled into shape. The steel was donated by Trinity Marine in Madisonville, Louisiana, and rolled at Nugent Steel in Port Allen, Louisiana. The original sections of steel were riveted together using an internal backing plate at each seam. Under the direction of industrial representative Mr. George Fairbanks, students fitted and back welded the cylinders together. Backing plates were then added to lend the effect of riveted construction. Because the submarine is displayed on the second floor of the museum, weight restrictions prohibited the entire craft from being made from steel. Again, weight calculations were determined from the students' 3D models. The Maritime Museum built the conical ends of the submarine out of wood that was textured and painted to give the appearance of steel construction.

Benefits to the Students

An integral component of a successful technology program allows students to benefit from working under the guidance of master teachers, designers, and builders. As Lee notes, "assimilating the materials and making connections are more creative and holistic processes . . ." when realized through collaborative learning (2003, p.86). This project also became an excellent opportunity for technology students to realize the necessity of the accurate detailing required in marine design and engineering. Students met with faculty on a regular basis over two semesters to review the progress of their work, incorporate new understandings, and have technical questions answered.

Mentoring relationships with faculty, museum, and industrial representatives provided students the opportunity to improve their occupational skills development. Working on volunteer projects within the community also enhanced the technology students' intellectual, personal, and social maturation. Student Sam Chapman who was involved in the constructions of the midsection stated "This is a great way to apply the skills I learned, while realizing you can build something the old fashion way" (S. Chapman, personal communication, September 18, 2004). Senior Annie Labruzzo who contributed to the drawings stated "The mechanisms of the *Pioneer* were simple, but they worked. I came to appreciate the methods the creators used to put her together". (A.P. Labruzzo, personal communication, September 15, 2004). The significance of the 19th century technology became relevant to the students as it was placed in the context of the Civil War. The development of the original Pioneer was a real word problem that gave rise to the evolution of new technologies.

Deliverables

Technology students were required to construct electronic and hard copy portfolios as part of the individual and team-generated deliverables. Students submitted their work electronically on a weekly basis prior to meeting with the technology instructor. These portfolios are a component of formative assessment that utilizes pre-established benchmarks for purposes of evaluating and tracking student performance over time. Short-range goals could be modified each week that reflected the student's strengths and weaknesses. The faculty involved would provide additional instruction or resources if needed. Assessment of this type provides technology students with an opportunity to capture evidence of their accomplishments. In addition, these ongoing assessments provided students with the motivation to continue to improve their submissions.

The student portfolios are also a representation of organized artifacts that can be used to present to future employers. Portfolios are indicative of technology student's learning, experiences, and work-readiness qualifications. In addi-

tion, the portfolios were used to pass on to the next group of students who might work on similar projects. Finally, the portfolios were an excellent measurement tool for teachers when self-evaluating their instructional effectiveness.

Summary

The reconstructed *Pioneer* made its début at the Wooden Boat Festival in Madisonville, Louisiana, on October 25, 2003. The submarine is on permanent display in the Maritime Museum. The intellectual partnerships that were cultivated by this historic project will serve faculty and technology students from Southeastern well into the future. Students have come to an understanding that a historical perspective of the technologies utilized almost 150 years ago can enhance future opportunities.

Students were held to professional and technical accountability. Technology students developed complete sets of drawings and provided fabrication that was instrumental to the projects completion. This process was put in place to reproduce standard industrial practices and to give students the experience of accomplishment that is achieved when they maintain their commitment to community-based responsibilities. As Hill notes, "service learning projects not only provide technological artifacts that have real-world purpose and value, but they cultivate desirable attributes of citizenship and charity that are beneficial to society (2004, p.11)."

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