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Toys Redesigned: The Intersection of Industrial Technology and Service-Learning Principles

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Wooden fish puzzle.
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toys redesigned:
the intersection of industrial technology and service-learning principles

This project promoted students' understanding of the importance of diversity of communities and cultures, and educated them on the challenges faced by children who are undergoing cancer treatments.

by
Jill Stefaniak, Petros Katsioloudis, DTE, and Basim Matrood

While industrial technology students are provided with many opportunities to hone their design skills in the classroom, opportunities to design for a variety of contexts is often limited to internships and cooperative education experiences. As aspiring designers, it is imperative that students develop the necessary skillsets to be flexible, adaptable, and cognizant of their clients' needs while problem-solving design solutions (Cross, 2011). Many instructors in higher education face the challenge of identifying authentic, situated learning activities that align with students' needs and existing performance levels (Stefaniak, 2015a). When designing situated instruction, it is important that learning activities allow for flexibility in order for instruction to be adaptable to learners' goals and contextual needs (Nicaise, Gibney, & Craine, 2000).

Instruction, grounded in situated cognition, bridges the gap between concepts traditionally taught in a classroom setting and real-world applications to provide practical experiences (Brown, Collins, & Duguid, 1989; Collins, 2006). "Situated learning places emphasis on learning in a variety of different contexts to help students utilize their critical thinking skills to begin generalizing information and identifying how it can be applied within different contexts" (Stefaniak, 2015b, p. 50). These learning experiences assist students with reflecting on how what they are learning can be translated to different projects and contexts and allows them the opportunity to gain practical experience. In addition, situated learning experiences promote problem solving and creativity as students make decisions that are going to impact a real situation.

To provide students with a situated learning experience that encouraged them to develop creative design solutions, the authors created a service-learning activity that required industrial technology students to apply design principles and procedures to design and develop toys to be given to pediatric patients at a local children's hospital. This project bridged disciplinary with civic engagement. Students were required to address course competencies through the design of toy prototypes as well as the unique needs of their pediatric audience.

This project was carried out in two industrial technology courses focused on industrial materials and processes. These courses promote the study of ceramics, plastics, composites, and biotechnological materials. Students are responsible for researching and designing enterprise systems for mass production. Emphasis is on manufacturing design requirements and the social, cultural, and economic impacts of manufactured products on society and the environment.

Benefits of Service Learning

Service learning is an instructional strategy that combines academic coursework with real-world application. An instructional activity must meet three criteria to be considered service learning: (1) the activity must meet a community need; (2) there must be curricular alignment between the activity and coursework; and (3) there must be a reflective component to assist students with making connections between coursework and real-life practice (Bringle & Hatcher, 2009). A benefit to service learning is that it meets reciprocal needs: students benefit from the hands-on learning experience, and members of the community benefit from services or assistance they may not otherwise receive. From an academic standpoint, these types of activities provide students with an opportunity to develop portfolios showcasing actual design artifacts that may be useful during job interviews.

Redesigning Toys in the Classroom

As a part of the activity, students were responsible for brainstorming, designing, fabricating, and testing several types of toys appropriate for three different age groups of cancer patients (ages 4-6, 7-11, and 12-18). Following the engineering design process and the guidance of the instructor, the students identified several ideas for toys. They needed to be able to develop sketches and have basic knowledge of drafting and computer-aided design skills. Students were allocated time during the semester to conduct research on the use of materials and tools required in the production of appliances.

At the beginning of the semester, students were assigned to small groups to brainstorm ideas for the three patient populations (ages 4-6, 7-11, and 12-18). Once the groups identified three ideas, the instructor listened to each and helped to identify important aspects of each idea. This was an important step, as students usually reject other ideas by choosing one and ignoring important components. Once the main three ideas were chosen, students began working on their prototypes. During this process, the students manufactured jigs that aided in the manufacturing of the final product. It was important that the toys chosen were complex enough to force the pediatric patient to spend a significant amount of time solving the toy or puzzle, but it was also important that the toys were simple enough so that the industrial technology students could manufacture them within the designated amount of time.

Once the prototypes were completed, the students created a lab layout so the equipment could be moved and adjusted for the most efficient path but to also identify bottlenecks in the process. Time studies were required from the construction of the prototype until the end of the manufacturing process. Each student was given a designated assignment during the production process, allowing him or her to perfect the specific process and cut time down to a minimum. Upon production of the toys, students were responsible for the creation of the packaging and instructions that accompanied each toy. It was important that all toys and packaging used nontoxic materials since the toys were being given to a health-compromised patient population.

Students used a number of different instruments and fixtures to test the toys they produced for quality-control purposes. It was important that each process be tested at the station of manufacturing to guarantee one hundred percent quality since any rejected parts would not be allowed to move to the next station. Activities such as the one described here are easy to correlate with *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA/ITEEA, 2000/2002/2007). See Table 1 for correlations with the *STL* standards.

Photo 2. Wooden Block Toy.

Student Learning Outcomes

Student performance was evaluated in a variety of ways. Students were responsible for developing draft designs and prototypes that adhere to industrial technology design principles. In addition, the service-learning components associated with the project helped the instructors assess the students' ability to take their end user (pediatric patient) into account when considering design. In particular, this project promoted students' understanding of the importance of diversity of communities and cultures, and educated them on the challenges faced by children who are undergoing cancer treatments. Table 2 (next page) demonstrates how the activities for this project aligned with characteristics of situated learning.

In the reflective exercise, several students noted that the toy activity helped foster their creativity and improved their ability to solve problems and work in team settings. Others stressed the importance for using exact measurements when designing the various pieces that needed to be assembled to complete the project. The following are excerpts from student reflections addressing the technological skills used and key takeaways from the project:

- "I was able to use my mechanical skills in this project by knowing how to operate the drill press and by cutting all the pieces that were needed and assembling them."
- "We were supposed to use most of the tools that we have been practicing using, such as a saw to cut the board, the pegs, the edges, and making holes after measuring the distance between them (math skills), not just the math skills, it also applied to designing (design skills)."

Table 1. Correlation with *Standards for Technological Literacy*

The Nature of Technology	Technology and Society	Design
Standard 1: Students will develop an understanding of the characteristics and scope of technology.	**Standard 4:** Students will develop an understanding of the cultural, social, economic, and political effects of technology.	**Standard 8:** Students will develop an understanding of the attributes of design.
Standard 2: Students will develop an understanding of the core concepts of technology.	**Standard 5:** Students will develop an understanding of the effects of technology on the environment.	**Standard 9:** Students will develop an understanding of engineering design.
Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.	**Standard 6:** Students will develop an understanding of the role of society in the development and use of technology.	**Standard 10:** Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
	Standard 7: Students will develop an understanding of the influence of technology on history.	

Note. Adapted from *Standards for Technological Literacy: Content for the Study of Technology*. (International Technology Education Association [ITEA/ITEEA]. [2000/2002/2007]. Reston, VA: Author).

Another theme that emerged from the post-project reflections was the importance of teamwork in a design environment. Students shared:

- "This project gave me experience with team building as well as using machinery that I hadn't had much experience with that I will most likely need in the future."
- "The skills learned while using all of the tools in the lab as well as the teamwork involved in all of the team labs will be lifelong lessons held dearly because once you learn those skills they do not go away."

The incorporation of the guided reflective exercise helped students take a moment to reflect on how they had applied course competencies to an authentic project context. By focusing on a pediatric population, students witnessed how their efforts could be used to benefit the community. Recognizing the impact that their toys would have for patients at the children's hospital, students shared:

- "It is something bigger than just making a child smile and play and affecting them positively."
- "I felt that it was a great opportunity to utilize individuals who are there to learn to make something with their hands and learn a new skill possibly or share their knowledge with others to learn a new skill. It also made me proud to be a part of a university that does something like that. I think some programs take for granted what they have at their fingertips. It is so easy to give back to someone in need...and utilizing resources for a common good in the community."

Conclusion

It was our intent that this project serve as an introduction for industrial technology students to understand how their efforts can be transformed and leveraged to meet other community needs outside of workforce training. Not only did this project promote creativity, it also identified other ways that industrial technology can be used. Incorporating service-learning principles into the assignment allowed for course competencies to be aligned with attributes of civic engagement. This activity demonstrated to students that they can apply their design knowledge and experience and direct it to design for different settings, including those that benefit the greater community.

Table 2. Alignment with Characteristics of Situated Learning

Characteristics Associated With Situated Learning (Herrington & Oliver, 2000)	**Toys Redesigned Project**
1. Provide authentic contexts that reflect the way knowledge will be used in real life.	Students worked to design and develop toys for a pediatric population.
2. Provide authentic activities.	Students used industrial materials knowledge to develop toys.
3. Provide access to expert performances and the modeling of processes.	Instructors provided support and guidance to students during the course of the project.
4. Provide multiple roles and perspectives.	Students worked in teams to design and provide feedback on prototypes.
5. Support collaborative construction of knowledge.	Students worked in teams to develop several prototypes before moving onto development.
6. Promote reflection to enable abstractions to be formed.	Students completed a reflection at the end of the semester addressing the service-learning components associated with the assignment.
7. Promote articulation to enable tacit knowledge to be made explicit.	The use of prototypes required students to articulate their specific design decisions for the toys.
8. Provide coaching and scaffolding by the teacher at critical times.	This project was carried out in several phases throughout the semester to scaffold the instruction and allow for adequate feedback from the instructors.
9. Provide for authentic assessment of learning within the tasks.	Students were evaluated on their knowledge of materials as well as their ability to design for a unique context.

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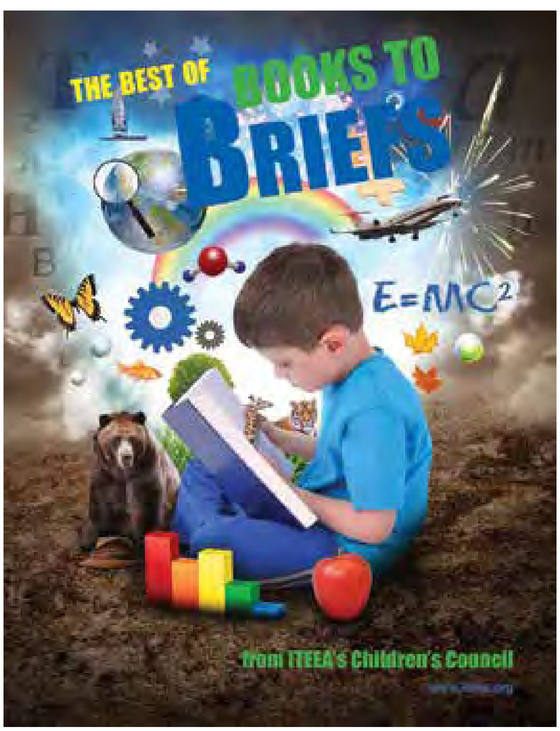

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