AC 2011-1190: DESIGNING STEM KIOSKS: A STUDENT PROJECT THAT TEACHES

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DESIGNING STEM KIOSKS: AN EXPLORATORY STUDENT PROJECT TO TEACH ERGONOMICS AND HUMAN FACTORS

Abstract

This paper explains how sophomore-level Interior Design students in a three-dimensional studio class were involved in a real-life design project in which the main emphasis was STEM (Science, Technology, Engineering, and Mathematics). The paper starts with a brief background about the STEMworks Indiana project and how it was integrated into the “INTR-225 Three-Dimensional Interior Design Studio” course at Indiana University – Purdue University Indianapolis (IUPUI), and then it presents assessment methods. Finally, it concludes with a discussion about lessons learned and future suggestions.

1.0 Project Background

STEMWorks Indiana is a collaborative initiative between the Indianapolis Private Council and IUPUI. It is a million-dollar initiative awarded by the U.S. Department of Labor to one of 92 applicants nationwide. The main emphasis of STEMWorks Indiana is to help qualified high school students and unemployed workers find their paths to high-demand jobs in Science, Technology, Engineering, and Mathematics in Central Indiana. It is a highly ambitious three-year initiative that will impact STEM industries throughout the state. The initiative aims to serve approximately 400 displaced workers and 100 disadvantaged students. Priority will be given to African American and Hispanic/Latino high school students who are enrolled in Indianapolis Public Schools and the Central Nine Career Center.

In order to better serve those individuals with STEM interests, STEMWorks Indiana created the “STEM Centers of Excellence.” In these strategically selected locations (three major WorkOne Centers and two area high schools), specially designed kiosks provide uninterrupted electronic communication about STEM jobs and self-help for individuals to decide a pathway to a STEM career. These kiosks are connected to the Internet and can be remotely operated and updated by the STEMworks Indiana Research Team from anywhere.

In order to design the kiosks, the STEMWorks Indiana Research Team approached the author, who has experience in industrial design. As both an outside consultant for the team and a higher educator, the author suggested offering the project as a class assignment to give students real-world opportunities to work with real-world clients. The outcomes of the project significantly contribute to student education, seamlessly overlap the STEMWorks Indiana mission, and fall into the course’s objectives. Therefore, the team gladly accepted the offer. After initial preparations, the project was assigned to students during the mid-spring semester of 2010.

2.0 Methodology

IUPUI’s Interior Design Program is accredited by the Council for Interior Design Accreditation (CIDA). According to the Professional Standards publication published by CIDA in 2009, Standard 3 mentions that “the work of interior designers is informed by knowledge of behavioral science and human factors”. Moreover, the same standard mentions that students in CIDA-accredited institutions must demonstrate “the ability to select, interpret, and apply appropriate
ergonomic and anthropometric data” and “the ability to appropriately apply universal design concepts”\(^2\).

The project of designing the kiosks was aligned with this standard and its sub-sections. There were a total of three benchmarks identified at the beginning of the project. Each benchmark has qualitative feedback and is critiqued as part of the assessment. Due to the timing of the adoption decisions and mid-semester insertion, six weeks of class time were devoted to the design development stage. Two weeks were dedicated for each of the three benchmarks; therefore, six weeks were allotted for the whole project. These benchmarks are explained in detail below.

### 3.0 Benchmarks

**Benchmark I:** During the first two weeks, team members from STEMworks Indiana visited the class and introduced the project to students. In depth information about the project was provided, the framework of the project was established, and questions were answered. WorkOne centers, where the finished kiosks are located now, were identified, and photos of the interior were shown.

The second task of the first benchmark was to gather anthropometric and ergonomic data. Students were assigned to create their own “sample” anthropometric data by measuring their own bodies and applying the ergonomic data creation methods outlined in two books: Panero and Zelnik’s *Human Dimension and Interior Space: A Source book of Design Reference Standards*\(^3\) and Tilley’s *The Measure of Man and Woman: Human Factors in Design*\(^4\).

In the spring semester of 2010, the total enrollment of the INTR 225 class was 13 students, of which 12 were females and 1 was male. Since this sample group was not balanced in terms of gender and could not represent the target user population, students were instructed to find and measure one opposite-gender person outside the class roster. In the end, the sample group was equalized with a total of 26 people.

Due to privacy concerns, results of the anthropometric and ergonomic data gathered in this study will not be shared in this paper.

The third task of the first benchmark was to create concepts. Students used freehand sketching, digital and traditional mass studies, and other concept development techniques. In this stage, they also used their own data, which they had created by measuring their own bodies, to shape their designs and establish key dimensions such as keyboard and LCD TV locations. Figure 1 shows an example of one student’s freehand sketch with annotations.
Figure 1. Sample student sketch.

*Benchmark II:* After receiving feedback and approval from the instructor at the end of Benchmark I, students moved to the second benchmark, where detailed drawings were made. Colored renderings, a list of materials, construction details, and client-ready presentations and animations were prepared in this stage as well. As in Benchmark I, students were given feedback and approval for advancing to Benchmark III.

Figure 2 shows the Google SketchUp model of the sketch from Figure 1.
Benchmark III: As the final step of the design process, INTR 225 students constructed scaled models. Scale and model materials were determined by the students, since each student design had different characteristics.

After completing all three benchmarks, the STEMworks Indiana Team was invited to the classroom for final presentations. A total of six members attended the final presentation, each representing different areas of the project. In addition to team members, facility managers from WorkOne locations also attended the presentations.

4.0 Assessment Methods

After six weeks of project time and three major benchmarks, the projects were presented to the STEMworks Indiana team and the WorkOne facility managers. Each student showcased his/her design via on-screen presentations and scale models in 20-minute sessions. After the student presentations, the research team privately assessed all of the student designs based on four criteria: aesthetic/usability values, cost estimation, construction methods, and sustainable material selections.

The team assessed aesthetic values by examining overall ergonomics, usability, and visual appearance of the design. Cost estimations were assessed by judging overall costs including labor costs and transportation solutions. Logical construction methods, joinery, and other manufacturing issues were the subjects of the construction method assessments. Finally, they were assessed on materials and finish selections and using sustainable design practices.
Four finalists were selected after judging. Those finalists can be seen in Figure 3.

Figure 3. Four finalists.

5.0 Results and Discussions

After reviewing four finalists for an additional two weeks, the STEMworks Indiana team finalized their decisions and selected a winner. The winning design was further developed and optimized for manufacturability by the author during the summer of 2010. At this moment, a total of four kiosks were built. They are now serving individuals in the STEM Centers of Excellence locations. The finished products can be seen in Figure 4.

Even though traditional data collection methodologies were intended to be used, due to difficulties from both the technological and IRB standpoints, such surveys and/or questionnaires could not be utilized for this study. However, informal opinion-based group discussions and exit interviews were conducted with students. During those interviews, students were asked to evaluate the project on its educational value, academic contributions, and overall effectiveness.

In order to assess the effectiveness of the project, these exit interviews were used to show evidence that the students benefitted from the project. Almost all of the students responded positively to the questions that inquired about the educational value of the project. The students all mentioned that working with real clients makes a difference in their motivation. In addition, most of the students agreed on the noticeable benefits of this project on their academic growth.

In conclusion, despite a few minor logistical issues, this project was quite successful because students were motivated and were able to benefit academically by having a real-world project and the STEMworks Indiana team was able to receive a high-quality product.
Figure 4. Optimized and finished product.

Bibliography