AC 2009-620: RAISING THE LEVEL OF MANUFACTURING CAREER AWARENESS AT THE MIDDLE-SCHOOL LEVEL

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Raising the Level of Manufacturing Career Awareness at the Middle School Level

ABSTRACT

The State of Indiana has identified manufacturing as an industry critical to its economic well being. Despite the abundance of manufacturing careers and positions available within the state, students are not being adequately prepared for them, nor showing any interest in them. Workforce development agencies in the state zeroed in on the concept that the general perception of manufacturing jobs was not good and that parents were actually discouraging children from pursuing careers in manufacturing. To counteract this perception, the agencies sought partnerships with K-12 school corporations and universities to educate middle school age children on the current state of manufacturing enterprises and the careers available within them.

The Purdue University North Central College of Engineering and Technology partnered with the Indiana Center of Workforce Innovations to develop an outreach program aimed at exposing middle school age students to the manufacturing industry. The primary objective of the program was to show students, in a hands-on fashion exactly what the manufacturing environment of today looks like, what types of careers are available in the field, and, most importantly, what academic preparation is necessary for employment in the field.

The program was structured into three phases. In the first phase, students were introduced to basic manufacturing concepts through the use of simple assembly kits. The second phase involved visits to an air compressor manufacturing company and a candy manufacturer. The final phase linked the first two by requiring the students to construct an assembly line for their assembly kits based upon principles they observed during the factory tours.

In this paper, the design concept for the program is detailed and results gathered from pre and post program surveys are presented.

Introduction

Over the last two decades, the United States economy has transformed from one based on manufacturing to one based on service. Manufacturing companies and jobs have been outsourced beginning with an exodus to Mexico in the 1980's and China since. Numerous media sources have proclaimed that manufacturing in the United States is dead and nearing extinction[2,5].

The supposition that manufacturing will soon be extinct in the United States has been greatly exaggerated. What hasn't been exaggerated is the decrease in the number of students that are interested in manufacturing careers[5]. The press is full of gloom and doom scenarios about the dwindling number of engineers and scientists being produced by United States universities and the impact that this will have on our standard of living[6]. Many national efforts are underway to attract K-12 students to STEM-type careers, yet little is being made with respect to the waning

interest shown in manufacturing careers. Much anecdotal evidence exists of parents warning their children not to seek jobs in manufacturing[2,6].

As technology and computers have become pervasive in manufacturing, so too has the need for manufacturing employees to be technically proficient. Many high tech firms encourage and strongly suggest that floor-level manufacturing employees have some type of college or technical school training.

Manufacturing is the largest sector of the economy in the state of Indiana with approximately twenty one percent of the workforce employed in it. Major products manufactured in the state include automobiles, trucks, engines, caskets, furniture, orthopedic implants, air compressors, bearings, steel, and pharmaceuticals.

As a result of dire projections of manufacturing employee shortages, the Center for Workforce Innovations(CWI), an agency of the Indiana state workforce development department embarked upon a program to expose middle school age children to the opportunities available in the manufacturing industry[6]. A Request For Proposals was issued to local universities that sought the development and delivery of summer manufacturing camps throughout the state. The budget for the program was limited to \$4500. Furthermore, the budget could not be used for salaries or any personnel expenses. Suggested tuition for the camp was set at \$29 per student, but this could be waived if a prospective student was enrolled in a free or reduced lunch program during the school year.

CWI had run similar camps in neighboring counties in previous years with mixed results. There were no firm program design requirements besides a one week length of time, at least one field trip to a local manufacturer, and participant age range of grades six through eight. Assuming these criteria were met, the actual details of the program were left to the university.

The Purdue University North Central College of Engineering and Technology partnered with the Michigan City Area School District to design and develop the camp. This approach assured that the minimum number of students would attend the camp and that summer enrichment opportunities for the district would be expanded. CWI awarded a contract to Purdue University to hold the camp in the summer of 2008.

Program Design

The program described in this paper is hardly novel or unique. Numerous K-12 programs exist and many more are being developed[4]. Since this was the first program of this type to be offered in the county, student perception of the manufacturing industry was unknown and assumed to be at a very low level. Thus, the design of the program focused on exposing students to a wide perspective of looks at the manufacturing industry[1,3]. This design feature is in stark contrast to many K-12 programs that focus simply on the use of table-top CNC equipment that allow students to 'design and build' a product[1,4]. While being hands-on and interesting, this type of activity does not present a broad perspective of the manufacturing environment, but simply immerses them in an activity that does not readily translate to knowledge about manufacturing per se. Using exposure as the theme of the camp, the following objectives were adopted.

- Expose students, through experiential activities to the process of designing a system to make products
- Expose students, through experiential activities to the process of designing products
- Expose students, through plant tours, to real-life factory environments
- Expose students to the global nature of manufacturing
- Expose students to manufacturing activity in Northwest Indiana
- Expose students to the wide range of manufacturing careers available
- Expose students to the academic preparation needed to work in contemporary manufacturing environments

The camp was designed around two plant tours. These tours were deliberately put in the middle of the camp to be used as reinforcement for learning. Tours were conducted of an air compressor manufacturer and a candy manufacturer. The first day of the camp exposed students to manufacturing terminology and principles. Participants were then given a number of items to 'look for' during the tours and to use these items as a basis for questions to ask of the tour personnel. Some of the items they were instructed to look for included:

- The names of countries other than the United States on boxes or shipping containers
- 'Pictures' hanging on machines or attached to walls or columns
- Numbers with three or more digits to the right of a decimal point
- The words 'order' or 'due date'
- A Federal Express or UPS logo
- More than three types of Safety Equipment
- Measuring devices of any type

Through the use of this 'search and find' technique, participants were much more easily engaged with tour personnel.

To illustrate the fundamental concept of components and finished products, participants were given a 'mechanical kangaroo' kit to assemble. This kit contained approximately forty components and was to be assembled by each student at home before the end of the camp. They were to also keep track of the total amount of time it took to assemble the kit and maintain a journal of the assembly experience, noting both 'highs' and 'lows' of the process along with entries relating the kangaroo assembly to the factory tours in any manner they could[4].

The first day of camp included an extensive exercise designed around a viewing of the popular 'How It's Made' television show. Participants were assembled into teams and allowed to select an episode of the show that contained a product of interest to the group. They were then instructed to speculate, and then formally declare how they thought the product was made before watching the episode. While watching the episode, the participants were instructed on how to make process maps. Specific emphasis was made on the roles of technology, people, and machines in the making of the product. Participants were then challenged to determine how many of the given product could be assembled in one week, one month, and one year using any facts provided during the episode.

The final activity of the camp was summarized into a single experience that required the students, using what they had learned during the week, to construct an assembly line to produce ten mechanical kangaroos as productive as possible. The participants were divided into two teams and given an hour to design their line. Each team was assigned a mentor that had received lean manufacturing training at a local company. The teams would then watch the lines operate and calculate productivity measures.

The design of this camp was to expose participants, through experiential activities, to the wide range of skills needed to manufacture a product. Through this wide exposure view of manufacturing, it was hypothesized that each student could find a particular aspect of manufacturing that appealed to them and would stimulate them to explore the possibility of seeking a career in manufacturing and, more importantly, select appropriate courses in high school to prepare them for it.

Results & Analysis

Eighteen students attended the initial camp in the summer of 2008. The students were entering grades six through eight. Five of the eighteen students were female. To be eligible for the camp, students had to have scored above a given threshold on statewide standardized test administered.

The first activity of the camp was an extensive survey of the participant's knowledge and beliefs towards manufacturing. A series of short exercises were conducted that included written surveys, small group discussions, and direct questioning. A sample of the information gleaned from this pre-assessment of beliefs and facts included:

- Sixty-one percent of the students had a parent that worked in manufacturing.
- Five percent of the students expressed a desire to work in manufacturing.
- Seventy-eight percent of the students could not name more than four local manufacturing companies.
- None of the eighteen students could name more than three materials that products could be made of.
- Eighty-three percent of the students selected 'ran a machine' as the number one task carried out in manufacturing.
- Ninety-four percent of the students stated that 'all the components of a product are made by the company'.
- Sixty-one percent of the students stated that a parent or elder expressed negativity towards working in manufacturing.
- Fifty percent of the students did not think that manufacturing could be studied in college.
- Sixty-one percent of the students did not classify packaged food as a 'product'.

At the conclusion of the camp, the participants were allowed to discuss what they had learned during the week and how their perceptions of manufacturing were affected by the activities of

the camp. Participants were given a short survey to fill out. A sample of the information gleaned from the post-assessment included:

- Thirty-nine percent of the participants said they would strongly consider a career in manufacturing.
- Eleven percent of the participants indicated they would enroll in the university to study manufacturing.
- One hundred percent of the participants indicated that math and science skills are necessary to work in all levels of manufacturing.
- One hundred percent of the students could name at least three career positions in manufacturing.
- Eighty-three percent of the participants expressed positive feelings towards those who work in manufacturing.
- One hundred percent of the students expressed interest in working at a candy factory.

As part of the post-assessment, the participants indicated a strong desire to repeat the camp experience again. The author is in discussions with the school district and the funding agency about the potential for offering the camp in the summer of 2009 as an integrated entity within the school district summer enrichment program. Additionally, there have been discussions about developing a similar, yet age appropriate version of the camp for children in grades three to five.

Conclusions & Summary

This paper described the design and implementation of a manufacturing camp aimed at raising the awareness of manufacturing careers to middle school students. Through extensive discussions and survey instruments, it was confirmed that middle school students in a given school district are being heavily influenced by their parent's negative perceptions of manufacturing and, as a result, not considering manufacturing as a career choice. Coupled with the fact that the students did not have knowledge of the contemporary manufacturing industry as a whole, this presents a serious challenge to the region in attracting the type of workforce it needs to remain competitive.

Through the deliberate choice of using exposure, rather than skills as the theme of the camp, student perceptions on manufacturing were queried, and, through the use of a multitude of activities, significantly changed. By using active exercises linked to factory tours of products of interest to middle school age students, i.e., candy, a much more positive image of manufacturing careers was presented.

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