

Creating a Mindset for Innovation

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To stay ahead of the development of new technology, we believe engineers need to understand what it means to be innovative. This research focuses on the developed methods and efforts being implemented to advance the culture of innovation within our college of engineering. The primary method we have developed to help our students better understand the process of innovation is what we call Innovation Boot Camp.

The Innovation boot camp is an intensive, hands-on, collaborative, experiential learning workshop focused on educating students on the principles of innovation by providing them real-world situations that require them to apply these principles. The structure of the initial Innovation Boot Camp is a two-day experience, blending students and faculty from different programs and departments (i.e., Technology Engineering Education, Manufacturing Engineering, Industrial Design, and Information Technology,) from the School of Technology in the college of Engineering at Brigham Young University.

The primary instructional techniques and curriculum were based on a hybrid model culled from several sources, including IDSA National Conference presentations, site visits to the Stanford d.school and IDEO, publications from the Rotman School of Management, and other sources on creative problem solving. We defined the innovation experience as being: Human Centered, Environmentally Safe, Multidisciplinary, Makes Ideas Concrete, and is Guided by the Process, those being: (1) problem finding by discovery through the activities of Observation, Experience, and Inquiry; (2) problem shaping by Organizing, Simplifying, and Clarifying; (3) broad divergent ideation through activities of Point of View, Association, and Connection; (4) problem refining by Visualizing, Validating, and Iterating; and (5) sharing insight using the activities of Show, Demonstrate and Describe.

The purpose of this paper is to further describe the purpose, curriculum development, organization and logistics, activities developed and engaged in, and methods of instruction of the Innovation Boot Camp. Additionally, the paper will outline the learning outcomes and the relative impact the Boot Camp is having on student understanding of and skills associated to innovation, and how the experience is impacting our college's initiative to create a culture of innovation.

METHOD

Kleppe (2001) notes that, dating from the late 1700s to the modern day, “a major source of technological advancement has been the result of individual inventors [and] innovations” (p. 16). Surprisingly, most technology and engineering programs in the United States do not explicitly teach innovation (Smoot, 2006). With the increasingly complex and competitive global market, and with new interest and concern over environmental issues, biotechnologies, and so forth, many companies (American and foreign) are reforming how and where they do business. Additionally, many academic institutions are calling for a “radical restructuring of the theoretical knowledge taught in academic education programs...in order to create competencies of professional value in today’s business situations” (McAloone, 2007, p. 770). In order to address the many challenges involved with the new global industrial arena, many technology educators believe the theoretical restructuring that needs to take place must involve and center on innovation. Kleppe (2001)

Despite the need to include innovation as a key component of technology and engineering curriculum, and although some universities have made restructuring efforts to include aspects of innovation, a study done by the Southern Technology Council found that there are very few universities supportive of educational initiatives that teach innovation. The lack of support and inclusion of innovation in technology and engineering-related programs seems to stem from archaic mathematics and science curriculum standards, as well as immature technology and engineering curriculum standards. Although engineering programs have existed and been taught for well over sixty years at the university level, most of the courses and degrees have focused on traditional engineering concepts (i.e., hard math and sciences) and have not bridged into the areas of creativity and innovation. It has only been in the last five years that universities have started to recognize creativity as a key component of engineering (Courter, 2006). In light of the need to ensure that our students are ready for the challenges of our global economy, we, as technology and engineering educators, need to ensure that we are continuing to evolve our practices and curriculum, which, at the present time, demand the need to include innovation as a key component of technology and engineering curriculum.

The purpose of this study is to understand the impact of the Innovation Boot Camp on students’ innovative abilities and attitudes. Holistically, we feel the adoption and commitment to explicitly teach and provide students with innovation training is necessary. However, the plausibility of a college-wide buy-in and adoption is questionable due to the college’s deeply traditional academic approach to teaching engineering and technology. The effort required to change this culture requires school administrators and professors to spend a significant amount of time, separate from our normal teaching and research load, as well as provide additional funding for the experience. Consequently, this research study not only adds significantly to the theoretical underpinnings of innovation and creativity pedagogy, it also provides insight as to the needs and benefits of such an endeavor. To understand the influence of the Innovation Boot Camp experience on our students and college we gathered data throughout the entire boot camp experience (i.e., during curriculum development and instructional time, as well as at the end of the boot camp). The summative evaluation efforts have included an online survey, a focus group interview session, and one-on-one follow-up interviews.

Statement of Problem

With the economic need and acceptance for outsourcing, as well as competition in areas such as global product development, many American engineering and technology institutions are rethinking and restructuring the content and instruction of engineering and technology curriculum (McAloone, 2007).

In an effort to address this issue, our college has established several school-wide technology and engineering initiatives that focus on the issues of leadership, global awareness, and innovation. College administrators established a committee to investigate ideas on how to promote innovation. The committee, known as the Innovation Design Team, travelled to several institutions recognized internationally for their exemplary models of innovation (e.g., Stanford d.school, IDEO, etc.), and performed a literature review on the subject of innovation and its various related topics.

One of the ideas the Innovation Design Team developed and hoped would make a positive impact on student innovation ability was to institute an Innovation Boot Camp. In short, the boot camp was developed as an intensive, innovation-focused workshop that would immerse students in an experiential collaborative learning environment that would require them to work in teams with students from various programs housed within the college (i.e., Industrial Design, Mechanical Engineering, Manufacturing, Technology Engineering Education, IT, and Construction and Facilities Management) in order to identify and solve problems using processes of innovation.

Approach

There are three phases to this research project: (1) developing and implementing the Innovation Boot Camp, (2) evaluating the Innovation Boot Camp experience, and (3) assessing and restructuring the Innovation Boot Camp.

Development

The Innovation Design Team used the data they collected from their observations during their visits to the various well-known innovation institutions, and the literature they read (i.e., *Handbook of Creativity*, *Creativity in Context*, *Lateral Thinking*, *Creative Toolbox*, various journal articles, and so forth) to formulate several ideas for creating a culture of innovation in our college of engineering and technology. Various ideas were hypothesized, though it was ultimately decided that an intensive experiential workshop highlighting the key principles of innovation would be first tried. This workshop came to be known as the Innovation Boot Camp.

Format

We are currently on our 16th iteration of the Boot Camp experience, and its structure is currently organized in the following way: it is a two-day experience, wherein students from the various programs of the college collaborate to engage in problem finding, shaping, and exploring, and communicate a proposed solution to the problems they discover. There were typically two to three students and one faculty member from each of the four programs, averaging 18–24 participants in all.

Boot Camp Process

The students were split into 4–6 multidisciplinary groups of 4–6 students each, while the faculty members were put in their own group. We wanted to give the students a chance to work independent of the faculty, without the influence of any authority figures. We also wanted to have a sense of competition between groups.

On day one, we introduced the students to the need and idea of innovation, leading the students to establish a working definition of the term. We then provided the students with the five key principles of innovation and had them engage in one experiential activity per principle—an approach that served as a tactical opportunity to semantically encode the principles. Each activity built upon the previous, thereby helping the students transfer and scaffold their learning from principle to principle. By the end of the day, the students had developed an innovative product or system as a result of working collaboratively through each innovation principle activity. To conclude the first day, each group of students presented the problem they identified and the innovative proposal they developed as a result of employing each principle of innovation.

At the conclusion of their presentations, they were introduced to a capstone activity that would require them to go through the steps of innovation one additional time. The students were expected to work Friday evening and early Saturday morning to ready themselves for the capstone presentation and evaluation. The purpose of the capstone experience was to evaluate whether or not the students understood the innovation principles well enough to combine them in pursuit of developing tools they could use to identify problems and develop innovative solutions.

Day two of the Innovation Boot Camp consisted of each group showing how they came up with their respective problems, accompanied by a proposal of their capstone projects based on the five key

principles of innovation. A panel of judges from local design and engineering companies were brought in to evaluate the students' projects, and awards were provided to the top three teams.

Before the boot camp was completed, there was a final summary discussion session wherein students were asked to share their reflections of the experience. They were encouraged to determine whether or not their camp experience helped them to develop and learn skills; they were also asked to defend their opinions. Exit surveys were emailed to each student at the conclusion of the boot camp in anticipation that the students would complete the survey within the first few days following the experience. Additionally, several students were randomly selected to participate in a focus-group exit interview.

RESULTS

As stated above, formative and summative methods were used to evaluate the impact of the boot camp experience on students and faculty. A video documentary of the boot camp was filmed and later used to critique and analyze the attentiveness and participation of each student. The instructors of the boot camp were also invited to watch the video to help evaluate their instructional methods and the associated activities and content. Two outside observers from the college were also in attendance at the documentary screening and asked to take notes on what was done, how they perceived the instruction was being received, how the activities were helping the students understand the principles and concept of innovation, how the students seemed to enjoy or not enjoy the experience, and so forth. The students were also asked to provide summative feedback at the end of the boot camp experience in both a survey and exit interview. A few of the key themes from the evaluations will be shared in this document.

Participant and Observer Feedback

Overall survey results and interviews (n = 54) stated that 100% of the students reported their belief that the Innovation Boot Camp should be continued, and 71% of the students (n = 54) identified their time spent at the boot camp as *Effective* on a scale that included *Ineffective*, *Not Very Effective*, *Moderately Effective*, *Effective*, and *Very Effective*. When the students were asked to rate on a 1–5 scale (5 being high) how the Innovation Boot Camp influenced their understanding of innovation, the mean was 4.0, the variance was 1, and the standard deviation was 1. When the students were similarly asked to rate how they believed their propensity for innovation to have been influenced by the camp, 43% responded that it made a significant amount of difference. Then, when the students were asked to rate how they believed their skills related to innovation were influenced by the boot camp experience, 86% reported that they believed their skills to have been *significantly* influenced by the experience. Also, 85% of the students said that they thought their time at the Innovation Boot Camp was spent either *effectively* or *very effectively*. The outside observers reported similar findings, and, while they proposed various suggestions, the majority of their thoughts centered on curriculum design issues and content.

DISCUSSION

We recognize that we are still in the beta stages of our development of the Innovation Boot Camp. However, we believe that the findings from the surveys, interviews, and qualitative observations have provided helpful insight as to how we might restructure and continually develop the Boot Camp experience.

The primary areas of restructuring we have thus far addressed center on curriculum issues. We have found that there are two primary sets of principles common among innovation-related literature, and though the principles innately suggest similar concepts, we feel it is important to solidify the language (i.e., vocabulary) being used in our own curriculum. For example, in the first few boot camps, we used the idea of “Design Thinking” and its associated principles, “*Think, Look, and DO*” (Welsh, 1993; Osborn, 1965; Sternberg, 1999; Kelly, 2005), while in the later boot Camps we used the principles of observing, questioning, idea networking, associated thinking, and experimenting (Dyer et al., 2001). We believe that there is a need to continue evaluating the boot camp experience. We anticipate a continued restructuring

of the workshop, though we also feel the results thus far have provided great insight as to how the seeds of a culture of innovation might be initially planted.

CONCLUSION

Although our data set remains somewhat limited for now as a result of the Innovation Boot Camp's newness, we believe that we are commencing on an important journey toward better preparing our students for the globally competitive technology and engineering market. In such a market, innovation is an essential and defining skill. We anticipate that the boot camp experience will continue to evolve, and we hope the experience will help us develop a culture of innovation, wherein our students will benefit from working on multidisciplinary teams to solve important problems while learning and becoming increasingly innovative. In this way, they will be better prepared for the rapidly evolving and competitive world in which we live.

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