EDUCATIONAL AFFORDANCES THAT SUPPORT DEVELOPMENT OF INNOVATIVE THINKING SKILLS IN LARGE CLASSES

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ABSTRACT

Innovative thinking skills are among the top characteristics that employers look for when hiring engineers. Universities are therefore charged with investigating and providing the type of learning environments that will foster the development of innovative thinking especially in large classes. This involves considering multiple factors such as the technology, teacher support, and learning task or educational affordances that are needed. This qualitative study examines undergraduate engineering students enrolled in large classes and their perspectives on educational affordances (i.e., technology, teacher support, and learning tasks) that they think will help them develop innovative thinking skills. Preliminary findings suggest that there are key factors in the educational environment that facilitate development of innovative thinking. Discussion will focus on effective practices and tools as well as suggestions for future research toward designing a model that presents effective pedagogical approaches to impact the development of innovative thinking skills among engineering undergraduates enrolled in large lecture classes.

KEYWORDS

Innovative thinking, educational affordance, engineering education

1. INTRODUCTION

The teaching and learning environment among undergraduate students of the 21st century continues to evolve. While the basic tenets of good teaching practice (Chickering and Gamson, 1989) remain relevant, factors such as students' generational characteristics, class size, and technology usage present challenges as well as opportunities. In addition, universities must consider what type of learning environment will produce graduates that possess the skills needed to effectively perform in the working environment.

Innovative thinking is considered a critical element in today's economy. However, recent trends indicate that the U.S. is in danger of losing what has been considered its greatest competitive advantage. A study by the Information Technology and Innovation Foundation recently ranked the U.S. 40th out of 40 in the rate of change in innovation capacity over the past decade (Atkinson and Andes, 2009). Newsweek reported that for the first time since the 1950's American creativity scores are falling (Bronson and Merryman, 2010). These and other findings implored a Wall Street Journal commentary to claim "The evidence is certainly mounting that we [the United States] face nothing short of an innovation crisis" (Lechleiter, 2010, para. 7).

While previous research identifies cognitive processes that can be used to identify when innovative thinking is taking place, few formal educational curricula exist that describe a pedagogical method that can be used to develop innovative thinking among engineering students. Students tend to enter university with a propensity to be innovative, but after a rigid, structured program leave discouraged and less creative. This decline in innovative thinking is often attributed to the large lecture based classes that students are enrolled in, especially in the formative first and second years of their engineering degree program (Jamieson and Lohmann, 2009).

Technology has allowed us to create enhanced learning experiences (Amelink and Scales, 2010; Chickering and Ehrmann, 1996). However, research indicates that comparing technology mediated environments with non-technology environments yields no significant differences (Clark, 1983; Lockee et al., 1999).

The question then becomes how does the use of technology facilitate learning of various skills in different contexts? In answering this question our attention is drawn to examining the affordances or the interaction between the features and characteristics of the learning environment and the learner (Kirschner, 2002). With this in mind this study seeks to answer the following research question:

What are the educational affordances (i.e., technology, teacher support, and learning tasks) that facilitate the development of innovative thinking skills among undergraduate engineering students enrolled in large classes?

2. CONCEPTUAL FRAMEWORK

Based on research in engineering education (Pappas, 2009; Raviv, 2008; Raviv et al., 2009; Raviv and Barbe, 2010) and social constructivist learning theory (Jonassen et al., 1993) we have identified seven (7) skills and related cognitive processes that can be used to identify development of innovative thinking among first and second year engineering students. These are knowledge acquisition (identifying new words and concepts, use of rehearsal strategies to memorize information.); scaling (organizing information and concepts so that they can be integrated into designing of new ideas and information.); elaboration (summarizing known information; ability to reframe content); critical thinking (application of previous knowledge to unknown, ill-defined and/or new situations; generation of new ideas); self-initiated exploration (ability to question ideas and information being presented); collaboration (ability to seek and entertain new ideas from peers and instructors; ability to utilize peers as a means to check new ideas and concepts); entrepreneurialism (use of team members to determine what creative ideas can become valuable innovations; effective presentation of new ideas to others).

The term affordance was first used by ecological psychologist James Gibson in 1977 to describe the relationship/interaction between an animal/person and the characteristics of its environment, (Gibson, 1977). Since then the term has been adopted and adapted in other areas, and has developed context specific meanings in these domains (Norman, 1999). In the educational context what the learning environment ‘affords’ will determine what learners gain. According to Kirschner (2002) the interplay between technology and learning is much more than the mere object and user, but is a “unique combination of the technological, the social, and the educational context” (p. 17). Thus he coined the term educational affordances which he defines as, “the relationships between the properties of an educational intervention and the characteristics of the learner that enable particular kinds of learning by him/her” (p.19).

A wealth of knowledge based in cognitive psychology identifies pedagogical approaches that can be used to facilitate more collaborative, active and engaging learning environments even in large lecture-based courses. This paradigm and the body of research associated with it suggests that instructional technology, if it is employed effectively, can serve as a means to engage students and promote active learning; facilitating educational environments that are related to the development of innovative thinking among undergraduates (Duncan and McKeachie 2005; Larwin and Larwin, 2011; Pintrich and Garcia, 1991). Foo et al. (2005) developed a “tripartite model” that consists of teacher support, technology and learning task. The model captures the dynamics of learning that takes place with technology and provides a framework for identifying the types of educational affordances that facilitate specific learning outcomes. They found that successful teachers focused on all elements of the model and those that were less successful focused on one or two elements of the model. Thus, more than the mere use of technology is required to successfully influence learning outcomes, rather the interplay of multiple factors need to be considered (Chickering and Ehrmann, 1996; Clark, 1983; Foo et al., 2005; Salomon, 1990; Wijekumar et al., 2006). Our study seeks to examine those multiple factors and how they may influence the development of innovative thinking among undergraduates enrolled in large lecture classes.

3. METHOD

A qualitative methodology was used for this study. Three separate focus groups were held in order to try to better understand how undergraduate students enrolled in large lecture classes perceived educational affordances that might help develop innovative thinking skills.

Purposeful sampling was used to select the participants for the focus group. Three faculty members who taught large lecture classes and used very different pedagogical approaches were identified. Students enrolled in these courses were sent an email message inviting them to participate in a voluntary focus group and interested students responded and confirmed their attendance for the event.

The protocol for all groups included questions that were designed to elicit information about students' motivation for using technology or other learning tools, instructor's pedagogy that they perceived helped them with innovative thinking and learning in general, and what tools they found helpful in the learning environment. All three focus groups lasted about one hour in length. The sessions were audio recorded and transcribed. In total 15 students attended the focus groups.

4. ANALYSIS AND PRELIMINARY FINDINGS

The focus groups were transcribed and are currently being analyzed. An a priori coding scheme, based on the educational affordances conceptual framework posed by Foo et al. (2005), along with the indicators (derived from social constructivist theory) of innovative thinking skills, is being used to identify themes that emerged in relation to how those affordances might facilitate development of innovative thinking among students.

Preliminary findings suggest that there are key factors in the educational environment that facilitate development of innovative thinking. Some of these factors include effective faculty use of the technology to provide "just in time" learning, feedback, and demonstrations/illustrations. We plan on continuing to code and further analyze the data to refine the themes.

5. CONCLUSION

Kirschner (2002) advises that in order to truly accomplish learning goals, research should examine the learner's perspective as only then will we be able to create the learning environments that 'afford' the types of behaviors we desire. The findings of this study will be very valuable as it will help in understanding how students perceive the learning support they get regarding innovative thinking as well as identify any gaps. The findings can be used to collate a list of best practices and tools, which can inform further research aimed at designing a model that presents effective pedagogical approaches to impact the development of innovative thinking skills among engineering undergraduates enrolled in large lecture classes.

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