Work In Progress - Flexible Learning Environments to Improve Interdisciplinary Creativity and Team Interactions

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Abstract – This paper reports preliminary results from a semester-long case study of interdisciplinary student engineering design teams that use a classroom with flexible features in order to examine the impact of team interaction and flexible environment on creativity. Twenty-one students recruited from a senior-level interdisciplinary class consisted of five self-formed teams with computer engineering, marketing, communication and industrial design majors. They were tasked with a “Smart Dorm Room” design project for students with special needs. Team meetings were observed and interviews and questionnaires were administered to examine student perception of the impact of physical environment and tools as well as team interaction levels and creativity of the teams. Preliminary findings confirm the positive impact of flexible environment as well as interdisciplinary team interactions on creativity.

Index Terms – Interdisciplinary teams, team creativity, team interaction, learning environment.

INTRODUCTION: INTERDISCIPLINARY TEAMS AND CREATIVITY

As industry requires many cross-functional and interdisciplinary teams in order to generate solutions for complex engineering problems, the need for increased interdisciplinary education is emerging [1]. Also, being creative in generating those solutions has become a priority for engineers, as creative products become an important source of corporate profit. In that regard, issues regarding interdisciplinary teams have received much attention [2]. Still, little empirical research has been conducted to investigate the environment that may enhance the creativity of those teams.

WHAT PROMOTES CREATIVITY: RESEARCH QUESTIONS

Through this study, we attempt to gain in-depth insight into what might be factors that enhance creativity of interdisciplinary engineering design teams. Thus, we seek to answer the following questions:

1. Do flexible learning environments enhance creative process as well as innovativeness of the product a team produces?
2. Is the level and quality of interdisciplinary team interaction associated with creativity?

These questions allow us to investigate how students perceive and interact with flexible learning environments as well as interdisciplinarity during creative processes and give us insightful understanding of how those factors impact their creativity.

‘SMART DORM ROOM’ PROJECT

Twenty-one students were recruited to participate in a semester-long study embedded in a senior-level interdisciplinary design class at Virginia Tech. They self-formed into five interdisciplinary teams with computer engineering, marketing, communication, and industrial design majors. Students were tasked with designing features of a “Smart Dorm Room” that uses pervasive computing technology to assist students with special needs while they live on-campus in their freshman year. Each team was asked to design one ‘smart’ feature (e.g., interactive furniture) of a Smart Dorm Room, and they were asked to produce a final design report at the end of the semester. To enable the flexible use of physical space, the classroom featured movable tables not oriented toward any specific direction and numerous wheeled whiteboards around the walls. To enable flexible social space, students were encouraged to self-organize in interdisciplinary teams and cooperatively conceptualize team projects within the configuration of a Smart Dorm Room where technology transparently interacts with users.

During the semester, two coders observed team meetings and coded the transcriptions in order to determine the level and quality of interactions among team members. Also, the students’ perceptions of the impact of the flexible learning environment on creativity were investigated using interviews, questionnaires and a focus group session. The students’ final design reports and presentations were reviewed to evaluate creativity of each team’s final product.

PRELIMINARY RESULTS

Preliminary results confirm the positive impact of flexible learning environment and interdisciplinary team interaction on a team’s creativity. Two interviews conducted in the middle and at the end of the semester indicated that students felt they were being more creative using flexible features of the classroom compared to the fixed features of a typical classroom. Also, all of the students who volunteered to be interviewed stated that the use of movable whiteboards supported their creative process. Some listed movable whiteboards as the creative force of the class. Students said whiteboards supported collaboration during the conceptual
stage of the project by “giving everyone a focus point to look at” and “a common piece of notepaper” for visualizing ideas.

For the questionnaire conducted after the interviews, the participants were asked to rank six different factors (e.g., teachers, flexible space, group members, etc.) in the order of enhancing creativity. The results revealed that students perceived the flexible environment to be more important than teachers or class content, but less important than team members or class structure (see Table 1).

<table>
<thead>
<tr>
<th>Flexible space (M=3.27)</th>
<th>Class structure (M=3.00)</th>
<th>Teacher (M=3.73)</th>
<th>Class content (M=4.20)</th>
<th>Accessible space (M=4.93)</th>
<th>Member (M=1.93)</th>
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When mean rank of ‘flexible space’ item was tested using a nonparametric one-way test, Kruskal-Wallis test, a significant overall differences among teams (p<0.05 and p<.09) at α = 0.01 level was found. In order to discern the source of differences, Tukey’s HSD test was conducted, and it was found that Team 3 perceived flexible space to be significantly less important than other teams. One possible explanation is that Team 3 mainly used virtual space for the main collaboration space instead of physical space, since Team 3 was the only team who utilized a non-course electronic collaboration tool (GoogleDocs) for communicating and sharing project relevant information. Although Team 1 ranked the importance of flexible space to be the highest, it should be noted that there was only one data point available from Team 1 for this questionnaire item.

The level and quality of interdisciplinary team interaction was determined from coding samples of observation transcripts. A pattern emerged in which teams with higher level of interactions with less signs of conflict showed better performance during the creative process and produced more creative product. For example, Team 2 indicated the highest level of interaction during discussions including cohesive communication as well as social bonding among team members, and Team 2’s final design report indicated the highest level of creativity. Interviews also suggested that interdisciplinary team interaction was enhancing creativity of students. It was mentioned that having members with different backgrounds could “spark a whole new level” of ideas in the discussion.

Creativity of final design reports were analyzed based on following criteria: 1) diverse user application, indicating the extent to which the intended product user population was targeted to both students with special needs as well as general students living in university dorms. 2) novelty of ideas, indicating the extent to which the idea was original and not modeled on a product currently in existence. 3) innovative technology, indicating the extent to which the technology required for the product would be used in a new, pervasive way that would be seamlessly integrated with the user’s environment. Results are presented in Figure 1.

As mentioned earlier, Team 2 showed the highest level of creativity in their final design. It was confirmed from interviews and observations that they were collaborating and interacting most actively among all teams. Also, Team 1 who exhibited minimal interaction and continual disagreement on project goals produced the least creative product. Thus, it was confirmed that higher level of team interaction corresponds to higher level of creativity. However, when the integration level of final design reports was analyzed, the integration level did not correspond to integration of disciplinary expertise during the design process, with high collaboration teams showing low cohesion in the reports. From the focus group session, it was revealed that low collaboration teams (1, 4, 5) had only one or two members who wrote the final reports. This could explain the higher cohesiveness of those teams’ reports.

Preliminary results confirmed the positive impact of flexible learning space and tools as well as interdisciplinary team interactions on creativity of student engineering design teams. The next phase of the study will be observing and analyzing innovative spaces and creative processes of a design consulting firm and transferring them to education to support team creativity.

ACKNOWLEDGMENT

This work was supported by the National Science Foundation, grant EEC-0648439. We would like to thank Eloise Coupey, Ed Dorsa, and Tom Martin for allowing us to observe their course.

REFERENCES