

Work In Progress: Assessing situational curiosity and motivation in open-ended design electives

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Abstract— Our institution has recently committed to develop five new entrepreneurially-minded elective courses called “IDEAS studios”. The entrepreneurially-minded aspects of IDEAS studios include close interaction with industrial partners and an emphasis on topics such as value proposition, opportunity recognition, intellectual property, and customer engagement. We hypothesize that in addition to specific topics and competencies these courses facilitate develop *attitudinal* skills needed for an entrepreneurial mindset. Such skills—which include persistence, curiosity, conscientiousness, optimism, and self-control—typically cannot be measured using standard assessment methods.

In this work-in-progress, we have identified seven structural attributes of IDEAS studios which we hypothesize support the courses’ ability to foster the attitudinal aspects of an entrepreneurial mindset. We have designed and are in the process of conducting a study of students enrolled in these courses to assess the impact of both the courses as a whole and the individual attributes on students’ situational motivation and curiosity. We hypothesize that the open and student-centered nature of IDEAS studios will foster greater curiosity and intrinsic motivation than will courses that lack these seven attributes. This paper reports on a pilot study of students enrolled in IDEAS studios to assess the impact of these seven structural attributes on students’ situational motivation and curiosity.

Keywords— *entrepreneurial learning; motivation*

I. INTRODUCTION

IDEAS courses were developed with the goal of instilling an “entrepreneurial mindset” in engineering students. Our operational definition of this mindset is that students will display curiosity, make connections, and create value (3 C’s) [4]. IDEAS courses are two-credit-hour elective studio-based engineering courses that have been designed to foster these

outcomes. We identify seven core attributes of IDEAS courses that will compliment course content in instilling the 3C’s:

- 1) The class is voluntary;
- 2) In the course, students create a physical artifact;
- 3) Student work is motivated by real problems;
- 4) Students apply broad perspectives to their work;
- 5) An open-process is applied to create solutions;
- 6) The course environment contains an interdisciplinary mix of students;
- 7) The number of students in the class is small.

Ultimately, six sections of four different courses will be taught, each on a different topic but all embodying the seven attributes listed above. The exact manner in which these characteristics are realized will vary slightly from instructor to instructor, but in general items 1, 6, and 7 are controlled through the course registration process. Items 2-5 are introduced through use of problem- or project- based learning as the main pedagogy for the course. The problem or project based upon on or more open-ended design problems, typically created in collaboration with an outside customer. For example, the customer for on IDEAS course was a surgical research team at a hospital. In the context of IDEAS course projects, students are encouraged to consider broad perspectives through topics including value, societal benefit, cost, scale, and marketability.

Our conceptual framework is that intrinsic motivation is key to development of students’ ability to achieve an entrepreneurial mindset. We expect that fostering students’ intrinsic motivation in a course based on entrepreneurial thinking will result in students who are most curious, best able to make connections between disparate ideas, and create value based on their insight. Using self-determination theory as our guide [5], the seven course characteristics were developed to

create an environment favorable for intrinsic motivation. Self Determination Theory states that motivation stems from autonomy, relatedness, and competence [5]. In the IDEAS courses, attributes 1, 4, and 5 relate to autonomy, attributes 2, 3, and 4 relate to relatedness, and items 2, 6, and 7 relate to competence. While these attributes are not entirely unique to these courses, we believe the combination of all of them might be, and might therefore be essential to creating the attitudinal change we are seeking in the students.

The data from this study are being analyzed to determine the impact of IDEAS courses overall on curiosity and motivation as well as determining the impact of each structural attribute on these outcomes. The results will serve as a pilot to design a larger study that considers other additional attitudinal skills and that seeks to understand the relative importance of the class' attributes.

II. METHODS

The study used a sample of convenience. Students enrolled in the Fall 2014 IDEAS course were invited to participate in the study. All 13 students elected to participate and signed an informed consent form. Both the study and the form were approved by the Bucknell IRB. Students were compensated for their participation: \$10 for each of the four surveys completed, plus a bonus \$10 if all four were completed.

Students were asked to consider their situational curiosity and motivation in both the IDEAS course and a "control" course designated "Course X". Course X is independently and anonymously selected by each student as a course in which they are concurrently enrolled that, in their opinion, shares as few of the IDEAS attributes as possible. Students were asked to select their own Course X for a number of reasons. The most significant reason is that students enrolled in the IDEAS course are from a variety of majors, there is no one other course in which they are all enrolled. In addition, because the student perception of the course may be different from the faculty intent, we felt students themselves would be the best judge of which other course is most different from their IDEAS course, with respect to how those differences impact their own attitudes.

Approximately every four weeks the situational motivation survey and situational curiosity survey were shared. Existing scales developed by Guay, Vallerand, and Blanchard [3], as applied by Stolk, Gross, and Zastavker [6] for situational motivation (SIMs instrument) and Chen, Darst, and Pangranzi [1] for curiosity were used. The combined survey consists of 5 items on situational curiosity from the Chen, Darst, and Pangranzi [1] instrument, and 16 items from the SIMs instrument, plus demographic questions. Students completed this twice during each instance – once, thinking of their IDEAS course, once thinking of the course they had identified as Course X.

At the very end of the semester, the "wrap up" survey was shared. This survey asked about each of the seven characteristics given above and the extent to which they were perceived to be present in both the IDEAS course and Course X.

Analysis of student responses used the item groupings for the SIMS questions as identified by [3]: Intrinsic-motivation; Identified-Regulation (I'm doing this because it's good for me); External-Regulation (I have to do this); and Amotivation (I don't know why I'm doing this). Item responses for both scales is a "strongly agree" (=5) to "strongly disagree" (=1). For the present preliminary analysis, the mean sum of all students' responses for each question group is presented.

III. PRELIMINARY RESULTS

Of the planned three-semester study, one semester has been completed, yielding student survey results (n=13) for one IDEAS course. As such, results are considered preliminary. By the conclusion of this study, we expect an n>100. The current sample is 69% male, and 69% white, consisted of 6 juniors, 6 seniors, and one sophomore, and 8 mechanical engineers, 3 computer/electrical engineers, and 2 biomedical engineers.

There are apparent differences in motivational state and curiosity between students when they are in the IDEAS course and Course X, as can be seen in Table 1. Table 1 combines responses for IDEAS and Course X for all three survey instances and all 13 students throughout the semester. Students' intrinsic motivation, identified regulation, and curiosity are all higher for the IDEAS course, consistent with course design. Students report higher external regulation for Course X, which is consistent with it being a required course (the case for most students, see Table 2).

TABLE I. MEAN STUDENT RESPONSES

Average of all questions in group (5-point scale) n=13		
Motivational State	IDEAS Mean(std.dev.)	Course X Mean(std.dev.)
Intrinsic motivation	18.39(1.76)	13.15(3.56)
Identified regulation	17.92(1.75)	14.92(2.33)
External regulation	6.85(2.41)	12.92(4.86)
Amotivation	6.31(2.10)	10.15(3.13)
Curiosity	22.15(1.73)	18.39(4.75)

Using a Wilcoxon test, the differences between the IDEAS course and Course X in intrinsic motivation, identified regulation, external regulation, and amotivation were all significant at the p<0.01 level. The difference in intrinsic motivation is consistent with our initial hypothesis, that intrinsic motivation would be fostered by the IDEAS course environment. The difference in identified regulation was not as expected, but seems consistent with the design of the IDEAS course to be driven by "real problems", giving students a sense of importance – they recognize that they will benefit from doing course work. Course X has a significantly higher score for external regulation and amotivation, which suggests that students in required courses do not always see the ultimate goal of their study. The curiosity result was significant at the p<0.05 level with the same test, suggesting students were more curious in the IDEAS environment.

A Wilcoxon Signed Ranks Test is the appropriate test for results with multiple modes and small sample size, as was seen in this case [2].

At the end of the semester, students were asked to characterize both the IDEAS course and Course X according to the seven attributes. Note one student chose not to participate in this survey. We anticipated when students selected Course X at the start of the semester, they might not have sufficient information to completely judge its similarity to the IDEAS course, therefore the request to characterize the course in terms of the seven attributes was at the end of the semester. We also asked students to characterize the IDEAS course to inform us if the student perception of the course design aligned with our intent.

TABLE II. COURSE ATTRIBUTES

Course alignment with 7 attributes		
List of attributes	IDEAS	Course X
1. Voluntary	Yes (12) No (0)	Yes (3) No (9)
2. Physical artifact	Yes (12) No (0)	Yes (5) No (7)
3. Multidisciplinary	Yes (12) No (0)	Yes (6) No (6)
4. Agreement: Real problems	4.8 / 5.0	3.4 / 5.0
5. Agreement: Broad perspectives	4.3 / 5.0	3.0 / 5.0
6. Agreement: Open-ended	4.8 / 5.0	3.2 / 5.0
7. Class size	15	25

There is a high level of agreement that the students perceived that the IDEAS course embodied the seven characteristics, as intended. These data also suggest that while Course X was dissimilar from the IDEAS course in some ways, for most students it was not entirely dissimilar.

The ultimate goal of this work is to not only characterize the differences in motivational and curiosity state for both IDEAS and X courses, but to use responses to these attributes

to determine the importance of each to students' motivational state. For example, because there are students who had attribute 3, an interdisciplinary mix of students, in IDEAS and in Course X, we should be able to assess the extent to which this attribute correlates with motivational state and curiosity. By the end of the study, we should have over 100 students' responses, which will enable this examination.

In conclusion, this preliminary study suggests that IDEAS courses are better environments for fostering students' situational motivation and curiosity than more typical courses. This observation is consistent with self-determination theory, where the greater levels of autonomy, purpose, and mastery are expected to result in higher levels of intrinsic motivation among students. As the study continues, we will see if this observation continues to be borne out with a larger sample size.

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