I Like Therefore I Learn! Engineering Student Motivation to Learn in Their Least and Most Favorite Courses

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Abstract

Although motivation for learning has been studied widely, there has been a lack of research examining student motivation for learning and course favoritism. Our conversations with students led us to wonder how much engineering students' perceptions of courses as their favorite or least favorite determined their motivation to learn. Further, we investigated if students shifted goal orientation from performance to mastery between their least and most favorite courses. The implications are substantial for student learning, success, and career persistence if motivation to learn shifts with how much students like or dislike a course, particularly if courses are degree requirements.

We examined how motivation to learn shifted with students' course favoritism, why students perceived courses as their most or least favorite, student course achievement, and if these were engineering courses, required courses, and/or STEM courses. We used a cross-sectional exploratory study, and a mixed methods approach gathering both quantitative and qualitative data. We selected items from the Motivated Strategies for Learning Questionnaire developed a standard demographics survey and free response items associated with course favoritism. The email was sent to over 500 students, and 82 fully completed our survey. Because our research was exploratory, we determined the sample was sufficient to answer our research questions.

Our analysis revealed that students displayed significantly greater mastery motivation for their most favorite course compared to their least favorite ($t(83) = 9.65$, $p<.01$). We found that the least favorite course was required for 91.46% of students, while 71.60% of students indicated their most favorite course was required. Significantly, a greater number of least favorite courses were required courses for an engineering degree ($\chi^2(1) = 10.70$, $p<.01$). Our findings indicate course content and instructor are primary factors associated with why students listed a course as most or least favorite. The intensity of the survey response statements indicated a high level of emotion associated with explaining why a class was most or least favorite. Our research revealed that the students are more likely to be mastery oriented in their favorite courses and more performance motivated in their least favorite courses ($p < .01$). Significant positive correlations ($p < .05$) occurred among perceived levels of learning, course performance (grade), and mastery learning in the most favorite course. Through our research and analysis several significant positive correlations emerged between level of learning and performance orientation for learning in the least favorite course. Implications and directions for future research are discussed.

Introduction.

Although motivation for learning has been studied widely (see Shah and Gardner, 2008[1] for more information), there has been a lack of research examining student motivation for learning and course favoritism. Our conversations with students led us to consider how much engineering students' perceptions of courses as their favorite or least favorite determined their motivation to

learn. Many other tangible or academic factors are likely to influence engineering students' motivation and engagement in learning. Some of these factors may include the desire to complete a degree, the need to maintain positive academic standing, the desire to get good grades to be competitive for scholarships or awards, and the desire or need to please those funding or supporting their education (e.g. parents, family, government). There is some level of expectation that regardless of the course the motivation for learning would remain consistent, being more of a trait condition (a personality trait of the learner) of the individual rather than the state the individual is in or the conditions being encountered[2]. While the relative stability of student motivation seems to make sense there is the possibility that motivation to learn substantially shifts based on students' impression of their courses. In other words, student motivation and engagement in learning may be very different in most favorite and least favorite courses.

While we are broadly interested in engineering students' engagement and motivational goals in learning, we specifically wondered how engineering students' course favoring or affinity was related to their learning motivation goals and engagement in the course.

Motivation and Learning

The investigation of motivation in learning has a rather extended history. The research on motivation in learning has evolved over time from a behaviorist perspective using the application of the stimulus and response model[3] to a more complex view of motivation to learn involving self-regulation, expectations, attribution, self-efficacy, situation, context, relationships, interest, and goal orientation[4,5,6,7,8,9,10,11] The evolution of the understanding of motivation to learn has led to a perspective of motivation as a multi-faceted construct composed of a collection of unique and overlapping elements[1,12]. Based on the multi-faceted nature of motivation in learning we argue that there are likely other salient, but less explored facets of motivation associated with students' learning. One such element is how much a student favors or has affinity for a course.

Our informal conversations with students about their course favoritism and their engagement in their courses led us to wonder how much engineering students' perceptions of courses as their favorite or least favorite were associated with their motivation to learn. However, given the multifaceted nature of motivation, we decided that we needed an efficient indicator of motivation that may effectively reveal differences in motivation related to difference courses. We selected to use students' goal orientation as associated with learning[13] as a proxy for student motivation and engagement in learning.

Briefly, goal orientation in learning is based on either the premise that learning is motivated by individual desire to achieve the goal of performing well in learning situations, or the goal of mastering the knowledge and understanding of content and concepts. Most likely, goal orientation is representative of a combination of both performance and mastery. Thus, goal orientation can be represented by a spectrum with one end defined by performance goals and the other end defined by mastery goals[14,15]. In general, students who are more extrinsically motivated tend to maintain performance goals in their learning while students who are more intrinsically motivated tend to maintain mastery goals for learning[16]. Thus, mastery goal learners are typically driven by internal desire to learn more and gain deeper understanding of ideas, while performance goal learners are typically motivated by task completion, scores, grades, and

competition with peers[17]. More recent research on motivation goals and learning has led to reports on how emotions associated with learning influence learners' goals[18] and with specific groups of STEM students[19].

We considered the association between motivation goals, student engagement in learning, and learner emotions and determined there was justification for examining similar relationships with engineering students. Specifically, we were interested in undergraduate engineering students' learning motivation goals with respect to their least and most favorite courses. Unlike research that has explored the relations between students' learning motivation and their activity choices (for more details please see Wiggfield and Eccles, 2000[20]) students in our study had few choices, as the courses they were taking were required for a degree in engineering. Thus, unique to our research was the notion that the students were basically required to take both their most and least favorite courses if they wanted to graduate with an engineering degree. The implications for our research are substantial for student learning, success, and career persistence – for if motivation to learn shifts with how much students favor or disfavor a course, particularly if courses are degree requirements, they may not gain the desired or intended knowledge and skills from the courses and therefore complete their degree program with critical gaps in their knowledge.

Methods

The fundamental goal of our research was to examine how undergraduate engineering majors' motivation to learn shifted with how much they favored or disfavored a course. We also sought to learn more about why students perceived courses as their most or least favorite, the levels of student achievement in the courses, and if these were engineering courses or some other STEM related courses.

Research Questions: We used the following questions to guide our research:

RQ1: How does engineering students' motivation to learn compare between their least and most favorite courses?
RQ2: What are engineering students' least and most favorite courses?
RQ3: What do engineering students identify as elements that influence their decisions that a course is their least or most favorite?
RQ4: What is the relationship among course favoritism, motivation to learn, and grade attainment?

Participants

The average age of the 86 undergraduate engineering majors was 25.99 years (*SD* = 8.18). Our sample was composed of 19 females and 67 males who had attended post-secondary education for an average of 3.60 years. Our participants were 82.8% Caucasian, 6.3% Latino/a, 2.8% Asian, 1.5% African American, .5% Native American and 6.1% selected other. About 56% of our participants were from suburban communities, 25% were from rural communities and 19% from urban communities. The students were distributed among the common engineering majors of mechanical, civil, computer, electrical, and materials science engineering, with a smaller proportion of students from construction management and bio-engineering.

Data Collection and Instruments

As a team we developed a unique instrument to gather the students' demographics data and information related to their learning preferences, most and least favorite courses, justification for their ranking of the courses, and learning expectations. To gather the students' mastery and performance motivation for learning goals data we selected items from the Motivated Strategies for Learning Questionnaire[21]. The Motivated Strategies for Learning Questionnaire (MSLQ) has 15 subscales which is designed to allow researchers to group selected items to create tailored instruments to assess aspects of motivation for learning or learning strategies. We selected 20 motivation for learning items related to extrinsic motivation (performance goals) and intrinsic motivation (mastery goals) learning orientation and some additional items related to general motivation for learning. From the items selected we created a group of 8 performance goal orientation items and 12 mastery orientation items (a total of 20 item) for our study. The MSLQ items are answered on a Likert-like seven step scale with 1 representing "Not true of me at all" and 7 representing "Very true of me." We included the same 20 items twice in our survey, requesting students to complete the 20 items while considering their most favorite course and again complete the same 20 items while considering their least favorite course.

We used a cross-sectional exploratory study, and a mixed methods approach gathering both quantitative and qualitative data. Our research took place in a College of Engineering at a metropolitan university in the western United States. We worked with the lead advisor in the college to draft and distribute an email to the college undergraduate engineering majors inviting them to participate in our research. The email was sent to over 500 undergraduate engineering majors, and 82 students fully completed our survey. Because our research was exploratory, we determined the sample was sufficient to answer our research questions and did not pursue additional participation.

Results

Motivation to Learn

Our first research question asked, **"**How do engineering students' motivations to learn compare between their least and most favorite courses?" To answer this research question we conducted an independent samples t-test using course favoritism as our factor and the average composite score on our mastery and performance MSLQ items (uses a 7 point scale) as the dependent variable. The composite score for mastery for the most favorite courses was M= 5.94 (SD= .67) and for the students' least favorite course the mastery composite score was M= 4.26 (SD= 1.23). Our similar analysis for performance items revealed an average score of M= 3.99 (SD= .82) for the students' most favorite course and an average of M= 4.11 (SD= 1.00) for the least favorite course. Our analysis revealed that the engineering students displayed significantly greater mastery goal motivation for learning in relationship to their most favorite course compared to their least favorite ($t(85) = 13.20$, $p<.01$). Our results suggest that students tend to be more intrinsically and mastery motivated in their most favorite courses. Our analysis of the performance scores revealed no significant difference, yet the mastery scores shifted

substantially suggesting that the students were more performance and extrinsically motivated in their least favorite courses when their overall motivation is considered as a whole.

Most and Least Favorite Courses

Our second research question asked, "What are engineering students' least and most favorite courses?" Our analysis revealed that the engineering students' least favorite course was required for their degree program for 91.46% of students, while 71.60% of students indicated their most favorite course was required for their degree program. A Chi-square analysis of course favoritism and required for a degree revealed a significantly greater proportion of least favorite courses were required courses for an engineering degree ($\chi^2(1) = 10.70$, $p<.01$).

Our further analysis of the specific courses that students selected as their most and least favorite revealed science, math, and engineering courses to be on the top 5 for most favorite and top 4 for least favorite (a required university foundational studies course was also listed in the top 5 for least favorite). Many of the other courses that were listed as both most and least favorite are required courses as part of the core curriculum (e.g. English) or part of the specific engineering curriculum (e.g. Engineering Design). The frequencies, percentages, and course titles or domains are presented in Table 1. In Table 1 we have highlighted the top 5 least and most favorite courses using a color code designation.

Table 1. *Most and Least Favorite Course Tiles or Domain, Frequency, and Percentage (N = 86)*

Courses	Favorite Rank Order	Most Favorite	Percentage Most Favorite	Least Rank Order	Least Favorite	Percentage Least Favorite
Math	1	14	16%	2	14	16%
Computer Science	1	14	16%	5	6	7%
Material Science Engineering	2	9	10%	7	3	3%
Mechanical Engineering	3	8	9%	4	8	9%
Science (Chemistry, Physics)	4	6	7%	1	15	17%
English	5	5	6%	6	5	6%
Civil Engineering	5	5	6%	9	1	1%
Philosophy	6	3	3%	6	5	6%
Art (Visual, performing)	6	3	3%	7	3	3%
Intro to Engineering	6	3	3%	8	2	2%
University Foundations	7	2	2%	3	9	10%
Communications	7	2	2%	7	3	3%
Construction Management	7	2	2%	9	1	1%
Electrical Engineering	8	1	1%	6	5	6%
Engineering Design	8	1	1%	8	2	2%
Anthropology	8	1	1%	9	1	1%
Psychology	8	1	1%	9	1	1%
Economics	8	1	1%	10	0	0%
Geography	8	1	1%	10	0	0%
Medical Terminology	8	1	1%	10	0	0%
Physical Education	8	1	1%	10	0	0%
American Sign Language	8	1	1%	10	0	0%

Theater	8	1	1%	10	0	0%
French	9	0	0%	9	1	1%
Sociology	9	0	0%	9	1	1%

Why Most or Least Favorite

Our third research question asked, "What do engineering students identify as elements that influence their decisions that a course is their least or most favorite?" To answer this question we examined the students' responses to our free response item that asked the students to share why the courses were their most or least favorite. We coded the students' responses based on their primary responses. Our analysis revealed that course content, the faculty member, or the course's instruction were identified by the students as the primary reasons for why they listed a course as most or least favorite. The intensity of the statements (e.g. adamantly positive and praising in descriptions of their most favorite courses or highly critical and insulting in descriptions of their least favorite courses – see Table 2) indicated a high level of emotion associated with explaining why a class was most or least favorite. The frequency of the responses and representative statements for the most and least favorite courses are provided in Table 2. A Chi-square analysis of the responses the students used to justify their most and least favorite courses revealed a significant difference ($\chi^2(2) = 24.45$, $p<.01$). Students listed course content with higher frequency for their most favorite courses (i.e., like the content) and instruction (like the way the course was taught) with greater frequency for their least favorite courses. Faculty members were listed nearly equally for both the students' most and least favorite courses.

Table 2. *The Frequency for Justification for Most and Least Favorite Course (N = 86)*

Justification	Least Favorite	Example Responses	Most Favorite	Example Responses
Course Content	22	Because it was extremely redundant and went over material that one should learn from their parents not required in a class in college Boring. Unsatisfying. Shallow busy work. It made class time feel useless.	46	I like learning about the fundamentals of how things work. The reason I say this is because I wasn't comfortable about it coming into it and now I am. Its cool to solve something complex and feel good about it after.
Faculty Member	25	I felt like the instructor (the first time I took the class) thought I was stupid. I felt so stupid around him that I didn't even want to ask questions. Horrible teachers for a difficult subject.	29	My teacher is really down to earth and had us do fun communication activities Very engaging and helpful professor, and interesting topic made it exciting and fun to learn.
Instruction	39	I feel that I could have learned the material faster and more effectively if I had just bought	11	Fun and involved assignments that I understood

	the textbook and read it cover to cover. Meandering instruction. Poorly described homework and labs. Lack of help from Teacher and Support staff	We actually got to design and build a device. First real hands on class.

Relationship among Favoritism, Motivation, Learning

Our fourth research question, **"**What is the relationship among course favoritism, motivation to learn, and level of learning?" To examine the relationships we conducted a series of correlational analyses. Our analysis revealed a positive correlation between engineering students' rating of how much they learned in the course and a mastery approach to learning (r = .47, p< .01) and no significant relationship to a performance approach (r = .16, p> .05). We found a similar relationship between students' ratings for their level of learning and their mastery composite scores for their least favorite course (r = .49, p< .01), and no significant relationship to their performance orientation scores (r = .11, p> .05). We found no significant relationship between the students' performance and mastery scores for their favorite course (r = .01, p> .05) but did find a significant relationship when they considered their least favorite course (r = .34, p< .01). Our analysis also revealed a significant negative correlation between course achievement (grade), and mastery learning in the students' least favorite course (r = -.29, p< .01) and for their performance scores (r = -.48, p< .01). We found no significant relationship between course achievement and the scores on either form of motivation.

Discussion and Implications

Our goal with this project was to determine how engineering student motivation shifts due to their favoritism for their courses and the nature of the courses that they identified as their favorite and least favorite. How engineering students approach and think about learning can substantially influence their success as students, completion of degrees as engineers, and their effective engagement in careers. Further, if instructors, advisors and administrators have a deeper understanding of the learning process and traits of students they can teach, advise and plan in ways that enhance student success.

As we answered our first research question it became apparent that engineering students' motivational goals for learning shift significantly and substantially from mastery in their favorite courses to more of a performance approach in their least favorite courses. Our findings indicate that motivational goals for learning with respect to course favoritism are reflective of a state dependence rather than a trait the students hold with respect to the way they approach learning. Thus, motivational goals of engineering students are likely to shift, some substantially, based on their affinity for a course. The implications for our findings are such that if students favor a course they are more likely to engage in learning at the mastery level and seek deeper understanding and develop more complex knowledge of subjects based on intrinsic factors. In contrast, if students disfavor a course they are likely to be driven by external factors, like grades, or simply passing and getting through, and are much less likely to develop and retain deep understanding of course content. The implications for faculty are the accomplishment of course content by students and their levels of engagement in learning. Thus, if faculty want students to

master course content they will need to determine what needs to happen to increase student favoritism for the course, which may be a complex and even unappealing process for faculty to consider.

Our analysis of the relationship between engineering students' most and least favorite courses and whether the courses were required revealed that the vast majority of the students' least favorite course was required and a major percentage of students also indicated that the most favorite course was also required. Thus, the students' most and least favorite courses were required for their major, and as a result, the vast majority of students did not choose these courses but were compelled to take the courses to complete an engineering degree. The implications are that much of the engineering program coursework requires students to take courses that they like in addition to courses that they do not like. While the classes the students favor are positive, requiring students to take courses that they consider to be their least favorite course may be a barrier to degree completion. Identifying these courses and modifying them to make them more appealing to students may increase program retention and completion. At the very least, modifying the courses could increase program reputation and make the students' experience more positive which could attract more students to a program.

In terms of what students identify as influential on their determinations of a course as most or least favorite, the faculty who taught the course and the content of the course were listed with high frequency for both classifications of courses. Thus, faculty teaching styles, interactions with students, pedagogical knowledge, and personality may heavily influence not only how much a student favors a class, but how they engage in learning. Inferring from our data it is likely that if engineering students perceive faculty members positively they will take a mastery approach to the courses. However, if they perceive the faculty member teaching a course negatively the students will take a performance approach to the course. There is likely a similar reaction by students based on the content of the course. We speculate it is more the manner in which course content is presented and the expected outcomes associated with learning the content that influence students negative or positive perceptions of content rather than the actual content because some courses in which content was shared as influential on students' course favoritism appeared as both least and most favorite of the students. The challenge with addressing course content as influential on student learning is the need to strike a balance between what students find appealing and assuring that the courses cover the necessary content. Research on these efforts is potentially a very fruitful direction for future research.

Our correlational findings relating course achievement, favoritism of courses and motivational goals for learning reveal positive correlations with students' most favorite courses and negative correlations with least favorite courses. There are substantial implications for evidence that students' performance, engagement, and learning in a course are associated with their favoritism. Based on our research, we argue that the courses that are the students' least favorite are likely to be gateway courses that may negatively influence engineering students' retention in degree programs. While some courses may be consistent among institutions there may also be institutional specific in the courses. Understanding how to effectively adjust courses to make them more appealing to engineering students may substantially increase student achievement, mastery of course content, program retention, and program success. The evidence revealing course achievement is associated with how much engineering students' favor courses provides

justification for examining and attending to students' emotions toward courses. Again, striking a balance may be important to assuring student success and attending to course goals. Regardless, students' long term retention of concepts in their most and least favorite courses is an interesting direction for future research.

Limitations

Our first limitation is that our data were gathered at one university, and therefore the generalizability may be limited. However, the foundation of our research has been documented across institutions and conditions. Further, the undergraduate engineering students in our research were similar to students participating in large scale multi-institutional studies[22]. We maintain that there may be nuanced outcomes for each institution and, therefore, to develop a more accurate portrayal we encourage others to explore these relationships with their engineering students.

Our second limitation was the volunteer and self-report nature of our research. Although such methods have been widely accepted in research[23] the methods have limitations in that those participating may not be completely representative of the larger population. However, over 85 undergraduate engineering majors (of about 500 majors) participated in our study which we contend is sufficient to provide a meaningful depiction of our targeted population. Further, the face validity of our results are consistent with conversations with engineering students, advisors, faculty, and administrators. Replication studies of our research will verify our outcomes and provide additional checking of the accuracy of our research.

A third limitation is the mixture of past and current courses that students selected and reflected on as they considered their least and most favorite courses. Thus, some students engaged in retrospection of their experiences while other students were currently immersed in their experiences. Limiting the sample to students currently enrolled in courses, or comparing the retrospective responses to those students currently enrolled are both interesting directions for future research.

Conclusion

Students' motivational goals for learning can be classified on a spectrum from performance goals to mastery goals. We have found that the motivation goals that engineering students hold for learning may shift substantially depending on how much students favor a course. Further, we found that engineering students' achievement and knowledge seeking substantially shifted based on their course favoritism. Given our findings, there is justification for examining how and why engineering students favor or disfavor their courses, particularly if the courses are required for a degree, and perhaps consider adjusting the courses in a way that encourages students to take more of mastery approach to their learning. Adjusting course instruction, faculty interactions, content, and relevancy based on engineering students' course favoritism may be challenging to accept. However, the outcomes of increased learning, retention and professional success is highly desirable.

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