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***Abstract*— This work in progress explores how instructional strategies and technology use were related to engineering students' affinity toward a class. Instructional strategies, such as contextual problem-based learning and teamwork, can increase student interest in a topic. Additionally using different technological tools affects student interest and learning. However, instructors can be challenged to encourage and maintain student interest, which makes this study worthwhile to pursue. To our knowledge, there is a dearth of engineering education research exploring the relationship between instructional technology, instructional strategies, and engineering students' course favoritism. This study aims to fill this gap by identifying effective instructional strategies and the use of educational technology that helped make a class engineering students' favorite.**

Keywords—instructional strategies; eductional technology; student interest; course favoritism

I. Introduction

It is reasonable to speculate that students learn more and are more motivated to learn in their favorite classes. Therefore, to identify and implement effective instructional strategies that help increase student favoritism for a class is a worthwhile goal. If students are more motivated to complete coursework, they learn or perform better [1, 2]. In searching the literature, we did not find any research study that specifically explored the relationship between instructional strategies and engineering students' favorite classes. Some instructional strategies identified in general, such as problem-based learning [3] and teamwork [4], make classes more motivating or interesting. However, to our knowledge, there is no set of specific instructional strategies that are proven to be effective in increasing student favoritism for a course.

Generating and maintaining student interest in the class or topic is a critical component of favorite classes. Interest refers to "focused attention and/or engagement with particular events and objects" [5, p. 169] so we can actively process the important and relevant information. Generating and maintaining student interest can contribute to creating optimal learning environments [5], which we argue should be considered when developing and implementing learning activities. Student interest in learning can be promoted via effective instructional approaches [5] and the use of educational technology [6]. There is a lack of research on motivational effects of instructional strategies and the use of educational technology on students' affinity toward a class. Likewise, few studies explore effective instructional strategies and the use of educational technology in engineering students' most favorite classes. Our study aims to fill this gap by identifying effective instructional strategies and the use of educational technology that helped make a class engineering students' favorite. We asked the following research question: What kind of instructional strategies and technology were used in engineering students' most and least favorite classes? We aimed to identify the instructional approaches and tools used in engineering students' most and least favorite classes.

II. Literature Review

A. Instructional Strategies

Some specific course instructional strategies may motivate student learning and engagement. For example, problem-based learning (PBL) can motivate students in applying what they have learned to solve real world problems [7]. Through PBL, instructors can encourage students to seek out new information and generate new knowledge based upon their prior knowledge. Students engaged in problem-solving demonstrate greater focus and attention to learning as well as engage in deeper cognitive processing [3]. Problem-solving also provides engineering students with hands-on activities, which helps develop and sustain interest [8].

Similarly, service learning that combines instruction/learning with meaningful community service helps prepare students professionally [9]. Service-learning provides students hands-on opportunities to gain skills and knowledge that may otherwise not be obtainable in their classes. Through service-learning, students are motivated to gain effective communication and project management skills [10].

Additionally, group projects or teamwork can develop student interest in subject content through the need for autonomy, competence, and social relatedness [11]. In group projects, students engage and interact with others, which allows interest to be modeled and remodeled, such as one develops an interest because of one's peers [4]. Friendly competition within a team or between teams can also promote interest in some subject topics. A meta-analysis of college students studying STEM subjects found small group work has a significant positive effect on academic achievement and motivation [12].

A study by Dartmouth University reported that engineering alumni' favorite classes involved problem-solving, service-learning or teamwork [13]. The participants also reported enjoying transferring theory to practice through solving real-world problems in their favorite classes.

In addition to specific instructional strategies that can help develop student interest in subject matter, there are some general approaches that can build student interest in learning. Krajcik and Mamlok-Naaman [14] suggest organizing instruction around a driving question rather than topics. This practice emphasizes the relevance of the material (driving questions) to real life. Using driving questions to organize instruction helps pull relevant information together, which facilitates application of learning [14].

Likewise, learner centered teaching approaches increase student interest in instructional material. Ellis, Rudnitsky and Scordilis [15] found that learner centered instruction in teaching introductory engineering mechanics could help students become more committed in the field of engineering.

B. *The Use of Educational Technology*

As educational technology becomes an essential element in teaching and learning, students' interest and motivation can be affected by the use of technology in their classes. Appropriate use of technology in the classroom can increase student interest [6] and can enhance students' learning [16]. For example, visualizations and simulations not only help generate students' interest but also allow students to better use evidence and data during their scientific inquiries [17]. Technology, especially technology-based student-centered learning, has the potential to optimize student learning [18].

Technology can be used to support learner autonomy, i.e. taking charge of one's own learning [19], and to encourage more active and deeper learning [20]. For example, providing technology-supported instruction in the form of motivational emails and links to supplementary instructional materials (such as videos) increased student motivation to learn [21]. Students who received supplementary motivational instruction perceived that they could take charge of their own learning and displayed more self-directed learning than students who did not receive supplementary motivational instruction. Similarly, educational games were found to be effective for learning and motivation in the context of learning computer concepts [22]. Educational technology may enhance student learning and attainment for learning, providing resources and learning platforms (such as Blackboard and Coursera) for independent learning and team collaboration [23]. Despite the promise of technology tools to engage and motivate, it is important to note that they are just tools, a means to accomplish an end goal. Therefore, educators need to focus on the learning processes (such as collaborative learning) instead of the tools [24].

III. METHOD

We created a survey containing a combination of selected and free-response items which we invited engineering students to complete. The survey included items asking the participants' to share their most and least favorite classes and justifications for their ranking of the courses, the major instructional approaches used in the courses, and the technology used in the courses. The survey also included demographic questions and Likert-scale questions asking students to rate the usefulness of the instructional strategies and use of technology in their most and least favorite classes. An invitation to participate in the online survey was sent to more than 500 undergraduate students in the College of Engineering at a Western university. Ninety-five students (73 men, 22 women) completed the survey. Participants included undergraduate engineering students from various engineering program areas such as mechanical and biomedical engineering, electrical engineering, materials science engineering, civil engineering, computer science (in the college of engineering), and construction management (in the college of engineering). The average age of the survey respondents was 25, 12 respondents were freshman, 26 were sophomores, and 26 and 27 were juniors and seniors respectively.

IV. RESULTS

Research Question: What kind of instructional strategies and technology were used in engineering students' most and least favorite classes?

According to the survey results, a variety of instructional strategies were adopted in students' most favorite classes including lecture (100%), live demonstration (65%), individual problem solving (63%), group problem solving (58%), full class discussion (54%), group discussion (49%), and laboratory experiments (35%) (see Table I). Only one most favorite class had adopted all seven of the above instructional strategies. The majority of participants believed the instructional approaches adopted in their most favorite class helped their learning. Similarly, a variety of instructional strategies were adopted in students' least favorite classes. However, it seemed that more least favorite classes had adopted less interactive (discussions) and less hands-on (labs) approaches.

Results showed that a variety of technology tools were used in students' most favorite classes including PowerPoint presentations (100%), video/simulation during class (71%), online homework system such as Masteringphysics.com and Webassign.com (48%), clickers (classroom response system 23%), relevant videos used outside of class (46%), Blackboard discussions or online discussion forums (23%), mobile devises (e.g. iPad, tablet computer, smart phone 17%), Blackboard quiz/test (17%), and recorded lectures provided by course instructors (17%) (see Table II). Only two most favorite classes

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did not use any other technology except for PowerPoint presentations. In the most favorite courses, more participants believed the use of technology outside of the classroom was helpful for their learning compared to those in the least favorite courses. However, more than half of the participants held a neutral attitude (neither helpful nor harmful for their learning) towards the use of technology in their most favorite class.

Most participants' most favorite classes incorporated several instructional strategies (see Table I). Similarly, most participants' most favorite classes included several technological tools (see Table II). Results also showed that a variety of technology tools were used in students' least favorite classes (see Table II). However, the percentages of the use of technology in students' least favorite classes were less than those of the most favorite classes. The Ns in Table I and II stand for the actual number of responses for that particular item choice.

TABLE I. INSTRUCTIONAL STRATEGIES IN THE MOST AND LEAST FAVORITE CLASSES

Instructional strategies	Most Favorite (%) N=71	Least Favorite (%) N=62
Lecture	100	90
Live demo	65	15
Individual problem solving	63	3
Group problem solving	58	23
Full class discussion	54	23
Group discussion	49	16
Lab experiments	35	10

TABLE II. TECHNOLOGY ADOPTED IN THE MOST AND LEAST FAVORITE CLASSES

Technology/ tools used	Most Favorite (%) N=52	Least Favorite (%) N=62
PowerPoint presentations	100	53
Video/simulation used in class	71	27
Online homework system	48	42
Other relevant videos used outside of class	46	16
Clickers	23	21
Blackboard discussion	23	16
Mobile devises (e.g. iPad, tablets, smart phone)	17	11
Blackboard quiz/test	17	23
Recorded lectures	17	6

In the most favorite classes, 97% of students (36 out of 37 responses) considered the instructional approach helped their learning, and only one responded the instructional approached was neither helpful nor harmful. About 32% of participants (22/69) considered the use of technology in class helped their learning, and 68% participants (47/69) considered the use of technology neither helped nor harmed their learning. In the least favorite classes, 73% students (24 out of 33 responses) considered that the instructional approach harmed their learning; only 2 responded the instructional approached helped their learning; and 7/33 participants considered neither helpful nor harmful. Only 3% of participants (3/87) considered the use of technology (including both in and outside the class) in their least favorite course helped their learning, while 13% participants (11/87) considered the use of technology harmed their learning; and 84% participants (73/87) considered the use of technology neither helped nor harmed their learning.

VI. DISCUSSION AND CONCLUSION

In our study we explored instructional strategies and the use of technology in engineering students' most and least favorite classes. Most participants considered the instructional approaches in their most favorite class helpful. Specifically, problem solving, hands-on activities, demonstrations, and discussions were found to be positively linked to most students' favorite classes. Instructional approaches are closely related to learner satisfaction and supportive course instructors, which are critical to generate and or sustain students' interest in the course. However, few students considered technology use helpful in their most favorite classes, which means the use of technology in those most favorite classes did not necessarily motivate the students to learn. Therefore, effective use of technology in engineering classrooms needs to be improved.

Although instructors play an important role in implementing the instructional strategies and technology tools, our study did not consider the impact of instructor in student's most favorite and least favorite classes. From the overall differences between participants' responses to the same instructional strategies and technology tools in both most and least favorite classes, we could see a clear trend with respect to our findings (see Table I and II).

Our study has some limitations. First, the survey relied on self-report data, which may be subject to bias of participants when recalling their most and least favorite courses. Second, the relatively low sample size may limit the generalization of the study. Future studies on exploring the relationships between instructional strategies and the use of technology with engineering students' favorite and least favorite classes from different types of institutions are needed. Nevertheless, the findings of the study can provide some practical guidelines on supporting students' interest via effective instructional strategies and use of technology (part of the instructional strategies). Future studies on how instructional strategies and the use of technology have the potential to help instructors learn how they can generate interest in those academically unmotivated students as well as sustain interest in students who are initially motivated. Different instructors could implement the same instructional strategy differently. For example, some instructors explain and discuss their PowerPoint slides while others just read their slides. Future studies may need to include the impact of instructors in such studies.

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