Incorporating Faculty Sense Making in the Implementation and Modification of an Instrument to Measure Social and Cognitive Engagement

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Background

Over the last decade, numerous calls for change in the engineering curriculum and content delivery have been made. Following these recommendations, the field of engineering education saw research on the development and implementation of several learning innovation and instructional practices. However, while there has been extensive research examining barriers and affordances to the adoption of teaching practices and curriculum, much less work has been done on assessment instruments. In addition, research highlights there is generally resistance on the part of faculty members when it comes to adopting new practices. This resistance often stems from faculty feeling as though that their input was not solicited during the development of these innovations.

Purpose

As part of a larger study to develop an instrument that measures students' social and cognitive engagement with a course, this work seeks to explore the sensemaking processes faculty undertake when they choose to adapt and adopt the aforementioned instrument. In addition, we seek to investigate how engaging faculty in the process of developing and using the instrument impacts the overall ability of the instrument to meet the needs of current and future users.

Method

A group of engineering faculty at a pacific northwest institution participated in this study through interviews and survey implementation in their course. Data were collected through three interviews. First, faculty were interviewed to understand their motivation in using our survey and their perception of its benefits. A second interview followed, using the instrument items as a guide, to determine how faculty made sense of these items in relation to their course and their students. In a final interview, faculty were given the opportunity to select results they wished to view thereby eliminating questions from the dataset that they deemed outside of their needs or interests. Faculty were also asked what parts of the survey they would like changed and why.

Results

This study demonstrated how feedback from faculty, as it relates to the usability of the instrument and recommendations for improvement, impacted the evolution of the social and cognitive engagement instrument. In addition, this approach allowed for an understanding of how the adoption of the instrument emerged through faculty input.

Conclusion

Engaging faculty in the process of developing educational initiatives is an important aspect of fostering change. Most importantly, understanding faculty perspective can guide current and future development efforts of our instrument. Future research will investigate the role of the instrument and student data on teachers' decisions to modify their teaching practices.

Introduction

The field of engineering education grew out of the need to increase research scholarship on educational issues specific to engineering. Over the last decade educators and researchers have engaged in the conversation about what it means to be an engineer and what educational and curriculum reformations are necessary to produce the type of engineer the world needs [1]–[3]. To this end, engineering education research has sought to highlight the importance of intentional instructional strategies, educational innovations and their ability to evaluate the effectiveness of these approaches on student learning. This gave way to increased calls for the use and creation of active learning environments to ensure student engagement and knowledge retention. Active learning researchers [4]–[6] posit students learn more and are better able to transfer knowledge of key concepts when they are actively involved in the learning process. Based on their recommendations, educators have often felt the need to make significant changes to their courses with the aim of actively engaging students. However, amidst the growth of research on student engagement there is no reliable instrument designed to assess student engagement in an effort to explore how and why students engage with course materials.

The Course Social and Cognitive Engagement (CSCE) survey was designed to assess students' in- and out-of-class cognitive and social engagement while completing learning activities associated with a particular course. In an effort to determine instrument reliability and validity, a pilot study of the instrument was conducted in partnership with faculty participants. While the overall goal was to have these faculty participants agree to distributing the survey to their students, the researchers saw a fruitful opportunity to engage faculty input beyond just sending their students a link to the survey. Consequently, an adoption study was designed to explore the motivation of faculty members and their perception of the CSCE survey.

Since previous research suggests that simply developing materials and demonstrating their effectiveness will not result in widespread adoption [7], a subset of the research team was dedicated to engage faculty to go beyond the passive role of dissemination and participate in the active role of propagation. To serve as a guide for engagement with faculty, the sensemaking framework was used. Sensemaking is defined broadly as developing a set of ideas based in plausible explanations [8]. Sensemaking is likely to occur when a current state of an initiative is different than the expected state [9]. In this study, a noticeable difference was seen in the current state of faculty evaluation (or lack of evaluation) of student engagement through their own means and the expected state of faculty evaluation of student engagement through the provided survey instrument. With this framework as a guide, the research team sought to involve faculty in the multi-phased sensemaking process of survey adoption. This process included faculty being introduced to the research study, previewing and interpreting survey items before implementing with their students and discussing results with the researchers. This resulted in faculty discussing their initial interest in using the instrument and what perceived benefits educational surveys of this nature can have for their overall professional and personal development. In each interview, the researchers used open-ended, semi-structured interview protocols to highlight areas of faculty sensemaking. While the survey itself was meant to measure students' self-reported levels of cognitive and social engagement, the purpose of this particular study was to explore how and

why faculty chose to adapt and adopt versions of this survey to measure engagement in their respective courses. The goal of this pilot study was to provide researchers with valuable information about the usefulness of our survey in measuring the cognitive and social engagement constructs. Additionally, this work was mean to showcase the importance incorporating faculty input in the development of educational innovations.

Background

Research on the use of evidence-based instructional practices in engineering classrooms and their benefits in promoting learning and student engagement is not a new concept. In 2005, Smith and colleagues reported "in the past twenty years engineering educators have implemented several means of better engaging their undergraduate students" [6]. These authors discussed that "educators, researchers and policy makers have advocated student involvement for some time as an essential aspect of meaningful learning" [6]. On the heels of the critique of traditional approaches to teaching and learning came the movement towards student engagement and active learning in engineering classrooms. Studies focused on approaches such as cooperative learning, problem and project based learning, learning communities and service learning sought to support the idea of increasing student engagement [5], [10]. In addition, engineering educators recommended specific changes be made to the engineering curriculum to reflect the importance of actively engaging students [11]. However, despite various studies on this issue "the engineering curriculum has been slow to respond" [12, p. 286]. Some scholars [13] attributed this slow response in curriculum reform to resistance of change initiatives on the part of faculty and other educational administrators.

One reason change researchers posit that change initiatives are often met with resistance from faculty was because the development and testing of instructional innovations usually occur with little to no faculty input [13]–[15]. Yet, it is usually an expectation that faculty should not only be competent in executing these initiatives but should be invested in their success. There often exists built in "assumptions that the faculty will be convinced to use these new instructional materials and strategies once they are shown data demonstrating that these new methods produce improved student learning compared to more traditional instructional approaches" [14]. Consequently, studies that engage future faculty users in the design phase of educational innovations are necessary. To this end, Lattuca [16] suggested the success of educational innovation or curriculum change is often affected by the motivation and instructional decisions of individual faculty members. It is also faculty members' commitment and reception to the use of innovative instructional approaches to improve their teaching and student learning that fuels their desire to implement these approaches in their classrooms. Therefore, sensemaking is a core concept of interest. Faculty's sensemaking of the CSCE instrument provided researchers and developers with the opportunity to understand why faculty chose to participate in the study as well as their perception of the usefulness of the instrument.

In a nationwide study of the adoption of engineering education innovations, Borrego, Froyd and Hall [17] explored how seven engineering education innovations were used across the US. The seven innovations were student-active pedagogies, artifact dissection, curriculum-based engineering service-learning projects, interdisciplinary capstone design projects, summer bridge

programs, learning communities or integrated curricula and design projects in the first-year engineering courses. The purpose of this work was "to understand and make recommendations to promote adoption of engineering education innovations with demonstrated value" [12, p. 186]. The authors surveyed engineering education department heads to assess how aware they were of these practices and how they use them in their respective departments. This study presented key recommendations that may serve as a guide for current and future adoption studies similar to this project. The recommendations were:

1. Adoption levels will be higher in situations where change agents focus on clients' needs over promoting adoption of a specific innovation.
2. Faculty members must be involved in adopting engineering education innovations.
3. Faculty are unmotivated to adopt engineering education innovations when they perceive that teaching innovation is marginalized in promotion and tenure considerations.
4. Faculty attitudes play an important role in peer willingness to adopt new pedagogies including active learning [17, p. 203].

These recommendations solidified the need to include faculty perception in the development and dissemination of educational innovations. In our study, we encouraged faculty to engage in reflection on their practice and why a survey aimed at evaluating student engagement with their course was important. In addition, since our intent was to get faculty to implement our survey in their courses it was necessary to first have faculty understand the purpose of the study and what the items on the survey are aimed at assessing. McKenna, Yalvac and Light [18] termed this approach as "collaborative reflection" (p. 17). Collaborative reflection encompasses the process by which researchers work directly with faculty to develop educational materials to improve faculty teaching and student learning by extension. While our survey items were drafted before engaging faculty, the sensemaking process used before and after implementing the survey allowed researchers to gauge faculty perception of the survey. Most importantly, the insights gathered from these faculty interviews helped to shape future modification of the instrument.

Method

Using a single case study with multiple embedded units design, five engineering faculty members participated in the multi-phase interview process in which their sensemaking of the CSCE survey instrument was studied. For this study, the case was the CSCE instrument with each faculty member serving as an individual unit of analysis. The courses taught by the faculty participants ranged from small (46 students) to large (over 200 students). The course structures were also different and included lectures, laboratories, workshops, and recitations (mandatory group problem solving sessions). In addition, the range of experience between faculty members encompassed first time instructors to others with over five years of teaching at the same institution.

Description of case

The CSCE instrument consists of two major sections. Section one is split into two main categories, in-class and out-of-class activities. In category one, students are expected to answer questions directed at gathering information about their in-class activities. Similarly, in category two, items are focused on students out-class-activities. The in-class and out-of-class items are measured using

a descriptive scale based on the work of Beach and colleagues [19], [20]. Additionally, for both categories, students are also asked to rate their level of concentration on a scale of zero to four with none (not thinking at all about the content/activity) being zero to high (intensely thinking about the content/activity) being four. In section two, items are designed to capture students' social engagement with their instructional team (instructor and/or teaching assistants) and peers both inside and outside of the classroom. The survey was designed using two broad frameworks, section one aimed at measuring cognitive engagement was designed based on the interactive-constructive-active-passive framework (ICAP) created by Chi [21], [22] while section two aimed at measuring social engagement was guided by the social capital framework [23].

Sensemaking framework

The sensemaking framework used to guide this study, grounded in the work of Weick [8], [9], focuses on how meaning is created based on one's perception. This framework consists of seven core properties:

1. Identity – fostered by how people view themselves within a given context and how this view shapes how they enact or interpret events in that context.
2. Retrospection – a necessary facet of sensemaking in that it is through the process of reflecting on a particular concept or event people make sense of what happened or their role in the event.
3. Enactment – speaks to one's ability to assume responsibility to construct and participate in their environment at the same time.
4. Social – posits that sensemaking is an individual as well as social activity. As people interact with their environment, they must navigate their roles and are held accountable for any related action as a result of such.
5. Ongoing – Weick purports sensemaking is a continuous loop that is never ending. There is no beginning nor end. Consequently, each new situation provides a stimulus that challenges or affects the process of making sense.
6. Extraction of cues – as people make sense of their actions within a particular context, they also extract necessary information from the context to assist in determining the relevance and appropriateness of the explanation.
7. Plausibility over accuracy – one key idea behind sensemaking is that people tend to rationalize what they are doing or have done. To this end, sensemaking is focused on, and more receptive to, information that is capable of creating "plausible images that rationalize what people are doing" [9, p. 410].

In this study, the seven properties of sensemaking and the overall framework were used to facilitate the development of the interview protocols. The interviews, discussed next, followed a three-phase process in which faculty were prompted to make sense of the research project, the items on the survey, and finally the survey results.

Phase 1 – Sensemaking of research project

In the initial interviews, faculty were asked to describe the structure of their course and how they were selected to be the instructor. Questions were geared towards understanding the sense faculty

had made of their potential participation in the study. This initial, loosely structured interview served to build rapport, mark the starting position of faculty prior to interaction with the survey, and establish a time in which the survey instrument could be discussed. The following are examples of questions faculty were asked:

a. When you were asked to participate, what was your understanding of what your participation would look like?
b. What is motivating you to use the survey this term?
c. What are you hoping to get out of implementing our survey?
d. What role do you see this type of survey having in your class?
e. Do you see assessment of student engagement having a purpose or impact on you as an educator?

Interviews were recorded and transcribed, with data gathered informing the second series of interviews.

Phase 2 – Sensemaking of survey items

In the second set of interviews, which occurred approximately a week later in most instances, faculty members were presented with a preview version of the survey. The preview version was electronically formatted in Qualtrics and was the exact version of the survey their students would be presented with following the interview. In most instances the interviewer presented and progressed through the survey on a laptop while the faculty member observed. The survey was approximated by the research team to take 35 minutes for students to complete. However, faculty spent significantly less time in going through the survey, often not taking time to read individual questions presented within question banks, as well as eliminating self-evaluation time necessary for student response. Various functional elements of the survey were brought to the attention of the faculty including the survey's skip function when particular questions were answered negatively and items requiring free response. The format of the interview followed that of cognitive interviewing in which faculty were encouraged to explain their understanding of each item. Cognitive interviewing is an important step in survey development as this type of interviewing helps researchers to evaluate participants' interpretation of the quality of survey items and their ability to measure the intended construct(s). In keeping with the sensemaking framework, this phase of interviewing was aimed at validating the items on the survey from the perspective of faculty who would be future implementers of the instrument. Also, using the cognitive interviewing approach along with probing questions to explore faculty sensemaking played a vital role in ensuring our survey was adaptable to the needs of the current participants. Faculty were asked to give overall impressions of the survey, with follow up probing targeted at understanding perceptions of individual questions. Methods of survey distribution and promotion were discussed, ending with faculty being requested to provide their students with the link to the survey in the coming week. The following are examples of questions faculty were asked:

a. What aspects of the survey stand out to you?
b. For what question(s) in the survey are you most interested in student response(s)?
c. Are there aspects of the survey that you think are more important or relevant to you/the way you teach/your course content?
d. Do you have any reservations about using this survey in your class?

e. Do you foresee students using this survey in a way that will provide useful feedback to you?

Phase 3 – Sensemaking of survey results

Due to low survey completion, the third interview was modified to incorporate assisting faculty to understand specifically the information they hoped to gain from the survey as was discussed in the first interview. This is discussed later in the results section. The interview was aimed at the generation of a specialized version of results for each faculty member. Towards this end, each faculty member was presented with a new print version of the survey. The print version of the survey presented each question in a condensed fashion (answer options were not present and questions using multiple scales were presented only once). Faculty were asked to look through each individual question bank and to select which results they would be interested in seeing. Questions were targeted at understanding not just results of the current survey, but how the survey could be implemented again in a future section of their course. This involved the potential removal of questions faculty deemed irrelevant or inapplicable to their classroom. The following are examples of questions faculty were asked:

a. After using this survey, do you think there is purpose or impact in assessing of student engagement having on you as an educator?
b. Would you share anything you learned through this survey with coworkers or others?
c. Would you recommend the survey to coworkers? Why or why not?
d. What questions remain for you about engagement of your students?
e. If you could change this survey, what changes would you make?

Results and Discussion

One hundred sixty-two (162) students participated in the study, of which only 47 completed the survey. The limited number of students participating in the study and the large volume of questions in the survey generated difficulty in presenting results through traditional practices such as distribution graphs and summary statistics. Consequently, response data were limited in spread across a large volume of questions. Based on interactions in previous interviews, it was concluded that it was unlikely faculty would want to see results for each question on the survey—some had more relevance to their course structure, their beliefs on their role in generating engagement, etc.—and would likely forgo sensemaking of a large body of results.

Faculty perception of research project

All five faculty members expressed an interest in the survey and were eager to implement within their courses. The main reason given for their interest in using the survey, even though all admitted they have never used an educational survey before, was being able to reach their students and by extension do a better job at teaching. Some faculty also discussed at length their desire to “mix things up a bit” in their class hence their interest in being able to assess student engagement. The following are quotes from the five participants when asked why they were interested in implementing the survey in their courses (pseudonyms assigned by researchers):

I think this will be a great term to use something like this because I feel like I'm doing the worst job I've ever done at teaching this class, so it'll probably be a good one…Usually I feel pretty good. This has just not been a good quarter. I don't know if I've got too much going on or what's happened, and then I had a family emergency…I just haven't been able to get caught up, and so I don't feel like I'm doing a very good job with engagement or with anything, because I don't feel like my normal self this quarter – Janet

I'm really interested in learning more about how my students learn. What works for them, what doesn't. Selfish really. But if they do well on the tests, I get to have a weekend. It's true, unfortunately. I care deeply about their learning, too, but that's a nice benefit – Kevin

I am an instructor by choice, and I say that because it's an interesting thing ... Well, whatever. Rather than going there, I want to teach. I like to teach, and I would be happy to be better at it – Kurt

In general, I'm happy to help advance engineering education in any way that I can, as long as it doesn't take too much of my time right now since that's not my main function – Nancy

I don't have a lot of experience teaching. I am interested in learning how to become more effective at teaching and making it more effective for the students to learn. I've gone to some workshops. I'm really interested in trying to embrace and implement some of these new ideas. You know effective active learning or just new teaching pedagogies. How to take the same material, but deliver it in a different way or maybe get the students more engaged. I just want learn – Thomas

Based on their desire to assess student engagement, faculty members expressed interest in particular portions of the survey both when discussing survey implementation and results. In the second interview faculty members spoke at length about most of the questions and based on the design of their course, decided what items were not of interest to them. For example, in the quote below, Nancy discussed the lack of exams in her course hence the questions related to exams would not be relevant to her students.

I mean in some ways for this course you can take out the exam part. I mean I give them two quizzes but there's not like exams, there not as technically hard or long or any of that – Nancy

In similar fashion, Kurt highlighted, on a printed version of the survey that was returned to the researchers, all the items that he believed would not be applicable to his students and represented activities he was not interested in learning about. On this same issue, some faculty members differed on whether the in the in-class or out of class items of the survey would be most beneficial to their developments as teachers.

The in class stuff maybe isn't so interesting to me. The out of class, what they're actually doing to study, is really relevant, but I'm not sure about the in class stuff for my

particular class. I wouldn't say it's not useful, but for me it's probably not so helpful – Kevin

Okay. Yeah. I'm very curious about the in class. That's most important to me is what is meaningful to them in class. I have no idea if anything I'm doing is getting through to them. I don't know – Thomas.

When discussing the implementation, some faculty members expressed their desire that the survey be modified to use language representative of their course.

The only other thing is some of these to me, I guess what you're getting at is thinking about ... Because when I work on lab projects in a group moderate, thinking about the course content. This just seems kind of confusing on what it's asking me to answer within those on the Likert scale. That was the only other thing that I'm kind of going, I don't know what I would select – Janet

Others expressed confusion about the relevance of certain questions or entire sections of the survey to their ability to increase engagement in their classroom. On the flip side, one faculty member raised the point of how group work might be perceived differently in her course. She felt that because there is the perception on the part of the student that they would be penalized for cheating if their codes were too similar this restricted how students engaged in a group.

You know what's interesting, I don't see anything on here ... with the working in groups, something that might be kind of interesting to ask them if they ... I don't see anything about cheating. I encourage them to talk to their peers, but they can't code it right beside their peers or do things like that because then I'm going to flag them for cheating because if their program is more than 70% alike from what somebody else's is in the class, I report them – Janet

The lack of faculty sensemaking before the development of the survey calls for a modification of the entire instrument. To allow for sensemaking of the entire instrument being implemented, we pose working with instructors to allow them to select portions of the survey they wish to use for their own purposes and further giving them the ability to make edits to individual questions. An instrument modified individually by instructors would work to ensure sensemaking occurs before implementation. This modification would also serve to advance sensemaking when instructors view results. It was observed instructors often were undergoing sensemaking of the instrument, detracting from sensemaking of the results with which they were being presented.

Faculty interest in survey benefit to students

Faculty sensemaking of the survey resulted in their seeing the potential benefit for both them as an educator and participating students. Faculty spoke of their interest in the survey not only providing feedback on classroom engagement, but for use as a tool to compel students towards engagement.

I'm very curious to know what the students do. I knew what I was like when I was a student and I know what I was like, I'm curious to see where my mode of operation falls

on the spectrum of what students like to do. I wish I had a sensor... I figure there's a lot of students that like to do their homework as a group. They come together and are like, "Let's do the homework together." As a student I hated that – Thomas

One faculty member wished to use the survey to gather data on the success of students who exhibited engagement in the course. This faculty member sought to replace folkloric stories linking engagement to success with actual data. As this was not part of its original intent, significant modification would be required of the instrument to meet this need. However, each faculty member was asked to provide questions they had about engagement and student success, so the viability of incorporating them in a future version of the survey could be addressed.

Faculty perception of survey items

Low response rates, with even lower completion rates, echoed a primary concern of faculty members—the approximate 35-minute response time of the survey would deter students from taking and completing the survey.

I'm worried when you're talking about freshman and they see they have to do something for 35 minutes, they're going to be like, I'm not doing this. A 10-minute survey I could see them participating in, but a 35-minute survey, this seems very long and many of them don't even do evaluations and things and there's not nearly this amount of questions on there, right? – Janet

35 minutes is like, that is a lot of time. They've been pretty much working all day, or they have a job. If you can get that to 10 minutes – Thomas

I think you'd get a lot better response rate. That's one of the reasons I wanted to see how many responses you've got. I'm curious if anyone's even done it, much less if it's 10 minutes, or 5, or 20 – Kevin

No, that seems long. 35 minutes seems like a long time – Nancy

Faculty likewise expressed concern over incomplete representation of student cognitive and social engagement in the classroom. It was of primary concern to many faculty members that the survey be representative of their class constituents. In addition, faculty members discussed the pros and cons of offering some form of incentive for the survey; pros included increased data while cons included the discounting of those voices not motivated by the incentive. It became evident that as faculty made sense of the survey, they believed it appealed primarily to a particular constituent of students (those compelled to go to great lengths to help others or those with great dissatisfaction in the course). The survey length was clearly foundational to this concern, so modifying the items on the survey to make the completion time shorter would coincide with faculty desires.

Current and future research

The third stage of interviews is still ongoing. So far one complete interview that has been conducted with Kurt whose sophomore-level course had the highest number of participants (86). Using a printed summary version of the survey, Kurt was able to eliminate several blocks of questions that were deemed irrelevant to his course. Questions eliminated included activities he

does not enact in his course delivery well as those perceived to be potentially ambiguous to his students. For example, Kurt was uninterested almost entirely in the social engagement portion of the survey, stating its application to generating a more engaged classroom unclear. The only items related to social engagement he was interested in were students' social engagement with their instructor and teaching assistant. Kurt was also concerned about how the divide between lecture and recitation would be maintained. For instance, some items on the survey pertained to in-class activities, which are common for lecture periods, while some items labelled as out-of-class activities could, in Kurt's course, be interpreted as activities students would engage in during the recitation portion of the class. One prime example is a survey item that asks about students solving homework problems alone and/or in a group. Kurt discussed this as something his students often do during recitation which would still be interpreted as "in-class". This raised a very important and insightful issue for the developers of the survey. How will the survey adapt to courses that have paired lecture and recitation and/or lab portions as opposed to those courses that have lectures or lab sections only? This case demonstrates the importance of adoption studies during survey development.

The data for the other four faculty members are still pending distribution. Survey results are still being generated and will be presented in graphical format for the requested questions. For faculty who have data available, a follow-up interview will occur in which faculty can express the clarity of the results presented. Continued iterations of how results are presented are occurring.

In addition, interviews discussing survey results remain ongoing. From the one in-depth interview, mentioned earlier, the importance of working with instructors not only to modify the data they will receive from the survey in the previous term, but to develop a version of the survey that uniquely addresses their interests in engagement was discussed. For instructors who do not have significant data to view, this will be the sole focus of the third interview. Based on faculty suggestions, multiple versions of the survey will be created to only reflect the areas faculty are interested in studying about their particular course and/or students prior to survey distribution. Finally, as the project progresses, our goal is to increase the number of faculty cohorts and number of participating institutions.

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