Student Perspective of Pedagogies of Engagement

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Abstract

Pedagogies of engagement have become increasingly prevalent in the teaching of Science, Technology, Engineering, and Math (STEM) courses. Research shows that students retain and absorb knowledge more proficiently when they are actively engaged. Most studies focus on quantitative results to support their claim. The University of Kansas School of Engineering recently added new facilities which encourage and promote an active learning environment. Having been in place for two years, there was a unique opportunity to qualitatively assess students' reactions to both pedagogies of engagement and the environment in which they experience them. Covering a wide range of student backgrounds allowed the research team to identify themes on student opinions of the use and implementation of pedagogies of engagement.

Introduction

Research has shown that incorporation of active learning in Science, Technology, Engineering, and Math (STEM) fields positively influences student learning, retention, and development (Hake 1998, Berrett 2012, Talbot, Hartley et al. 2015, McCavit and Zellner 2016). An active learning atmosphere encourages students to interact with course material and facilitates deeper learning (Felder and Brent 2005). Collaborative, cooperative or team-based learning can strengthen academic performance as well as provide social benefits (Gafney and Varma-Nelson 2007, Haidet, Kubitz et al. 2014, Talbot, Hartley et al. 2015, Van Dusen, Langdon et al. 2015), particularly for low-performers (Conway, Johnson et al. 2010, Haidet, Kubitz et al. 2014). In addition, team-based learning is relevant to the development of interpersonal, communication, and leadership skills that are in high demand in the engineering industry (Kumar and Hsiao 2007). In cooperative learning, students can create a network amongst their peers and develop an increased sense of confidence, encouraging participation in class discussions (Astrachan, Duvall et al. 2002).

In an effort to shift to an active learning culture, the classroom environment also needs to change. The SCALE-UP (Student-Centered Active-Learning Environment with Upside-Down Pedagogies) project has paved the way for active learning classrooms and is the basis for the "flipped" classroom model, where the majority of content is delivered outside the classroom, and classroom time is used for active-learning activities, and often, group work. The SCALE-UP model has been shown to result in increased academic performance and student satisfaction (Beichner and Saul 2003).

The School of Engineering (SOE) has placed a high priority on supporting pedagogical shifts to student-centered, evidence-based practices across its undergraduate curricula through its Engaged Learning Initiative (ELI). As part of the ELI, the SOE opened the LEEP2 building in Fall 2015, which boasts six state-of-the-art active-learning classrooms. The six new classrooms are

Figure 1. Active learning classroom in the School of Engineering

structured to accommodate team-based learning and group problem solving (Figure 1). The rooms are equipped with round or U-shaped seating to encourage teamwork, technology to allow for increased faculty-student interaction (USB and HDMI cables, screens at the tables or on the wall, elmos, iclicker receivers, microphones), and furniture that is mobile so the rooms can support multiple functions. The different classroom types are shown in Figure 2.

As an additional support to faculty who transition to active learning, the SOE developed an "Undergraduate Teaching Fellows" (UGTF) program. The UGTF program is an adaptation of existing peer mentoring models (Gafney and Varma-Nelson 2008, Otero, Pollock et al. 2010) and is primarily aimed at supporting in-class activities, such as team-based learning, demonstrations, and student problem-solving. This program started with four UGTFs embedded in two classes in Spring 2015, and has since grown to 28 UGTFs supporting active learning activities in 13 classes across the SOE in Spring 2017. Faculty may apply for UGTF support each semester they plan to utilize active learning.

There is a great deal of evidence that shows that active learning provides several benefits to students over traditional teaching styles. However, there is less research analyzing students' attitudes and willingness to accept these pedagogies. For some students, it can be a difficult transition from traditional lecture to active learning, whereas others welcome the change. As the SOE undergoes a transition to pedagogies of engagement, and as the new classrooms have been in place for two years, we aim to gain first-hand feedback from students about their perception of active learning and how their perception changed based on the classroom environment and their level of exposure. Feedback may highlight gaps in the current implementation of active learning and benefits of interactive learning classrooms over traditional style rooms. Identification of

prevalent themes could help ease the transition at the SOE and other institutions hoping to implement a similar model.

The aims of this project were to a) identify students' understanding of pedagogies of engagement, b) evaluate students' satisfaction with the implementation of active learning in the LEEP2 classrooms and c) evaluate students' perception of active learning over time and with various levels of exposure.

1a) 60-person classroom with U-shaped tables

1b) 90-person classroom with U-shaped tables

1c) 120-person classroom with U-shaped tables

1d) 160 person classroom with round tables

Figure 2. Active Learning Classroom Layouts. Photo credit Treanor Architects.

Methodology

The University of Kansas Human Research Protection Program approved this study. The study aimed to provide qualitative, unedited feedback from students based on a one-on-one interview process. The interviewer asked students about their experiences with pedagogies of engagement and the active learning classrooms. The feedback and themes derived do not reference the student's success with the course, rather their perceived success of gaining knowledge.

Undergraduate students enrolled in the SOE were eligible to participate in the study. An email was sent to all undergraduate students in the SOE asking their participation in a 30-40 minute interview related to their instructional experiences in the SOE. Students interested in participating were asked to fill out a Qualtrics Survey indicating their name, email, major, and year in the program (freshman, sophomore, junior, senior), gender, race, and ethnicity. The year in the program related to how many years they have progressed through the curriculum, not their credit hours.

From the 67 students who responded as interested to the recruitment email, a list was compiled with gender, race, and ethnicity noted. The general population was broken into five subsections: 1) Aerospace Engineering 2) Bioengineering and Mechanical Engineering 3) Chemical and Petroleum Engineering 4) Civil, Environmental, and Architectural Engineering 5) Electrical Engineering, Computer Science, and Engineering Physics. Within each of these subsections, a first-, second-, third-, and fourth-year student was randomly selected. Any students enrolled in a course taught by a member of the research team were excluded.

After the 20 selections were made, the set of participants was reviewed for diversity in terms of gender, race, and ethnicity to ensure that the sample was representative of the SOE population. In cases of under-representation, the research team replaced the randomly chosen participant with a participant that was in the under-represented group. This process continued until the sample population was representative of the diversity in the SOE.

Students selected for interviews were contacted again via email with further details: selecting an interview slot, a copy of the consent form to be reviewed, and the location of the interview. Interviews were held in the Dean's office suite and did not begin until a consent form was signed. Participants were asked an IRB-approved set of questions and additional follow up questions, if needed.

Due to the nature of a qualitative study, there was a heavy reliance on students to follow through on their initial willingness to participate and a short deadline to conduct interviews. Consequently, several planned interviews did not come to fruition due to outside conflicts for participants and time constraints for the research team. Eleven interviews were conducted by the end of the school year.

After recording the interviews, they were transcribed verbatim using InqScribe, a software that allows one to slow down speech and rewind small segments while typing out the interview. These transcriptions were reviewed and highlighted to find common themes. This project will

continue next year using the same methodology, in hopes of obtaining all planned interviews and further developing themes.

Questioning

The following questions were asked to each participant. Modification of questions occurred to match each student's experiences. Additional questions were asked when more explanation was needed or an interesting point was mentioned.

1) Have you had a class in a LEEP2 room? How was the course(es) structured? Was active learning (group work in class, clicker questions, etc.) a component of the course or was the majority of time spent listening/writing?
2) What type of active learning activities have you participated in those classes? Do you do more group work or individual work during class?
3) In a typical week, what sort of activities are assigned outside of class time (homework, pre-class prep, group work, etc.)? What do you find to be most beneficial? Why?
4) How was the classroom conducive or not conducive to learning? Did the classroom support the structure of the course?
5) What was your first impression of the LEEP2 classrooms? How have your experiences changed or enforced this first impression? How do the classrooms compare to traditional classrooms?
6) How have you seen active learning implemented in your classes in LEEP2? Does this differ from classes that have used active learning in traditional classrooms?
7) How have the LEEP2 classrooms impacted your learning in the SOE? What features of the rooms are most supportive of your learning? What features are least supportive?
8) What instructor behaviors are most important when teaching? What about in the LEEP2 rooms?
9) Have the LEEP2 rooms changed your opinion of active learning? In what way?
10) Describe a class you feel you learned the most in. Why do you think this was?
11) How would you describe your motivation to participate in class? What motivates you? What causes you to lose engagement?
12) If you were an instructor of a course, how would you teach the material? How would you set up the class? What would you do (and have students do) before/during/after class? How would you assess student learning?

Themes

The qualitative interviews conducted aimed to address three main points: identifying students' understanding of pedagogies of engagement, evaluating students' satisfaction with the implementation of active learning in the LEEP2 classrooms, and evaluating students' perception of active learning over time and with various levels of exposure. After conducting interviews, the research team analyzed participants' answers for common themes.

Student Understanding of Pedagogies of Engagement

Questions did not include making students give their definition of pedagogies of engagement or active learning. Instead, the questions posed asked the student to describe their experiences with active learning in both LEEP2 and traditional style classrooms. To ensure students understood what was meant by active learning, examples such as worksheets, individual work, and clicker questions were given in addition to a simplified definition: "anything that is not just listening and teaching, essentially lecture, is considered an active learning activity." This definition did not always resonate with students and sometimes they did not remember all the classes that used these strategies. Later on, they would recall a class that used active learning that they had not mentioned in the beginning. Observation during the interview showed that clickers and simply asking questions to the group was generally not perceived as an active learning activity. Students also identified active learning as a synonym to the "flipped" classroom model if they had that experience.

The confusion and need for clarification of what active learning entails is an important theme. The generalized problem is that students did not identify active learning as a range; they identified it based on their experiences with certain activities. In reality, an active learning environment may include tasks as simple and quick as teachers asking questions or as extensive as entire class periods spent doing group work. Students holding negative opinions about certain activities might lead them to hold negative connotations with active learning as a whole.

This type of reaction was demonstrated through one student's answers: *"Personally I like more lecture. I felt like sometimes the group activity wasn't as productive as… hearing someone teach something."* He proceeded to explain the challenges of working with a group and struggling to get past areas they did not understand. Although initially dismissing group work after a negative experience, the student notes it as part of a different class, one they claimed to have learned the most in, *"I think I got the most out of a class that… stands out in my mind, it was a half lecture, partly group work. I don't know if it was half and half. But it was both."* The student further explained, *"I think hearing the lecture and doing it, practicing what you're hearing it is good. I think the part that stands out to me is being able to get the help I need when I need it."* The student then expresses the benefits of group work when describing how they would structure a course, *"I would try to blend a variety of activities and styles... I wouldn't want to lecture the whole time, I know that because I know some students would check out. Hearing someone speak the whole time. To what degree I would divide it up I'm not sure. I guess it would depend on the material."* These comments show how a negative experience can lead to a negative reaction to active learning, while a positive experience can change a student's mindset.

Evaluation of Student Satisfaction with the Implementation of Active Learning in LEEP2

Reactions to active learning and LEEP2 rooms depended heavily on the course topic and instructor. Each student had different set of experiences and exposure to the classrooms. The size, layout, and instructor influenced students' reactions to active learning in the rooms.

Students consistently listed the table-dedicated screens as one of the most helpful aspects of the room, especially in the larger, 90-, 120-, and 160-person rooms. Most preferred the screens mounted to the end of the U-shaped tables so that they faced their professor during periods of

lecture, *"Front is definitely better. Otherwise, I'm splitting my attention. Like the fact that the monitor is here but the instructor is like off behind them to the right I don't have to look this way and then look that way."* One student however, who had larger classes, found the room with the round table set up the most beneficial because the instructor taught in the center and could give the same level of attention to each student. In comparison, students who sat in the back of the large U-shaped rooms have little to no interaction with the instructor during periods of lecture. Most thought the monitors that allowed them to see everything mitigated the large size of some of the classrooms. When in the larger classrooms, the students found the at-table microphones an important tool. The other technology that is in the center of the table was found as a distraction, *"I know there are little tools in front of the tables that you can hook up into your phone or iPad to like help display something but those can be kind of distracting because when I came here I was like whoa what do these do. I kind of toyed with those for a couple minutes,"* rarely used, *"In one of the rooms they have stuff in the middle of the table, technology, stuff we don't ever, we haven't even used in any of my classes"* and the least supportive feature to learning, *"Least supportive would be all of the junk on the tables besides the monitor."* Overall, technology was viewed as a benefit as long as the instructor knew how to use it and class time did not get wasted on technological difficulties, *"I mean they're [LEEP2 rooms] a little bit different for the professors that chose to make use of the new equipment. But like I said not all of them did. So it's just a different change of scenery."*

The one common thread was the layout of the rooms. Everyone agreed that if active learning with group work was a component of the course, the U-shaped or round tables were crucial. Otherwise, group work was limited to the people directly next to you and often did not offer students the chance to truly collaborate. It became more of a time just to share answers, *"I prefer… a table where you can work together at one table rather than at individual desks because then… it segregates you a little bit. Like you're in your own space and you're trying… and someone else is just doing their stuff in their space and you're doing your stuff in your space. And then you kind of share what you did… instead of it being one whole area where you're working together on something."* All tables being on the same level as the instructor also played a key role in student satisfaction. It was noted that when students are in a riser style class, questions cannot be easily answered during group work, *"way better than anything we ever had. In [LEEP2 rooms], being able to actually have the teacher walk over to you without having to go halfway up the height of the classroom to get to you."* The LEEP2 rooms offer the benefit of allowing instructors, TAs, and UGTFs to easily move around the room and answer questions when groups become "stuck" during an activity or problem-solving session. It also adds a level of accountability to group work that students feel is important to making sure everyone is participating: *"a lot of times people just wouldn't do group activities because someone in the back of the room can't see what's on the board or doesn't feel like there's… any repercussions for not doing it whereas when everyone can see and the teacher can just walk around the room everyone does the group problems."*

Compared to traditional classrooms, students felt active learning was made more effective in the LEEP2 rooms. The level of success ultimately depended on the structure and the use of the media in the room. If media was not utilized and no active learning was involved, students felt

no preference to the room beyond enjoying a change of scenery, *"I think if it was a normal classroom I would learn about the same amount. I think if they did use the stuff more often… that would be more helpful. But not most of my teachers do."*

Evaluation of Students' Perception of Active Learning over Time and with Various Levels of Exposure

Again, student perception was closely linked to the course instructor. The interviews showed that negative impressions were often in reaction to a perception of how active learning was implemented, not the active learning activity itself. A negative experience was able to taint a student's entire perspective on the teaching methodology, while a positive experience was able to change their mind completely. The more experiences the student had, the more they were able to pinpoint what has worked well and what is lacking. The student perspective can be broken down into instructor behaviors and class structure.

Most students noted that they need organization and structure to succeed in a course. Clear expectations from the instructor were a vital component to their learning of the material. When an instructor was not organized, students struggled to learn the content, *"Especially [motivated] when the person I'm learning from is well organized and is well prepared to teach... One thing that's really frustrating is… I've had some professors and they are not organized and have expectations of you to be able to get through their material and they don't realize they're not organized."* Students also needed an approachable instructor, *"approachability is really important. Because if you don't feel comfortable asking your professor questions you're probably not going to learn anything,"* and an instructor who engaged students and made them a part of the learning process, *"I like when professors walk around and actually engage with the students. That's the most helpful. Because that makes sure everyone is paying attention."* Regardless of their proclaimed level of motivation, students wanted instructors who would hold them accountable. Although students recognized their responsibility to hold themselves accountable, they admitted that they would not do something if there was no incentive. For example, if there was a homework assigned but no grade associated with it, a student would choose to focus on the other homework they have due. Students actually preferred frequent homework and tests, *"Because it makes them stay on track with the schedule you're making."*

Students identified almost the same ideal course structure. All students wanted an element of lecture. Some students had an open mind about pre-class work if done correctly, *"The videos are really helpful, except for when they aren't. The homework is really helpful except for when it isn't."* Statements such as these highlight the need for instructors who are implementing aspects of a flipped course structure to ensure that all class materials and pre-class materials are well-aligned and of clear value. Students preferred amount of lecture time ranged from one fourth of the class to two thirds of the class. A few noted that the amount of lecture would depend on the topic. Some topics are more difficult and require more lecture, while other topics are picked up easily and do not need as much explaining. The next element of the class would include active learning activities, preferably a combination of individual and group work. Both provide different benefits, *"In my group I had a lot of experienced guys. And it was beneficial and really bad at the same time. They knew what they were doing before we even went up to the board but I*

didn't. So they kind of taught me, but I couldn't really learn for myself because they were going at such a fast pace. So I think some situations, single learning is better. And in some situations group is better. There's no… one answer." The benefit of group work is the ability to work together through the tough problems and have help when it becomes too difficult for your current knowledge, *"If you don't get it you're just like, what's going on again? You can ask the professor, but I'm really shy so it's really hard to ask the professor. But in a group I can just say… did you understand this better than I did? And I can get it explained to me in a more student-to-student sort of fashion which is really helpful."* The drawback is not being at the same level of understanding as other group members and being left behind or having group members that do not participate. A combination of activities could help students gain their own understanding while also allowing them to share knowledge on a peer-to-peer level: *"I definitely prefer working by myself and then working with a group. …Some people will figure things out faster than others and so they'll go through the problem extremely fast so we'll be trying to catch up the entire time and we're not learning how to do the problem. We're just trying to figure out how to catch up."*

Completely flipped classrooms were not a preferred course structure because of the amount of work required before coming to class. Students reported feeling as though they are required to learn all of the material on their own, which can contribute to misunderstandings: *"I… actually find a flipped classroom pretty difficult. Because you're supposed to learn everything outside but there are so many… questions that could pop up or… maybe I'm misunderstanding something from what I learned. Then after I keep reading through the book, I get a bad misunderstanding of this section and then I get confused when I come to lecture..."*

Conclusions

To solidify emergent themes from these interviews, further research needs to take place. The more student experiences that are captured, the more clearly the effectiveness of different methods and environments can be seen. Based on the sample size of this study it seems that LEEP2 active learning rooms are perceived to be more effective for active learning than traditional style classrooms. According to the students, the U-shaped tables with at-table monitors at the end and all students facing the professor are the largest contributors to the rooms' successes. Most additional technology at the table was viewed by students as a distraction when not utilized by the instructors. Importantly, students tended to perceive active learning based on the positive or negative experiences that they have had. The perceived effectiveness of active learning was directly related to the implementation techniques used, not necessarily the activities themselves. Active learning activities implemented without enough structure and organization were viewed as ineffective and were not a positive experience for the students. On the other hand, even if the students preferred a traditional lecture style, active learning courses were perceived as effective if implemented in a highly structured and organized manner. Even if students were more inclined to enjoy working alone or lecture, they saw value in working in groups and would prefer to incorporate that as part of *their* course if *they* were the instructor. None of the students would opt for a completely flipped class and would instead utilize at least a quarter of class time to lecture, most varying that amount of time depending on the course topic.

The student perspectives gained during the interviews provided some key insights into how students perceive active learning and active learning classrooms in the School of Engineering. The insights gained through this process can be used by faculty when designing a course, and when planning to use an active learning classroom.

Acknowledgements

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