Board 13: The Effects of Frequent, Multimodal Questioning to Drive Lecture: A Positive Case for IRE Student-Instructor Interactions

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Work-in-Progress: The Effects of Frequent, Multimodal Questioning to Drive Lecture: A Positive Case for IRE Student-Instructor Interactions

Introduction

Lecturing is a traditional instructional practice that is less effective and most prevalent in Science, Technology, Engineering, and Mathematics (STEM) undergraduate courses. Vivekmetakorn and Thamma (2015) report the most prevalent instructional practice is lecturing. Lecturing involves the instructor talking at the students with minimal student-instructor interaction. Lecturing is "teaching by telling" (Freeman et al., 2014) which is a continuous exposition or monologue from the teacher. Crawford and Camiciottoli (2008) compares students' participation in lectures to reading a textbook. While reading, the student (reader) minimally contributes to the textbook's contents. Because students minimally participate and contribute to the teacher's spoken content, lecturing is less effective in fostering student learning. Freeman et al. (2014) systematically reviewed 225 studies on lecturing versus other instructional practices with more student engagement; students in lecturing based instruction were 1.5 times more likely to fail and earn half a letter grade lower than other instructional practices that have more student engagement. (Freeman et al., 2014). The work presented here introduces how an active and engaging learning environment was investigated and will be analyzed.

Classroom Engagement

Student Response Systems (SRS) is one instructional practice for increasing student engagement and activity during lectures. If SRS or clicker questions invite student participation in lectures, they would be advantageous in fostering student learning and classroom engagement. SRS is a technological platform used by instructors to engage students during lectures. SRS has been reported by students to be helpful and engaging which is more likely to foster learning. Thomas et al (2015) found students report SRS engaging and helpful to their learning (Thomas, Pinter, Carlisle, & Goran, 2015). The use of engaging instruction or interactions like SRS more actively engage students fostering more student learning. (Mayer et al., 2009) found students who used SRS in the classroom to answer multiple choice questions performed better on exams than students without in-class questions. Specifically, when there are 2 to 4 SRS questions per lecture, the students performed statistically greater than the controlled resulting in a higher grade in the course. Blasco-Arcas et al. (2013) report how classroom engagement and active collaborative learning to be significantly correlated with learning performance. Prince (2004) defines an active collaborative group as work done in small groups towards a common goal. In the meta-analysis by Hunsu, Adesope, & Bayly (2016), clickers were reported to have significant effects on desirable student learning outcomes. It is apparent that the use of SRS in lectures has a positive effect on student engagement and learning in large lecture classrooms.

In addition to the students' course outcomes, the effectiveness of clickers can be evaluated from the students' perceptive. Heaslip, Donovan, & Cullen (2014) studied students' outcomes and perceptions on the effects of SRS with qualitative and quantitative methods in a large classroom setting. The effects of SRS were quantitatively assessed pre-/mid/post-test and qualitatively assessed via semi-structured interviews on student focus groups. Their findings report a statistically greater increase in student interactivity during lecture when using clickers (SRS). From the focus group, students elaborate on how clickers provided them the opportunity to participate in class and receive immediate feedback from the instructor. Having this immediate feedback cycle allowed the students to better calibrate their understanding using clicker

questions with course content. Another questioning sequence with an immediate feedback cycle would be the Initiate-Response-Evaluation (IRE).

Initiate-Response-Evaluation (IRE)

The Initiate-Response-Evaluation (IRE) questioning can be viewed as a similar assessment and feedback cycle. Mehan (1979) defines the Initiate-Response-Evaluation (IRE) as a three-part instructional interaction sequence. In an IRE sequence, the instructor *initiates* by asking a student a question (I); the student then *responds* (R) to the instructor's question; the instructor assesses the student's response and *evaluates* (E) their response to the initiated question. One iteration of the IRE cycle parallels questions posed via SRS. The instructor poses the question *initiates,* the students then *respond*, followed by the instructor revealing the answer and *evaluating* the students' responses.

Positionality

The data collector was a graduate of the program. Having experienced the undergraduate curricula, the first-year chemical engineering course was chosen because it functions as a gatekeeper to future courses. The research team purposefully selected a distinguished teaching award recipient and their classroom to be studied. Previous interactions with the instructor noted their confidence in teaching practice and a vibrant passion for teaching. Moreover, this instructor taught at a large research institution where less than 2% of instructors receive a distinguished teaching award over 5 years.

Purpose

In this study, the perceptions of the instructor and students were investigated. The instructor and the course were purposefully selected for an in-depth analysis. Specifically, the instructors questioning strategies via TopHat are studied relative to IRE-like interactions to answer the following research question. While the literature on the SRS as an instructional practice is extensive, less is known on the perceptions of students and instructor(s). Moreover, the research team was curious about what can be learned from deeply studying an instructor who has been recognized for their distinguished teaching.

What are the instructor and students' perceptions of the ways in which the instructor's questioning strategies promote classroom engagement?

Data Collection

In this qualitative study, multiple methods were used with no control group. The instructor's questioning strategies were collected through ethnographic observations. The data collector observed the classroom and instruction throughout the semester. These observations were video recorded and may be transcribed for further analysis. Additionally, semi-structured interviews were conducted for student and instructor perspectives. While 12 students were asked to participate in an interview, only one agreed. The interviews are currently being transcribed and are to be holistically coded.

Preliminary Findings

The questioning mediums (TopHat, verbal, worksheets/quizzes) were observed to have multiple functions. The data collector inferred the questions functioned as follows:

- Probe students for deeper understanding
- Connect content from other courses (calculus, physics, chemistry)
- Build rapport
- Stimulate thinking
- Extend the discussion
- Develop students' problem-solving strategies
- Communicate expectations (student learning expectations)
- Assess student learning
- Clarify interpretations/misconceptions

The researcher's observations of the instructor's questioning strategies were triangulated by interviewing the instructor about their instructional practices. In a semi-structured interview, the instructor, Carlo, elaborated on their intention of posing questions across multiple mediums and their function.

Carlo desired *some variety* in posing problems (questions).
"They [students] want some variety. I try to minimize the time lecturing to students with what I need them to do… [Example problems] are essential for them to learn. I am a huge fan of the book and one of the reasons there are lots of example problems."

Carlo posed over 400 questions in Top Hat and utilized over 10 worksheets claiming these questions aid students in developing *confidence in their abilities*.
"I tell them [students] I am trying to develop their technical arrogance or confidence in their abilities. I want them to be confident and [be] able to explain [the course's content] to someone else. I have them learn the skill then apply it [in groupwork or worksheets]."

One white female student, Angela, was interviewed for her experiences in the course. Angela explained her interpretation of the Top Hat questions posed by the instructor. Angela perceived the Top Hat questions to be *simpler* and *helpful for understanding.*
"*I kind of had a hard time with sometimes some of the Top Hat questions. Those tended to be problems where we didn't really go through them and a lot of them. They [Top Hat questions] were just quick in covering basic content… a lot of the Top Hat tournaments were simpler than what we were given on exams or quizzes. But still helpful for understanding material. So I think those questions are still really important. and I think that having them enhanced my learning, but they're just not quite as like in depth or the detail problems and solutions that we do*."

The combination of clicker and verbal questions invite students to engage during class time. While Angela perceived these questions to be *simpler*, she believed they helped her to review prior content and quickly practice what she learned. Carlo would likely add how these questions helped Angela *develop confidence* in *her abilities.*

Future Work

From classroom observations, the instructor used Top Hat questions to 1) assess student learning and 2) the beginning of questioning sequences (IRE) to further discuss content. These classroom questioning sequences are to be transcribed. Anecdotally, the observer perceives the instructor's questions (Top Hat and verbal) to be IRE questioning sequences; where the question is initiated (posed)-- students respond (via clickers)— answer is revealed (evaluated) – a probing or follow-up question is posed (verbally)—which starts the second iteration of the IRE sequence.

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