Skip the clicker: A narrative inquiry of a professor's 'Teaching Toolbox' for large class sizes

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***Abstract*— This full research paper uses narrative inquiry to examine the emergent 'Teaching Toolbox' of a faculty member in an electrical and computer engineering department amid the backdrop of increasing class sizes. Four years ago, this ECE department received an NSF RED grant (Revolutionizing Engineering Departments) to enact large-scale curricular and culture change in the department over five years. The work under the grant has uncovered faculty-driven pedagogies that had formerly been at the periphery of the values held by the department - but did not receive much attention prior to the award. We use narrative inquiry to investigate the experiences of one electrical and computer engineering professor through a single case study. Our case study comprises multiple reflexive interviews contextualized within the history of the department through institutional documents and department meeting notes. This work is focused on the emergent pedagogical innovations one professor has enacted to [at least] maintain, [at most] improve, class engagement and participation as class sizes have increased. These pedagogical innovations reveal the multiple ways in which a professor has adapted their teaching practice to the institutional and departmental changes brought on in the past decade.**

Keywords—electrical and computer engineering education, large class sizes, narrative inquiry

I. Introduction

Fifty minutes may seem like a long time in the student's chair, but for an electrical and computer engineering professor teaching one-hundred and thirty-five students, each of those fifty minutes is precious. The United States engineering curriculum has many stakeholders—ABET accreditation, course professors (former and post), industry advisory board, alumni, and students in the course—each of whom has varying levels of influence on curriculum design. The increasing number of curriculum stakeholders follows the trend of increases in course enrollment.

Large class sizes are becoming a necessity for the undergraduate engineering curriculum. The expansion of higher education, as well as the national emphasis on STEM education, has led to large classes as commonplace for many first- and second-year undergraduate engineering programs. The increase in class sizes has yielded a variety of strategies developed by stakeholders to reduce costs [1]. Disadvantages of large class learning experiences for students range from the lack of interaction with faculty members to poor discussion sessions [2]. Less engaged students can fade into the background and consider it "easier to do anything you want, sleep, not attend, or lose attention" [3, p. 21]. Solutions have primarily taken the form of increased disciplinary checks, such as attendance quizzes, clicker tests, or higher cut-offs for exam marks. Accordingly, large courses can slowly turn into gatekeepers of the degree program.

II. Literature Review

Higher education institutions have undergone a period of sustained massification, a process by which student enrollments have climbed during the end of the 20th century [4]. In part, stemming from the reduction in federal funds since the university's golden age of the Cold War era, increases in enrollment offer increases in revenue [5]. To further spur enrollment growth, universities are adopting incentive-based budget models that reward high enrollment [6].

The audience of higher education has expanded beyond the typical age band of eighteen to twenty-five. Older adults have joined the college-attending population in nontrivial numbers with intentions to study a subject out of purely intrinsic interests or professionals such as doctors and lawyers looking for continuing education opportunities [7]. While a broader group of individuals are engaging in the higher education enterprise, particular institutional sectors are experiencing a more significant proportion of the stress.

The massification has crept into colleges of engineering, exacerbated by STEM being promoted as an essential area of expansion in K-12 and higher education - mostly to meet the demand for graduates with STEM skills [e.g., 8]. The last decade has seen consistent increases in undergraduate engineering programs, reaching 622,502 full-time students, and the most productive major, mechanical engineering, awarding 31,936 degrees in 2018 [9]. In the STEM labor market, the government sector and private industry have shortages in specific areas, such as disciplines in engineering like petroleum engineering at the bachelor's level [10]. To meet this unmet demand, and even in cases where disciplines are oversupplied, enrollments have swelled and show little signs of slowing down. The swell has transitioned to increasing class sizes to manage the influx of engineering-degree-seeking students.

To accommodate students in the expansion of STEM programs, faculty have been encouraged to adapt their pedagogies to improve if not maintain student learning at scale. Additionally, centers for teaching and learning across universities have developed a multitude of resources that seek to help faculty improve their teaching in large classes. Consistently, these centers share their resources across centers at peer institutions, further showing that the trend toward large-class teaching is prevalent across the United States. For example, Dr. Jenny Lloyd-Strovas, of the Teaching, Learning, and Professional Development Center at Texas Tech University, has authored a document titled, with on Tips for Large Class Teaching, that is widely shared on university teaching and learning center websites across the nation [11].

Wulff et al. claim the key to improving large class environments is to enhance instructor-student interaction [3]. A variety of studies provide pedagogical suggestions for large classrooms as ways to engage students more actively, such as "muddiest point" and "think-pair-share" [12]. According to students, large class sizes are difficult because "it's hard to get the teacher's attention" [13 p. 182]. In a study on minoritized engineering students, Lancaster and Xu note that students "attribute the size of the classes to faculty shortages" [13, p. 182]. For the engineering students studied by these authors, the large class sizes pose as barriers to the students' degree to completion.

Universities approach adaptation of these pedagogical suggestions through a variety of lenses. From an individual faculty perspective, there are accounts of instructors creating novel pedagogical adaptations that accommodate students in larger classes. Dr. Daniel Klionsky offers the techniques he uses in his "introductory biology course with an enrollment of about 300" [14, p. 1]. On the first day of class, Dr. Klionsky makes "the entire class literally raise their hands" to show that they "are clearly capable of raising their hands," and he "wants them to do so if they have any questions" [14, p. 1]. He describes the strategy of his former professor who "told the class to hiss if they did not understand" [14, p.1]. Students do not have to identify themselves in these cases. Thus they are more apt to interact in the course.

With all the pedagogical and technological adaptations, however, there exists a need to interrogate these adaptations. Considering national trends in massifying education, we must ensure these adaptations are not just managing the symptoms of a structural issue. At worst, the adaptations could be enabling larger classes to proliferate without addressing the underlying drawbacks of such courses.

III. Methods

We use narrative inquiry [15]–also called narrative analysis - to investigate the experiences of one electrical and computer engineering professor through a single case study. Humans employ narratives as meaning-making tools, as stories are what helps us give meaning to the world [16,17]. Considering the rich description narratives can bring analytically, multiple disciplines have used narrative-based methodologies in researching peoples' experiences [18]. Walther et al., identify two types of narrative methodologies, analysis of narratives and narrative analysis [19]. The 'analysis of narratives' focuses on the stories of the participants.

On the other hand, narrative analysis involves the construction of a narrative from a set of data. Here, we co-construct the narrative with the instructor. Therefore, we use narrative analysis as a formal method to gain an understanding of how one faculty member conceptualized and adapted to a particular event - in this case, increasing class sizes [see 20].

This narrative is embedded within a particular single case study. The case study method is embodied by a bounded system or set of bounded systems over time that involves multiple sources of data [21]. Single case studies are recommended when a researcher wants to study a specific idea or person [22]. Compared to multiple case studies, which can be time-consuming and expensive to conduct [23], Dyer and Wilkins contend that single case studies can generate better theory because the researcher is completely immersed in the story of the single case–not juggling between multiple narratives [24]. Accordingly, we bound our single case study to the experiences of a faculty member in a Department of Electrical and Computer Engineering regarding the evolution of her pedagogy to cope with increasing class sizes. We characterize our case using data from multiple reflexive interviews with the instructor. These interviews are further contextualized within the history of the department through institutional documents and department meeting notes.

We use narrative inquiry to investigate the experiences of one electrical and computer engineering professor through a single case study. Our case study comprises multiple reflexive interviews contextualized within the history of the department through institutional documents and department meeting notes. After an in-depth member check, the professor became a co-author of the study. The professor has taught ECE courses for thirteen years at a public, land-grant research university. We backdrop this narrative approach with a review of the national trend toward larger engineering class sizes as well as the local context of the department-wide curriculum change.

A. Setting

Four years ago, the department received an NSF RED grant (Revolutionizing Engineering Departments) to enact large-scale curricular and culture change in the department over five years (BLINDED). The work under the grant has shown a light on faculty-driven pedagogies that had formerly been at the periphery of the values held by the department - but did not receive much attention prior to the award.

In the context of the RED grant, Dr. X, the professor with thirteen years of computer engineering teaching experience, is a vocal and supportive contributor of the curriculum redesign implemented through the RED project. Dr. X became an early adopter of many of the continuous improvement measures suggested by the RED team and has provided valuable insight regarding the faculty's perspective amid this large-scale change. This study is one example of the openness and transparency exhibited by Dr. X regarding her course.

B. Data Collection and Analysis

The study consisted of multiple points of data collection. Data regarding the course Dr. X currently teaches was collected initially through RED meeting notes and observations relating to the course's initial redesign and its current implementation. There were three additional meetings with Dr. X and engineering education faculty to discuss the single course in more detail. Meeting notes from these discussions were recorded. These points of data were largely contextual as they informed the interviews with Dr. X regarding the development of her 'teaching toolbox.'

In-depth member checking was conducted as the data from the interview and contextual references with the RED project were integrated. To better describe several of the interruption techniques described in the next section, the first author attended a course lecture to observe the use of the interruption techniques in practice, specifically, by observing how students interact with the course content through Dr. X's pedagogical techniques. Lastly, broader institutional trends were documented by collecting enrollment data in Dr. X's home department, Electrical and Computer Engineering.

C. Methodological Considerations

We recognize that experiences are fluid, so documenting their development will always be a process of reflection by the participant and interpretation by the researcher. Narratives may be modified to highlight different aspects of an experience, which we hold as reflections of the "current, situated responses to the question(s) posed" [25, p. 564]. Consequentially, even if these experiences were to change, in their current interpretation, they represent the existing reality of the participant and "appropriately reflect properties of the social setting investigated" [26, p. 636]. As such, by describing the narrative of this engineering faculty member, there is transferability for other engineering professors at similar points in their teaching development journeys.

IV. Findings

Thirteen years ago, Dr. X's teaching assignment was an introductory engineering course in general engineering and computer architecture in electrical and computer engineering. For the past three years, Dr. X has taught embedded systems, which is a sophomore-level required course for both electrical and computer engineering students.

Prior to the five-year RED project, Dr. X notes that she used to teach sophomore-level embedded systems "once or twice and then go back to teach other courses." She notes that *"there was no plan for* [her] *to stay this long on the course, but as* [she*] entered after one semester,* [her course instructor team] *decided to change the* [microcomputer board] *and everything*." In these types of changes, she reflects that "*when you* [make changes], *it takes a ton of work just to settle."*

During this time, she notes that "she was also involved with RED so [she] started changing the material, etc., making it ready for this transition to become the new course that it is now." Consequently, she notes that the department head "*expected that whoever is leading the base courses will teach it at least two times*." Dr. X will have taught the course twice by the end of the fall 2020 semester. Still, Dr. X expects to teach the course the spring of 2021 "*and then find new people to teach*."

The logistics of teaching that Dr. X describes in her recent teaching history are examples of the changes that this professor has been subject to in the larger department. The course has changed and expanded, increasing section sizes from 45 to 75 to 135 in the current year's offering.

According to the university's institutional data, the headcount of EE and CPE majors has risen steadily since 2009. In 2009, 235 undergraduate students were majoring in CPE and 307 in EE. In 2018, these numbers rose to 560 in CPE and 543 in EE [27]. The number of faculty has also risen but not at the same rate. The percent increase for faculty who have teaching loads is nearly 30%, whereas the percent increase of EE and CPE students is over 100%.

TABLE I. Growth in ECE Department from 2009-2018

	Electrical and Computer Engineering Department Headcounts		
	Fall 2009	***Fall 2018***	***Percent Increase***
Undergraduate Students	530-550[a.]	1090-1110	103.5%
Faculty[b.]	70-90	90-120	29.4%

[a.] Ranges have been used to preserve confidentiality.

[b.] Only faculty with teaching appointments have been included in this headcount.

[c.]

A. Teaching Toolbox

Through observations of Dr. X's course, it is clear that she has taken ownership over how she uses course content to interact with the students. Her teaching toolbox, as she describes it, is a development of the many practices she has implemented and iterated on over her thirteen years as a professor. The teaching toolbox is rooted in the fact that "learning for the students happens outside of class." Dr. X "*sees* [her] *role in class as creating motivation and confidence*" for students to learn outside of class. Motivation as she defines it is the students' "*love for learning*" or when they "get excited about the topic." She notes that students are motivated when they see also topics as "*useful for society*" or to "*get enjoyment*" from the topics. The other anchor of the teaching toolbox is confidence. With confidence, Dr. X positions herself as the student and defines it as "something [her students] *understand…something that* [their] *brain can manage*." She gives the example of tools in the class as something that can either inspire or detract from student confidence. Motivation and confidence are the two themes that Dr. X focuses on, "*If I can prepare these two components enough, the rest, the students will do on their own."*

Specifically, in designing homework, Dr. X explains how she makes sure the undergraduate and graduate teaching assistants "*get the kinks out*" of the problems before her students complete it. This speaks to the confidence component of making sure the assignments are "*vetted*" to ensure that students are not struggling in unproductive ways. To ensure that each of the many assignments, quizzes, and tests are vetted before students complete them, Dr. X points to the importance of her undergraduate and graduate teaching assistants.

In addition to ensuring the assignments do not have '*bugs'* in them, the student assistants also provide office hours to students in Dr. X's class. One of the difficulties in hiring multiple teaching assistants is conflicting schedules. She notes the need to hire assistants with different schedules, otherwise, their availabilities will be limited. Because the engineering degree requirements are so rigid, this scheduling challenge can be reoccurring. "*I can't hire five people with the same schedule, I have to go around and find some other people that have a schedule that works*." In doing so, Dr. X takes on an administrative role in seeking out and organizing her student assistants' schedules with that of her class.

The administrative and preparation work that occurs outside of lecture time comprises negotiations support from the department in the form of student assistants as well as the organization of in-class activities and assignments for the students. Dr. X emphasizes how she spends "*a lot of time preparing quizzes and detailed homework that is step-by-step so students are skill-building and confidence-building."* She notes that these smaller assignments "are not very challenging," because the goal with these is to build student confidence.

Projects, on the other hand, are open-ended and directed at building student motivation. These projects require "*a lot of abstract thinking, problem-solving, and then mixing these together."* She also speaks of the "discipline required to be a good programmer." In writing code, she tells her class that "[they're] *trying to write code that is easy to read and easy to debug*." She emphasizes that "*it's not enough to write something that works."* She helps students try and see their code in the context of industry and how their code will not only be used one time and in one context but will need to be read by others and changed to adapt to new problems. Dr. X notes that in "almost every lecture or every other lecture," she reminds students "*of why you're studying the topic.*" She uses anecdotes and industry examples to explain why topics have professional importance for students beyond their homework sets and tests.

The other piece of her teaching repository is to find ways to glean student engagement during class. Through the class time, Dr. X notes that even with the different tools she uses to engage students, there are still "*20-30% of students that are very hard to engage*." In classes of 125 students, this means at least 25 students are not engaging in the course material. From the literature, the population of these students is more likely to be minoritized students [13]. The professor notes that the grade distribution in her class does not follow that of a normal distribution. The majority of students receive A, A-, B+ marks, but then she describes "*this long tail that spreads all the way to the bottom.*" She notes that these students do not withdraw, but *"are barely there*" in class. Sometimes they "do two homework assignments overall" and nothing else. She notes that it is difficult, near impossible, to reach this group of students during the semester.

1) Interruption Techniques

For the students who make up the other 70%, she speaks of several ways to check in with their engagement. She notes the importance of "*making sure that we are moving together*" through the course content. The techniques she uses are what we deem interruption techniques that let students interact with the professor in an unassuming, quick manner that allows the professor to quickly gauge involvement across the room. These techniques target similar objectives as clicker technology, which has also been cited to increase "the degree of interactivity in large classrooms" [28, p. 9]. Instead of clickers, Dr. X uses these interruption techniques to engage students through vocalizations and body movements. Throughout each lecture, Dr. X uses common phrases in the class period in which she asks students "*Everybody with me*" or "*Make some noise,*" and students respond with any vocal noise or body movement to signal that they are following along. By skipping the clicker, Dr. X notes that these techniques bring levity into the classroom while increasing student-teacher interactivity.

With each interruption technique, she quickly scans the room of over 100 students to gauge the percentage of students following along in the classroom. For the vocalization, she will comment if there is a low murmur or a specific side of the room is silent. In a 50-minute time class period, these small check-ins allow for her to take the temperature of the class, so to speak while still moving through the class content.

In a recent class period, she reflected on using this technique, "*last lecture, I was teaching something, and most of the time I was saying, everybody with me and then suddenly I asked, and I had lost four-fifths of the class. There were just a few hands. What happened? I really missed you. Okay, let's go back. Where did I miss you?*" Dr. X notes that with 120 students and the setup of the classroom—two blocks of students with a gap in bisecting the classroom—she finds it more difficult to quickly estimate the percentage of the class that is engaged. She notes that when she had 90 students in a single block, this technique was more beneficial in quickly seeing how many students were following her remarks. The constraints of a physical classroom are another example of change that is enacted on faculty as they navigate increasing class sizes.

Another interruption technique that Dr. X uses is an analogy. Throughout the lecture, Dr. X will note the specific points at which students can "*get on the bus*." The bus metaphor is a phrase she uses throughout to guide students back into focus so they "*don't fall off the bus*" of learning completely. In this sense, she gives students ownership of their learning as they are reminded to re-engage with the lecture content. Because this computer engineering class and many engineering classes are cumulative in content, students can feel overwhelmed and begin to lose focus during lectures. Unfortunately, missing a few key elements in a lecture can strand students as they then lack the necessary knowledge to build on their understanding. Dr. X has used the bus metaphor to prevent her students from staying checked out, as she offers them several points throughout each lecture to "*get back on the bus*" and regain control of their learning.

2) Class Artifacts

The next teaching tool, Dr. X describes, is the handout. She notes that "*yes, handouts are very old, but I liked it…* [my] *professors did handouts.*" Dr. X notes that she "*doesn't print out take-home handouts*" for the students. "*that's one of the wishes I have. Usually, I don't have time to go to the copy machine before. There's too much stuff to get it ready and then be in class on-time*." She notes that she still provides handouts on occasion, but "*not as often as* [she] *'d like, but* [she] *believes in it*." Instead, Dr. X uses "*electronic handouts.*"

Dr. X uses an electronic notebook to provide electronic handouts to the students. Students first 'opt-in' to the Class Notebook through the course's learning management system to gain access to the material. By the mid-semester point, Dr. X notes that 120 of the 125 students had opted in.

"*It's like the equivalent of the old handout paper.* [Students] *basically take this handout page and copy it to their own notebook*." So, when I say, "*copy this page, then* [students] *take this, and they can just build over it.*" The handout also helps Dr. X "*with* [her] *lesson plan*" for the class period. This handout-filled lesson plan "*is usually how* [Dr. X] *teaches*." She notes that she *"creates content*" with the class. *"It's never neat*" with this structure, but "*it's lively" as she is "preparing it in front of them, typing and creating tables,* [that] *they get to see instantly in their version."* She notes the similarity to an overhead projector, in which "*the professor drew, and the students could see it.*"

In reflection on her development of these tools, Dr. X notes that "*when I became a professor in 2006, I used PowerPoints, because that's what my professors and everybody else used. I think already there was some research on how PowerPoint is bad, but I wasn't very familiar with it yet.*"

"*As I taught, I was going to the* [Teaching and Learning Center] *presentations, almost on a regular basis, like at least several times a year. I kept hearing about* [PowerPoint] *is so bad.*" Specifically, "*using PowerPoint and having all the content up there*." [Teaching and Learning Center] *talked about having PowerPoints that are not fully populated, and I started changing my PowerPoint so that some had empty spots and that was the first step*."

After *"three or four years*" of teaching with PowerPoints, Dr. X realizes that she "*doesn't need PowerPoints anymore… I turned on the camera, and I had notebooks in front of me, and I would just teach."* Additionally, she remarks that the notebooks "*were good because* [she] *would keep them and look at them if* [she] *had made mistakes."*

Dr. X used a class notebook and camera system for "*many, many years*," but found "*the issue with that was that more and more students were asking for the pictures*." "*Because this was on paper,* [students] *wanted the notes."* They asked Dr. X if she could "*take pictures of them after each class period."* This "*became a regular practice,"* and the students would then "*turn them into PDFs and sent them to* [Dr. X] *and* [she] *would put it online for the whole class.*" In this way, Dr. X built a collaborative learning environment among her students and herself.

Later, as technology developed, Dr. X notes that she transitioned to an electronic notebook. Up until two and a half years ago, she switched to OneNote and can draw in the electronic notebook through her touch-enabled computer screen. At the end of the lecture, Dr. X would "*share the files with the students."* Only recently has Dr. X noted the real-time change, "*I think it was just the past semester, actually, that the speed has become so high that as* [Dr. X] *writes, the students are seeing it*." Even with the multiple technological changes, Dr. X maintains that the technique "*was still the same."* But now, she can "*open and see which of them are actually taking notes*." But she notes that students have "*their own notebook because* [students] *know that I see what they do… If I were a student, I probably wouldn't*" use the same notebook.

In sum, Dr. X reflects on the teaching tools she uses as pedagogies she "has learned from papers and older professors." The adaptation to technology, specifically with the electronic notebook, came from a combination of instructor experience rooted in student responses.

V. Discussion

Over thirteen years, the professor at the focus of this study has devised and adopted a variety of teaching techniques. Some of these techniques are a response to the change in environment, from class sizes to technological change. Others have been based on past experiences in teaching, literature or guidance in instruction, or solutions to problems she's identified in the classroom.

The development of a teaching toolbox can be indicative of the context from which it is developed. For one, professors can take on new teaching assignments in a variety of different ways. The differences may play a role in how the professor delivers content, in that, a professor who has taught the same course several times might approach the material differently than if it were their first time teaching.

In the case of Course X, Dr. X led the redesign of the course as her department restructured the second-year major courses through the RED project. Because of her involvement, she expected to teach the course multiple times before finding "new people to teach." However, to teach a course multiple times that changes because of a departmental restructure may constitute a different level of ownership in teaching.

To the credit of universities, centers for teaching and learning, as well as educational technology support guidance, have proliferated across campuses in the United States. These centers have greatly helped professors adapt to the changing context of the university. From changes to technology, student privacy, teaching techniques, and increasing class sizes, these institutional infrastructures have provided a space for faculty to workshop their teaching skills. An exemplary case, Dr. X has a covered office wall with certifications from the university's Teaching and Learning Center.

However, pedagogical changes are not solely a feature within the class period. Many of these changes increasingly require more time outside of class in the form of administrative work, as in the example of scheduling teaching assistants. For some professors, this administrative work is not deemed essential and such courses do not have nearly as many or coordinated teaching assistants supporting students. Each decision a faculty member makes in the design and implementation of their course is a tradeoff between time that could go elsewhere and teaching effectiveness. These decisions exist in the context of the department culture wherein teaching effectiveness may be less valued than research. Additionally, these decisions may be reactions to the changing institutional environment of increasing class sizes in the department and the university at large.

In this new era of the university, revenue streams are less reliable than they were during the university's golden age during the Cold War [5]. As federal funding for research and state subsidy investments continue to decline, universities must rely on different forms of revenue, student tuition being a major contributor [29]. For reference, Dr. X's university has experienced a significant increase in students and tuition from 1999 to 2015. In 1999, undergraduate tuition and fees were roughly $3,500 for in-state tuition and $12,500 for out-of-state tuition [30]. By 2015, these costs had become close to $12,500 and $28,500 for in-state and out-of-state tuition, respectively. During the same period, the enrollment for the total student body was roughly 27,500 in the academic year of 1998-99 and approximately 33,000 in 2014-15. [27]. These trends are not isolated to Dr. X's university, as the increases in enrollment are desired across all universities, for they provide the revenue necessary to sustain the university. Consequently, large class sizes may become even more prevalent across the engineering curriculum, which can be essential to maintain the university's finances. Still, large class sizes can disadvantage students, especially minoritized students, without intentional pedagogical interventions.

VI. Conclusions and Implications

Teaching large class sizes requires an intentional integration of multiple roles. In the teaching role, Dr. X takes on administrative roles in managing teaching assistants, lecturing in the fifty-minute class, and the role of the learner in seeking out areas of improvement from teaching professionals. Large class sizes add another layer of complexity to each of these roles. The restricting of a university budget to draw in more students has all but ensured that class sizes are to become a staple in higher education.

Consequently, there is a need to systematically interrogate teaching techniques as they have been adapted (or not) to the changing classroom environment. Rather than relying solely on faculty-driven, emergent methods of pedagogy—to maintain if not improve student learning—developed by few instructors, departments will need to address the long-term implications of enrollment growth. These actions can take the form of institutionally supporting the professors who are developing new strategies and working to disseminate them across other instructors. Professors have long-held autonomy over the way they teach their course material, but teaching course material is no longer the entirety of what teaching entails. There is a disconnect between faculty-driven pedagogical improvements and department-level decisions on physical course structures that requires a realignment. Faculty are given the responsibility of deciding how to teach but still lack that in the physical constraints that make up their courses. Overall, there is a need to expand our definitions of what it means to teach and acknowledge the multiplicity of roles with structural design decisions in the curriculum.

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