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STEM department chairs' perspectives on navigating teaching culture to influence instructional change: a four-frames model analysis

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Academic departments have been highlighted as key targets to sustainably transform the learning environments of postsecondary science, technology, engineering, and mathematics (STEM) courses in the United States. Despite STEM department chairs playing a critical role in shaping their unit, few studies have characterized how chairs view the teaching culture within their department and how cultural features influence instructional change. This study addressed this gap by applying the four-frames model for organizational change to analyze interviews conducted with 14 STEM department chairs at one research-intensive institution in the United States. The department chairs identified several challenges to supporting and advancing teaching culture. These challenges were mostly related to the *structures* and *symbols* frames and included an institutional emphasis on research over teaching, inadequate methods to evaluate effective teaching, and weak teaching feedback mechanisms available to faculty. The chairs also described how they leverage their *power* to affect *people* and thereby influence the teaching culture. For example, they strategically position teaching as an important aspect of the departmental culture during hiring processes and elevate certain groups of faculty who have demonstrated interest and efficacy in teaching. This study contributes to the literature by providing a rich description of the teaching culture in STEM departments at a research-intensive institution from the perspective of department chairs. This unique focus on department chairs helps identify opportunities for instructional reforms that are grounded in the reality of the departmental environment and provides a framework for considering how change might occur in STEM departments at research-intensive institutions. The opportunities identified emphasize the importance for department chairs to consider and leverage all four frames to enact instructional change.

KEYWORDS

change agent, culture, department chair, four-frames model, instructional reform

Introduction

Instructional reform efforts targeting science, technology, engineering, and mathematics (STEM) courses at the postsecondary level have been ongoing for decades. These reforms have aimed to enhance the implementation of evidence-based instructional practices (EBIPs) and curriculum to ensure equitable learning outcomes. A review of the undergraduate STEM educational change literature found that change processes can be characterized based on the extent to which the target innovation is individually-focused versus community-focused and prescribed versus emergent (Henderson et al., 2011). Many instructional reforms have focused on changing the instructional practices of individual faculty (Henderson et al., 2011), an approach that recognizes and leverages the agency that individual faculty have in teaching their courses (Couch et al., 2023) but that has resulted in only modest changes in STEM courses (e.g., Stains et al., 2018). This occurrence has led to an increased emphasis on understanding the broader institutional systems and cultures that influence faculty teaching practices (Fairweather, 2009; Austin, 2011).

A large body of research has demonstrated that faculty view institutional and departmental cultures as barriers to instructional innovation (e.g., Sunal et al., 2001; Walczyk et al., 2007; Landrum et al., 2017; Shadle et al., 2017; Sturtevant and Wheeler, 2019). Consequently, researchers and change agents have shifted toward reform initiatives focused on changing teaching culture (Edwards, 1999; Lee et al., 2007; Fairweather, 2009; Austin, 2011; Miller and Fairweather, 2015; Dennin et al., 2017; Reinholz et al., 2017), with a particular focus on department-level teaching culture since departments represent an important functional unit influencing teaching quality (Quardokus and Henderson, 2015; Coleman et al., 2019). Researchers have argued that changing departmental teaching culture can have broader and longer lasting effects than reforms solely focused on individual faculty (Gess-Newsome et al., 2003; Schein, 2010; Miller and Fairweather, 2015; Kezar, 2018; Reinholz et al., 2019).

Department chairs play a critical role in shaping the culture of their unit (Hecht et al., 1999; Angelo, 2000; Lucas, 2000; Lee et al., 2007; Schein, 2010; Bystydzienski et al., 2017; Dennin et al., 2017; Fisher and Henderson, 2018; Coleman et al., 2019). For example, their influences on policies, practices, and faculty career trajectories (Coleman et al., 2019; Freeman et al., 2020; Kruse, 2022) shape departmental values and norms. The literature has thus positioned them as critical agents in changing departmental and institutional cultures (e.g., Lee et al., 2007; McRoy and Gibbs, 2009; Bystydzienski et al., 2017; Coleman et al., 2019). However, department chair is a challenging and complex role (Edwards, 1999; Maddock, 2023). Chairs have to lead faculty who are often their peers while also meeting the needs and requirements of deans and upper administrators at their institution—in other words, chairs must navigate their department's culture while acting as a nexus between faculty and upper administration (Gmelch and Miskin, 1993; Gonaim, 2016; Freeman et al., 2020). The position is also challenging because chairs have a responsibility to implement policies and meet goals, such as defining teaching evaluation practices and achieving student success outcomes, but often have little power over how faculty fulfill their academic roles, such as how much time they devote to teaching and what teaching practices they employ (Lucas, 1986; Kruse, 2022).

These challenges highlight the need for chairs to be provided with support, resources, and training in order to be effective change agents (Morris and Laipple, 2015; Bystydzienski et al., 2017). Unfortunately, it is well documented that chairs enter their position with underdeveloped administrative and leadership skills (Knight and Holen, 1985; Lucas, 1986; Creswell et al., 1990; Gmelch and Miskin, 1993; Cooper and Pagotto, 2003; McRoy and Gibbs, 2009; Kezar, 2023; Maddock, 2023). To address this need, several organizations and some academic institutions provide professional development programs specifically targeted for current department chairs (e.g., Council of Colleges of Arts and Sciences, 2022; ADVANCE, 2023; American Association of State Colleges and Universities, 2023; The Chronicle of Higher Education, 2023; The Council of Independent Colleges, 2023). These programs represent promising avenues to involve, support, and empower chairs to elevate the teaching culture in their department. The effective design of these programs relies on an understanding of chairs' perceptions of their departmental teaching culture and their perceived sphere of influence within that culture. By understanding chairs' perspectives, these programs can better prepare chairs to function within their departmental context and institutional system.

While an extensive body of work exists on department chairs, a recent review of this literature recommended that research focuses on elucidating the cultural aspects under which department chairs operate (Maddock, 2023). Only recently have researchers started to explore the culture of STEM departments. For example, one study describes the development of the Departmental Education and Leadership Transformation Assessment (DELTA), which aims to characterize a department's culture around undergraduate education (Ngai et al., 2020). One in-depth longitudinal case study of a STEM department explores the sustainability of an educational reform through the lens of an organizational culture framework (Reinholz et al., 2019). Another case study of 11 universities from eight different countries characterizes leadership styles with respect to teaching of chairs of departments renowned for their teaching excellence (Gibbs et al., 2008). They found that, in most cases, the department chairs played a critical role in developing the department's excellence in teaching and that they engage in a variety of leadership activities to achieve this goal.

To date, few studies have directly explored STEM department chairs' perspectives on the teaching culture within their department. One study focuses, in part, on factors that engineering department chairs deem important for the adoption and sustained use of EBIPs in their department (Borrego et al., 2010). Analysis of the survey responses collected from 197 engineering chairs revealed that faculty agency was seen as a key factor to the adoption of these strategies. In other words, adoption of EBIPs cannot take place without faculty members' willing participation. The authors commented that department culture plays a significant role in promoting this agency: "… they respond to the values of their environment. Faculty are unmotivated to adopt engineering education innovations when they perceive that teaching innovation is marginalized in promotion and tenure considerations and that their colleagues are skeptical of assessment evidence" (Borrego et al., 2010, p. 203). Here, we extend these previous studies by interviewing 14 STEM department chairs from one research-intensive institution to address the following research question: What cultural elements (i.e., structures, symbols, people, power) do STEM department chairs perceive as shaping their department's instructional mission? By addressing these questions through a single-institution case study, we aim to identify salient elements that appear consistently across STEM disciplines, while also

capturing examples in which departments develop distinct cultures apart from the broader institution. In this way, our research seeks to delineate shared challenges at a research-intensive institution while also pinpointing exemplary ways that chairs advanced their departmental teaching mission.

Theoretical framing

We leveraged the four-frames model for organizational change to characterize each chair's description of their departmental teaching culture (Bolman and Deal, 2008; Reinholz and Apkarian, 2018). The Reinholz and Apkarian (2018) model adapts the four frames from business (Bolman and Deal, 2017) into the context of higher education and STEM departments. This model has been fruitfully used in the literature to explore educational reforms in postsecondary STEM contexts (e.g., Reinholz and Apkarian, 2018; Reinholz et al., 2019; Stavrianeas et al., 2022) and to study postsecondary leadership (Bensimon, 1989; Kezar et al., 2008; McArdle, 2013). Thus, this model will be used to examine department chairs view of teaching in their roles as leaders and potential change agents.

The four frames—*structures*, *symbols*, *people*, and *power*—represent interrelated lenses through which to view culture, which the authors define as "a historical and evolving set of *structures* and *symbols* and the resulting *power* relationships between *people*" (Reinholz and Apkarian, 2018, p. 3). Each frame provides a lens that a change agent such as a department chair can leverage to promote culture change, and effective cultural change efforts typically target multiple frames at a time (Figure 1; Vuori, 2011; Bolman and Deal, 2017; Reinholz and Apkarian, 2018; Stavrianeas et al., 2022). Delineating culture through the four frames thus provides a way for change agents and chairs to identify and define the diverse elements that shape teaching in their department while also enabling them to see the interplay and need for alignment across these elements.

Structures are the "roles, responsibilities, practices, routines, and incentives that organize how people interact" (Reinholz and Apkarian, 2018, p. 3). The structures frame aims to leverage the strength of each member of the department and provide mechanisms for these members to work both individually and collaboratively to achieve the department's collective goals (Reinholz et al., 2019). Structures in an academic department include committee structures, instructional assignments, performance expectations (e.g., for research, teaching, and service), as well as incentives and rewards (Reinholz and Apkarian, 2018).

Symbols are "the cultural artifacts, language, knowledge, myths, values, and vision that department members use to guide their reasoning" (Reinholz and Apkarian, 2018, p. 4). They represent "the norms, values, and ways of thinking in a department" (Reinholz and Apkarian, 2018, p. 5). Department members rely on symbols to make sense of and engage with the different structures. Due to the close relationship between explicit *structures* and the implicit *symbols* conferring meaning to them, Reinholz and Apkarian (2018) recommend that these two cultural components be considered as a coordinated pair.

The *people* frame highlights the individuality and diversity of individuals within a department. Indeed, each member of the department has their own goals, agency, needs, and identities, which may lead individuals to experience the departmental culture differently (Reinholz and Apkarian, 2018; Reinholz et al., 2019). Understanding a department's culture thus requires understanding differences in perspectives among its members (Reinholz and Apkarian, 2018).

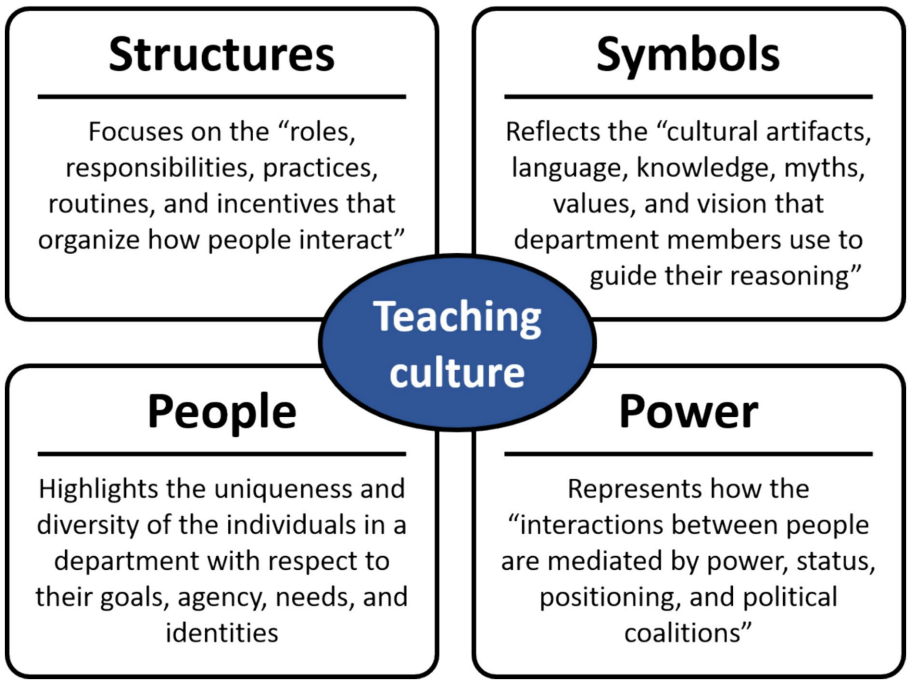

FIGURE 1
Four-frames model for organizational change as defined in Reinholz and Apkarian (2018).

Power represents how the "interactions between people are mediated by power, status, positioning, and political coalitions" (Reinholz and Apkarian, 2018, p. 5). This frame acknowledges the existence of department politics and the role of power dynamics in decision-making. For example, some members of the department may have a higher status due to their academic rank, formal role such as department chair, or status within their research field. Consequently, these members will have a greater ability to influence the circumstances of others (Reinholz et al., 2019). Reinholz and Apkarian (2018) similarly recommend viewing *people* and *power* as a meaningful coordinated pair since the people frame draws attention to the individuality of department members while the power frame emphasizes that these members are interconnected within a political system.

Beyond their application of the four-frames model to STEM departments, Reinholz and Apkarian (2018) also emphasize three characteristics of an organizational culture that are relevant to academic departments. First, the culture of a department is immersed in and thus influenced by other cultures within the college, school, and institution. Second, the culture within one department is not homogenous and sub-cultures are likely to exist. Third, the culture is ever changing. Change agents knowledgeable about the development of the current departmental culture can leverage this knowledge to lead transformative cultural change.

Methods

Institutional context and sample

This study took place at an institution with a Carnegie classification of very high research activity, four-year, public, large doctoral university. At the time of data collection, the institution had received a federally funded multi-year, university-wide institutional change initiative grant. This change initiative aimed to enrich STEM courses with EBIPs and to facilitate change in how teaching is valued, evaluated, and rewarded in departments. This initiative presented the impetus for our single-institution case study, since the project also worked directly with chairs to reflect on their department goals and plans with respect to EBIPs. Roughly half of all STEM departments ($N = 14$) agreed to participate in the change initiative, and all of these chairs agreed to participate in this study. To maintain confidentiality, we do not share any demographic information about these chairs. This research project was reviewed and approved by two different Institutional Review Boards (protocol numbers 14316, 16000, and 3765).

Interview design, implementation, and processing

Department chairs participated in semi-structured interviews before their respective departments began to participate in the change initiative. The interviews were conducted by JH and AS who acted as evaluators external to the change initiative, meaning they were paid by the project but they were not involved in conducting the project activities. These interviews were part of a broad data collection by the external evaluation team, whose primary role was providing feedback and monitoring progress toward the goals laid out in the proposal. The interview protocol was designed to establish a baseline of each chair's perceptions of their department's orientation and capacity toward implementing EBIPs. The protocol was also designed to identify important aspects of the departmental context and potential supports and obstacles to reaching the change initiative goals. The semi-structured interviews asked 11 open-ended questions such as "Describe your department's culture with respect to undergraduate teaching" and "How do you think change in teaching practices among faculty takes place?" While acknowledging that chairs would likely be recognizable to their project-based colleagues, evaluators in the interview consent agreements offered chairs confidentiality and an opportunity at the end of the interview to identify particularly sensitive information that needed to be redacted or only reported in general, aggregate terms. These procedures were intended to encourage forthright discussion of challenges and difficult issues. The entire interview protocol can be found in Supplementary materials.

Prior to sharing the interview transcripts with the authors, JH and AS reviewed and redacted any sensitive and identifying information including those that the chairs wished to remove from the record. AEM removed any additional information identifying each department's specific discipline and assigned each transcript a three-digit reference number, in preparation for qualitative analysis by all authors except JH and AS.

Qualitative analysis

We employed a qualitative approach to characterize department culture from the perspective of each chair using the four-frames model (Bolman and Deal, 2017) adapted for systemic change in STEM departments (Reinholz and Apkarian, 2018). Based on the recommendations of Reinholz and Apkarian (2018), we organized our thematic analysis of the interviews and the presentation of our findings according to the larger pairings of *structures–symbols* and *people–power*.

The qualitative analysis occurred in five stages, summarized in Supplementary Figure 1. First, two interviews were read and summarized by five authors (AEM, BAW, BAC, LBP, MS; Supplementary Figure 1, interview familiarization) to calibrate summary styles and discuss emergent patterns.

Second, one author (AEM) created a summary for each of the 14 interviews. Each interview summary had sections for the chair as a change agent as well as the chair's perceptions of their department culture with subsections for *structures–symbols* and *people–power*. For each interview, two additional authors read the transcript and created their own unique notes, which they then used to check each interview summary for accuracy and coverage, adding nuances and clarifications as needed. The three authors met to discuss changes to each of the 14 interview summary documents.

Third, the interview summaries were used to develop overarching inquiry probes, aligned with the four-frames model, that were addressed by the majority of chairs (Supplementary Figure 1, data reduction). The probes were organized within *structures–symbols* and *people–power*, and they became the headings of columns in a spreadsheet with each row representing a different chair. For each chair, one author (AEM) captured quotes and summarized the responses to each probe. Again, for each chair, two additional authors

checked the responses against their own notes to clarify, make corrections, and add nuance.

Fourth, responses to each inquiry probe (i.e., spreadsheet column) were analyzed by one author (AEM) to identify patterns across the departments. These patterns were summarized at the bottom of each column along two different levels dubbed "forest" and "trees." The "forest" captured common answers across all departments, while the "trees" captured answers common to multiple but not all departments. Three additional authors (BAC, LBP, MS) checked the patterns captured for each probe.

Lastly, four authors (AEM, BAC, LBP, MS) analyzed the forest/trees patterns to identify themes within the *structures–symbols* and *people–power* categories. These themes represent a synthesis of the tensions, challenges, and opportunities that featured prominently in the chairs' reflections. They are reported in the Results section of this manuscript.

Trustworthiness of the interview data and analysis was established in the following ways (Creswell, 2015). First, collecting data from across an array of STEM department chairs and documenting in detail the context, participants, and data collection processes enhances the extent to which our case study represents the target institution and provides insights for other research-intensive institutions. Second, we took multiple steps to account for potential bias arising from investigators having personal connections with the participants, including having the initial interviews be conducted and redacted by external evaluators and having multiple authors analyze the data at each stage of an iterative process, including multiple cycles of independent coding followed by author discussions. Third, documenting in detail the context, participants, and data collection processes enhances the transferability of the findings. Finally, JH and AS ensured the dependability of the data through their evaluation of our analytical process and the emerging themes.

Other considerations

This sample of 14 departments from one university provides insights into department culture and decision-making at a research-intensive institution. However, our relatively small sample of chairs included only one university, which limits the generalizability of finer patterns observed within the data. We also do not claim that our sample is representative of chairs everywhere. We propose that our sample provides a valuable institutional case study perspective on phenomena impacting the four frames.

The cultural aspects that this study captures are confined to the moment in time when the data were collected, roughly 10 years prior to the writing of this manuscript. Instructional reforms have been at the forefront of undergraduate STEM education over the last decade, so the findings from this study may not be fully replicated today. However, the literature on organizational and cultural change has demonstrated that transforming the culture of an organization is challenging and takes time. Moreover, similar themes to those observed in these studies have consistently been reported over the last decades, providing some external validity that the findings presented here would still largely hold today.

The interview was not designed with the four-frames model in mind–instead it was designed by the project evaluation team with the goal of capturing a chair's perceptions of their department's orientation and capacity toward implementing EBIPs. Consequently, each frame was neither explicitly nor systematically asked of chairs. Our findings thus reflect the frames and aspects within each frame that the department chairs found most salient as they engaged in a conversation around instructional reform with the interviewers. Thus, certain frames and frame components may have been found to play more prominent roles if the interview protocol had been designed around the four frames.

Results

This study aims to characterize STEM department chairs' perceptions of the cultural elements that shape their department's instructional mission. In this section, we organize the perceptions of the 14 chairs into the *structures–symbols* and *people–power* frames as described in the four-frames model adapted for higher education by Reinholz and Apkarian (2018). Figure 2 provides a summary of the findings.

Structures—symbols

Institutional administrators signal that research activities should be prioritized

Several department chairs indicated that there were significant institutional pressures for faculty to have active, well-funded research programs. For example, Chair 140 stated:

> "If you have got a major research appointment, the push to always go find some more money is pretty hard … it comes from everywhere. … The college pushes, the university pushes, and most research programs just could not operate at the level they operate. … We expect all of our faculty to have graduate students, and they have to have the kind of money to do that."

The chairs commented that an active research program requires tremendous intellectual effort and time to achieve, which may come at the cost of other activities. For example, Chair 210 indicated that teaching may be an unintentional casualty of the pressure to have a productive research program:

> "It's just perceived that to build up … a research program is a large time commitment. … We want that to be successful. … I worry sometimes that the message you give is, well, the teaching is not really important, and … that's not the message we are trying to send. But you look at how the resources are spent and the mentoring that's done, and it's really about building up the research program. And again, it's not by intention to slight the teaching mission. It's just that the reality is, it's a huge intellectual investment to get a research program going."

The chairs further described how this imbalance between research and teaching is emphasized in promotion and tenure (P&T) processes. The chairs explained that P&T values a very high standard of research and a moderate standard of teaching. Chairs 250 and 260 exemplified this point of view:

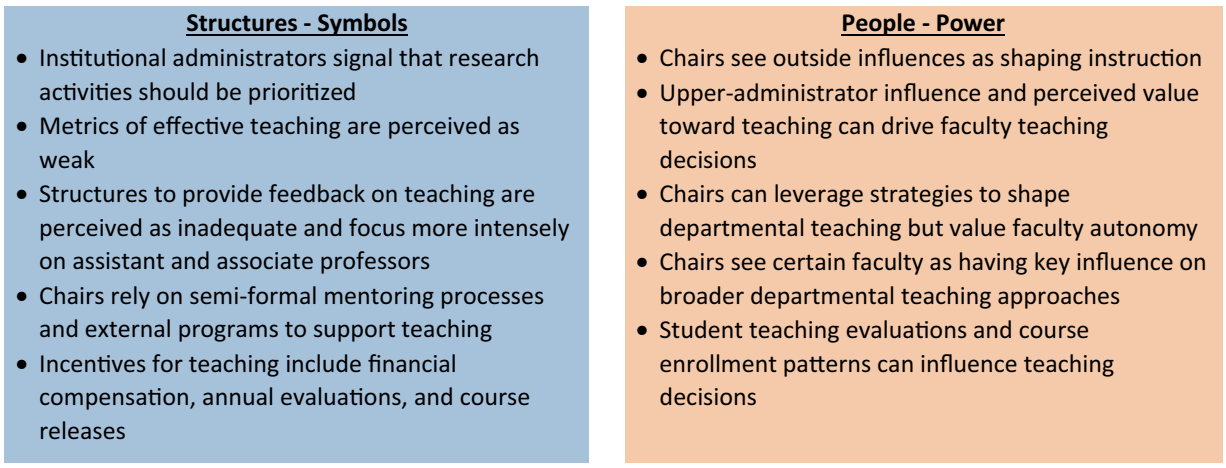

FIGURE 2
STEM department chairs' perceptions of the cultural elements influencing their department's instructional mission.

> "I think everyone would tell you … but this is my personal opinion, and I believe it's true, and when I mentor junior faculty, I tell them this: your research is going to get you tenure. That's what's going to get you tenure. You cannot afford to be a bad teacher. You cannot be a bad teacher. But being an excellent teacher and a poor researcher, you will not get tenure. So, you have to have an excellent research program and then you cannot fall below a certain level of teaching." (Chair 260).

> "The college and the campus say, teaching is important. … But really, teaching is important in the sense that there's a threshold. And once you meet that threshold, it's research that's important. And we are a research university, and I'm actually okay with that policy, with that philosophy. I mean, we should be providing a high-quality education, but we are supposed to be producing research. That's who we are. That's what we are supposed to be. And so as long as the teaching is passable, as long as you are not going in and doing damage, as long as the students are getting out of it what they should be getting out of it, which I think is primarily determined by how much they are putting in. So, then it becomes a question of how well is the instructor motivating the students, right, on top of their self-motivation. But as long as all that's happening, the place where you really want to develop your junior faculty is in their research." (Chair 250).

Beyond P&T processes, the upper administration also demonstrates the higher value for research through institutional awards. For example, Chair 260 indicated that the awards offered for teaching are easily achievable as many of the faculty within their department had received them; something that was echoed by Chair 250 as well. Chair 260 lamented that the teaching awards do not go far enough to recognize the most effective instructors:

> "The university has a number of awards for teaching and we have done a pretty good job of getting our share of those awards. I just wish there was a better way to value and reward really good teaching."

Chair 260 further elaborated that the upper administration values research expenditures over teaching:

> "I mean, honestly, I do not want to go back to research again, but the way these things work is, you are allowed to go to the higher parts of the university and say 'I have these people that are high performing, and they should be rewarded.' And I could make a very impassioned plea that someone's a great teacher. But for someone else, all I have to do is say, they expended $800,000 this year and boom, they will get it. Right? So, if we are serious about [teaching], if the institution is serious about it, they'll figure out how to value it in some way that makes sense."

The value research reflects in many departmental and institutional structures leads faculty to prioritize research at the expense of innovating their teaching. Indeed, chairs indicated that instructional innovation takes time and that research-active faculty cannot afford and will not be rewarded for spending time in this way.

> "I do not feel we can ask some of our research active faculty to give up a big portion of their research in order to pursue [EBIPs]. And obviously, the rewards will not be there in terms of the university." (Chair 150).

Metrics of effective teaching are perceived as weak

Chairs indicated that student evaluations play a major role in annual evaluations and P&T processes.

> "When it comes down to it, right, when we do annual evaluations, we have very little to look at beyond, what did you teach, and what did the students say about you? ... It really comes down to, what are the students saying? And I mean, and it's actually a huge problem, I think, in our evaluation system." (Chair 250).

However, as Chair 250 indicated, most chairs view student evaluations as poor metrics of effective teaching. For example, Chair

140 expressed dissatisfaction with student evaluations because they do not provide insight about the adequacy of the content taught:

> "I do not put a lot of weight into those [student evaluations] because my thinking is, the information you get from them will tell you about delivery. It will tell you if you are prepared. It will tell you if you are interacting with the students in an appropriate fashion. It will not so much tell you, or me, about, did you deliver the appropriate content? Maybe at the graduate level, the students can start giving you that feedback, but I would not put a whole lot of stock in what the undergraduates say in that matter."

Chair 120 felt that student evaluations are biased toward less rigorous courses:

> "It's not a great metric. I'm not a big fan of student evaluations, but they are a part of it, right? … but if you use that as your only guide, especially when the data clearly says there's a strong correlation between grades and evaluations, right, well then that indicates that if you lack rigor in your classes you'll have higher ratings, theoretically, right? That does not make sense. If you only use that metric, then you have a problem."

While they dislike the numerical scores provided in these forms, they do pay attention to and value the written comments made by students:

> "So, the thing we all like to see in evaluations, is where someone says, 'this is the hardest class I ever saw, but I learned so much, and I am so glad I was in this class.' Those are the evaluations you like to see and we have instructors that get those kinds of comments pretty often. … those are highly valued, of course, by anybody that sees them." (Chair 110).

Peer observation, whether by chairs or other faculty, is another tool used as part of the evaluation of teaching but it is also seen as problematic by chairs. For example, faculty question the validity of assessing one's teaching based on one or two classroom visits:

> "I did for a while, and the faculty did not care for it. ... They said, well what's the point? You're only here once or twice. … if you really wanted to give me feedback, you'd have to be here all the time, and you do not want to do that, and I do not want you to do that either." (Chair 140).

Some chairs also mentioned that faculty dislike being observed:

> "I mean, nobody enjoys it, necessarily and so … people do not bring it up. You know who enjoys having someone come in and sit in on their lecture? It … can be a little uncomfortable." (Chair 150).

However, the main barrier is the time it takes to conduct peer observations:

> "That's where we are lacking, and that's one of the sore points is that we do not have a tradition for observing faculty members in their courses. … everybody knows that's what we should be doing, but nobody wants to do the work, when it comes down to it to be honest and it's very frustrating." (Chair 160).

Overall, chairs were frustrated with the existing evaluation mechanisms and wished that more rigorous and viable measures existed.

> "The faculty talk about [what is effective teaching] a lot. … You know what? There's no way you can measure. Maybe there is. I'm sorry. I do not know enough about some of these educational research strategies. But you know, you hear the term, you see the lightbulb go off. You know, you see the students responding with an answer, six weeks into the semester, that they would not have been capable of even developing a beginning of an answer six weeks prior. How do you measure that? I do not know. I bet there's a way, but I do not know how you do it." (Chair 120).

> "Well, I would say we do not have a clear message from the institution and the college to measure those, or, well, to report on those things [effective teaching], as part of the evaluations. So, in other words, it's been stated that it's important, and there are resources committed to it. So, from that standpoint, you know, the administrators do put their money where their mouth is. But for instance, we do not report up … how many of your faculty did participate in … some teaching improvement workshop, just as a number, you know, just throw out a number, that kind of thing. I mean, we do not really report that kind of information. So, how would you know, how do you assess improvement in instruction? That would be a question, and then reporting up the chain on that ... I think we need to do more." (Chair 210).

This lack of effective teaching metrics led chairs to question the efficacy of innovative instructional strategies:

> "We all think that this interactive learning, these new methods work, but we do not really know how to measure it. ... I suspect we do not have good measures in place to tell whether these newer methods work. What we do know is that the students initially, at least, do not like them, and that, I mean, several faculty members have seen their student evaluations take a hit when they start to try to implement the new methods." (Chair 160).

It also makes it challenging for chairs to address and promote growth among ineffective instructors:

> "Well, how do you go to the professor, if the person is already a full professor, and tell them that you do not think that the way that they are teaching is effective? And secondly, ... it's causing a lot of students to change majors, and in short, it's causing damage to the department. Then they say, no, the only thing that they are really doing is, they are upholding high standards. Of course, I can go and say that to a professor, but I cannot say that to the professor if I do not have hard evidence in front of me." (Chair 230).

Structures to provide feedback on teaching are perceived as inadequate and focus more intensely on assistant and associate professors

The chairs indicated that it is a requirement to have teaching evaluated as part of the annual merit evaluation and P&T processes. Typically, non-fully-promoted faculty have their teaching reviewed by their more senior colleagues until they are fully promoted.

> "We have a faculty review subcommittee for every non-full professor. So, once you become full professor, you lose this committee, and that's an interesting twist. But if you are an assistant professor or an associate professor, you have a three-faculty member committee that oversees your progress. Those folks are supposed to keep an eye on peer evaluation of teaching, and the chair of that committee in particular would probably ask 'could I visit your class?' and 'what are you teaching?', and tries to get a mix of different classes that the person teaches, and usually would announce to the faculty member ahead of time that 'I'd like to sit in on this day,' sit in the back, take notes, write it up, and submit it to the faculty member. But then that same report normally comes to the executive committee, and that's part of the [annual evaluation and P&T] report." (Chair 130).

Chairs mentioned that the teaching evaluation is used to provide feedback and suggestions for faculty improvement:

> "The peer evaluation is as well, and we can send that message and say, the peers and I both agree that this is something you need to work on, and it needs a little improvement and this is how we suggest you do it." (Chair 120).

However, some chairs indicated that this evaluation of teaching is implemented more to satisfy institutional requirements and not necessarily integrated in the overall faculty assessment:

> "So, there's supposed to be a peer review of teaching that goes into the tenure portfolio ... the P&T committee was on top of that, and so they sat in on the classrooms. But it's kind of the as-needed, oh, check, check, check. We get it done because we are supposed to, instead of it being an integral part of, you know, the assessment." (Chair 220).

Chairs recognized challenges with this peer feedback process. For example, Chair 160 explained that senior faculty may feel ill-equipped to support their junior colleagues' implementation of innovative strategies and thus may resort to recommending teacher-centric methods:

> "We have concerns that if we are going to be encouraging our junior faculty members to implement these methods [EBIPs], it's going to hurt them in their teaching evaluations. We do not want to do that. So, I think we are in a bit of a dilemma here. And also, frankly, most of us were not trained to teach in this way. And the ones who start to implement, some of them realize that it's hard. It's not just a matter of, okay, I'll just go in and do this interactive stuff, and it'll be fine. It is hard."

Once promoted, full professors are no longer provided feedback by their colleagues or chairs on their teaching. Chairs identified the extensive time required to provide meaningful feedback as the main reason for the lack of engagement in this process:

> "We have not done as much with the fully promoted folks, just because it is a significant service duty to go three or four times in, to review syllabuses and teaching materials and tests and things, to do a reasonably good job." (Chair 150).

The lack of time and formal structure for regular evaluation of full professors' teaching results in the absence of monitoring, feedback, and opportunities for growth for the fully promoted faculty as Chair 230 indicated:

> "At the end of each semester, we receive student evaluations. … It becomes part of a document when somebody goes up for promotion or for tenure. But for more senior professors who have those processes behind them, those student evaluations do not really see the light of day, and it does not, and it's not scrutinized by any other independent party as well. So frankly, there is not, that I am aware of, any feedback mechanism to improve teaching."

Chairs rely on semi-formal mentoring processes and external programs to support teaching

Chairs identified mentoring as one mechanism to support faculty in their teaching. The chairs described that new assistant professors are either encouraged to identify or are assigned a mentor from the more senior faculty in the department during their first year.

> "If we have somebody with a major teaching appointment when they come in … we put them with the teachers that we know are good at what they do, and that are progressive in their technique. … and that seems to be very effective, if they engage. If they do not engage, then it's the face-to-face evaluation that I do annually that says 'oh, it does not look like you have engaged as we have sort of instructed, and, you know, your teaching appears to be suffering.'" (Chair 120).

However, mentoring is not always enforced and depends on the junior faculty's proactiveness.

> "We have a teaching advisory committee, and our junior faculty, and our post-docs, and our grad students are all offered the opportunity to have a mentor. We do not require it, but they are offered it, and they are told, 'you really need to do this.' That person will … attend their class a couple times and talk with them, and that sort of thing. Then the hope is that for the junior faculty, this continues throughout their time as an assistant professor." (Chair 250).

> "We do also have some peer evaluation of teaching within the department, but that's on a voluntary basis. It's not mandatory. What I mean by that is, we have individual faculty who ask peers to sit in, and they evaluate their lecture or evaluate their teaching. It's something that we encourage, something that I tell all of our young faculty, 'hey, this is something you ought to do. This is an

> opportunity.' But I do not have a formal, mandatory participation in that arrangement." (Chair 170).

Moreover, the mentoring is not necessarily focused on teaching and teaching improvement. Several chairs described that the mentors provide advice on all aspects of the faculty's career:

> "In a general sense, there is mentoring of junior faculty by more senior faculty. But this is in the whole professional development, which includes research and [teaching]. So, any specific mentoring towards teaching *per se*, not that I am aware of." (Chair 230).

Finally, the senior faculty who serve as mentors in these initial years typically will be members of the peer evaluation committee for the junior faculty. This creates a power-differential that may influence the nature of the feedback and response to this feedback.

> "Whoever the mentor was becomes the person who does the peer evaluation of teaching at the time of the fourth-year review, and then tenure. … That's the goal, is that it changes from this mentoring relationship to a peer evaluation relationship." (Chair 250).

A second mechanism that chairs use to support teaching is providing opportunities for faculty to engage in professional development programs. In particular, several chairs indicated that they financially support faculty to attend teaching-focused workshops or conferences organized by professional organizations.

> "We give our faculty some money that they can use for travel and they can choose where to go. So, there's a [regional] section of [disciplinary organization] that we had several faculty go to. … I've had a few faculty requests for going to conferences of that sort that go beyond what we normally give, and usually we have been able to support that." (Chair 240).

Incentives for teaching include financial compensation, annual evaluations, and course releases

Chairs mentioned several incentives that they use to enhance the value of teaching in their department. First, chairs extensively leverage annual evaluations both formally through the official letter they write to their dean, which is also available to the faculty, and informally through conversations. The following quotes illustrate these two mechanisms:

> "The [annual evaluation] keeps people's attention on [teaching]. They will get a letter at the end of every year that gives them an evaluation adjective for their research, their teaching, and their service. Those words, whether it's outstanding, superior, good, satisfactory, unsatisfactory, those words mean a lot. I had faculty members who take their teaching really seriously and if they get a word, an adjective that they think does not adequately describe their teaching, boy, they are upset. So that is a stick or carrot, I do not know what you want to call it. But it does matter." (Chair 160).

> "If there's a course or an instructor that has, you know, proven to be having issues teaching, then we have a meeting, sit down, and I try to figure out what is the source of the problem." (Chair 220).

Chairs also leverage their control of salary raises to reward effective teaching.

> "An associate professor who has been that rank for many years … that person's salary is comparable to a full professor, because they have been rewarded year after year for their excellent teaching." (Chair 150).

A third incentive that chairs use are course releases as they see this as a means to address the time constraint that faculty experience when they try to transform their teaching.

> "I'm always looking for innovative ways to try to dangle carrots in front of people to do things. The biggest one, of course, is time commitment so I try to do course relief for people." (Chair 210).

However, some chairs did not feel that course release was an option since their teaching resources are limited:

> "One of the things that [upper administration] had mentioned is perhaps lowering someone's teaching load for a semester. Well, that means raising the teaching load on someone else cause we are at capacity. So, I'm not sure how to do that one." (Chair 240).

Finally, a few chairs did not feel that they had options to incentivize teaching:

> "I mean, incentive would just be pretty much personal satisfaction of the course going better, it being more interesting to teach, or whatever. I mean, we do not have the resources to incentivize much, right?" (Chair 250).

People—power

Chairs see outside influences as shaping instruction

Chairs pointed to accreditation boards and professional societies as entities outside of the institution that may drive departmental change. For example, Chair 240 remarked on the need for the department to ensure that changes with the course curriculum align with accreditation requirements.

> "The decision-making happens on many levels. So, we have a curriculum committee that is very involved. When faculty are making changes to courses, they go through the curriculum committee, and all sorts of reviews like that. Then we also look at, how does this address our accreditation issues?" (Chair 240).

Professional societies conduct teaching-related workshops and host teaching-focused conferences. Participation in these events can change how the department engages with teaching as faculty attending these meetings learn about new teaching practices and bring these

ideas back to their departments. Chair 170 indicated that these professional societies' activities are one of the main sources of teaching-knowledge for their faculty:

> "[Faculty] do participate in seminars. … the college offers at least once or twice a year, teaching seminars, … and then I'm not the only one who attends teaching symposiums. When we have professional meetings, there're sections … that talk about innovative teaching or new teaching practices that the other faculty at other universities, and [similar depts], have been using and implementing. And they attend those. So, those would probably be the two major ways that our faculty learn about, you know, state of the art efforts to improve teaching." (Chair 170).

Upper-administrator influence and perceived value toward teaching can drive faculty teaching decisions

Chairs identified administrators, such as deans, as drivers of change through the incentives they provide for teaching commitments. These administrators play key roles in creating and maintaining the institutional culture around teaching, both positively and negatively.

> "That's the part where, you know, the department chairs and the college administration, the dean and so forth, play a role, is if you can reward people for making some of those time commitments." (Chair 210).

One chair noted that administrators' requests and actions can heavily influence faculty decision-making in favor of teaching:

> "For the faculty that strongly believe that their entire world should revolve around what the [high ranking administrator] wants, and [this administrator] has said that we are on this DBER [disciplined-based education researcher] thing …. You know, they'll change, at some level, just to adhere, for lack of a better term." (Chair 120).

Conversely, if faculty perceive that administrators value teaching less than research, this perception can negatively affect the effort faculty allocate toward teaching.

> "You always get that tug, especially as a new faculty member, from the administration that, no, you need to focus on your research. And that's true. I mean, that's very true. If you put too much time into your teaching and you are not doing enough research, you are not going to get tenure." (Chair 150).

Chairs can leverage strategies to shape departmental teaching but value faculty autonomy

Chairs identified themselves as potential drivers of change when they shared information about teaching innovations, encouraged or rewarded their use, influenced department structure, and hired teaching-focused faculty. For example, some chairs promoted change by rewarding teaching and encouraging participation in professional development programs.

> "[I encourage teaching excellence] by leading by example and by demonstrating that I think that teaching is an important part of our mission, and making that clear in everything that I do, and in rewarding faculty, in encouraging their participation in these kinds of projects." (Chair 160).

> "That's a way where, if I can convince them to go [to the disciplinary professional development program], and so far my record is perfect. If I can convince them to go, then, you know, that program will do all the selling and convincing. That's nothing I have to do." (Chair 110).

Another chair shared a vision for the department in which teaching is a key area of focus akin to established areas of research already existent. The chair supported this vision by hiring more faculty into "a career teaching line," which has room for career expansion and increased career stability.

> "We're transitioning a temporary lecturer to a [teaching faculty], and we have just completed the hire of a new [teaching faculty]. …The high-level message here is that the department is changing its structure for the first time in a long time, and the way it's changing that structure is to elevate teaching to a fourth … component [alongside three areas of research emphasis]. ... It's my vision, and I have not heard people … express too much dissent." (Chair 260).

However, chairs see faculty achieving effective teaching in different ways and are thus conscious of preserving faculty autonomy in their teaching practices.

> "Well, I've always been reluctant to tell somebody, 'you have to make this teaching change,' because … I've seen people that taught various ways, and all have been successful …. I've seen some really extremely good, at least from my perspective … and all they did was stand in front of the chalkboard … they got their students to work hard, and the students seemed to grasp the material … and to be able to apply that knowledge later on. So, I'm not convinced any particular teaching style is the best. It varies. Some people work better one way, and others work better a different way, and interact with their students a different way." (Chair 140).

Consequently, chairs feel that they cannot or should not compel faculty to use a particular instructional approach.

> "The students have to be engaged in the learning process, right? But how you get them engaged, that completely depends on your own personality, and how you are going to approach teaching, and … what you want to do. There are different ways of doing it. So, I try to convey that to people, and let them know that, first of all, they are not expected to rise to the level of [Teaching Excellence] professor or a [Creative Teaching Award], right? That's okay. That's not what I'm asking of them. I try to get them to understand that

> what they need to do is figure out what they think will work for them." (Chair 250).

Chairs see certain faculty as having key influence on broader departmental teaching approaches

Several chairs in this study reported formal and informal peer-to-peer interactions as mechanisms of change. They identified informal sharing about teaching as a driver of changes in teaching practices.

> "I think in our case, [instructional change is] primarily peer led. That's what I've seen, that we have had … a couple people, maybe starting with [former chair] who got really involved, and got other people involved. Then they start talking about it with each other and they get excited about it. You just see it catching on." (Chair 160).

Many of the chairs who indicated that their departments had a strong teaching culture thought that new faculty exposed to this culture upon joining the department are likely to engage in similar teaching practices.

> "So I've only been here for one [program assessment] meeting. I would say probably 90 percent of the teaching faculty participate. And it's just part of what we do. It's just so ingrained in the culture that we are going to talk about students and curricula during the school year …. But a lot of what's happened in terms of new faculty coming in, giving them guidance in teaching, it's been, oh, go talk to this person, go talk to that person." (Chair 240).

The influence could also flow in the opposite direction, where new hires bring innovations or different attitudes toward teaching into the department.

> "And this is part of the reason that we have hired [faculty member], because we realized that, you know, we all think that this interactive learning, these new methods work, but we do not really know how to measure it. So, we are very excited to have been able to get a position for a DBER faculty line, and particularly to have somebody whose expertise is in the area of assessment, because I suspect we do not have good measures in place to tell whether these newer methods work." (Chair 160).

> "This is my perception, teaching among the new hires with 20 percent teaching is, they are valuing that 20 percent, or putting emphasis more on that 20 percent than historically has occurred." (Chair 120).

Chairs also mentioned more formal mechanisms through which peer-to-peer exchange could drive changes in teaching practices. For example, some chairs reported change being led by committees within the department. Other chairs, such as Chair 110, identified co-teaching as a formal mechanism that leads to change. In this department, faculty who co-teach a service course share their teaching innovations through designing and offering a workshop to train all faculty that teach the course. Through this type of workshop, new faculty can gain information from others who have previously taught the course:

> "So probably all faculty at one time or other are teaching a section or two of these [service courses]. They appreciate, especially the new faculty that have gone through that workshop, they appreciate that there are better ways, or best ways to try. The first time they teach, anybody teaches any of these courses, they get all the materials and help they can from the seasoned veterans who have been teaching it. By now, everybody has used some variation of some of these approaches. So what they inherit already sort of expects they use, and they certainly want to try a lot of this stuff." (Chair 110).

Teaching faculty and DBER faculty were identified by chairs as key change agents. Chairs indicated that the hiring of these professionals signals a serious commitment to teaching by the department and administration. For example, in Chair 250's department, a Teaching Faculty trained graduate students in teaching:

> "We've hired a [teaching faculty] who's going to oversee all this [training of graduate students on teaching]. [Graduate students] are going to be taking a graduate level pedagogy course from this [teaching faculty]. So very intensive learning how to teach, and training, and especially with regard to the collaborative learning, and this kind of thing."

Chairs indicated that both teaching faculty and DBER faculty led by example by implementing teaching innovations that engage students. Additionally, the chairs thought that DBER faculty had contributed to changing the culture of teaching in their department by inviting education researchers as seminar speakers and conducting teaching-related workshops:

> "The other thing I can think of that's changed the culture a little bit in the department in the last few years is having [a DBER faculty] join the department. ... [The DBER faculty] brings in … a few people each semester and they are usually talking about aspects of teaching and that sort of thing. So, I think that's made people think about these things a little bit more than they would have otherwise ... in fact, I've noticed when those people come in, we do have a lot more people coming from outside the department seminars." (Chair 150).

> "I think [a DBER faculty's] workshops have been really important in that regard for some of these things, and I took their [teaching] workshop, and I mean that was very, I could see why that would be really helpful if you were trying to implement some of these methods, particularly in larger courses." (Chair 260).

Department chairs also identified senior faculty as potential change agents. Senior faculty who support innovative teaching can have positive impacts on teaching practice by establishing the culture of the department and serving as mentors for junior faculty as the following two chairs indicated:

> "We have had a tradition that some of our senior faculty, and this goes back many years, have held informal mentoring lunches, particularly for the junior faculty involved in the large enrollment courses .... They would meet for lunch maybe once a month or

> maybe several times a semester, and just have lunch and talk about whatever." (Chair 160).

When such senior faculty retire, there can be a vacuum of support for teaching, which may change department culture.

> "When I came, we had a sizable fraction of faculty who were not really research active anymore. They had a heavier teaching load, and they were much more engaged in—this was before all of this newfangled stuff came up. But they were exploring lots of stuff ... they often are mentors automatically for new faculty. They were a great resource. But they had time to do just the teaching stuff, right? We do not have anybody anymore at all. Everybody is 100% research active." (Chair 110).

On the other hand, chairs indicated that some senior faculty may not value teaching or education research as highly as their disciplinary research. In such environments, junior faculty may hesitate to use teaching innovations as this may not align with the values of senior faculty who have evaluative power. These values and behaviors can create a culture that is unsupportive of teaching innovations. The following two chairs illustrate this point:

> "Junior faculty want to do things that are innovative, but they gotta be careful, because they do not want to piss off somebody that could end up evaluating their package later on." (Chair 270).

> "Maybe it's only a couple [senior faculty]. But you know, this research on education for them is some lower tiered kind of thing, right? And there are also people, it surprises me, though, that think … if we have people conducting education research, they can just tell us exactly what we should do to do it right? ... It's funny, cause in their own field of research, they will understand it can take decades to figure something out, right? … They're not different than the general public that like to see some instant solution to problems." (Chair 110).

Student teaching evaluations and course enrollment patterns can influence teaching decisions

Finally, chairs also identified students as bottom-up change agents, mediated through peer-evaluation of teaching or chairs' reviews of teaching evaluations.

> "The system of peer evaluation of syllabi means you immediately see who's actually using these things … so, there's some peer pressure there if people start using them. If the students like it, it's bottom up." (Chair 130).

> "I have a fair amount of influence, because they know that [student feedback is] important to me, that I look at it as part of the total faculty evaluation process, that I'm interviewing students who are at the end of their four-year program, and getting feedback about … what the students perceive as strengths and weaknesses." (Chair 170).

A change in the student population can also drive teaching changes. One chair mentioned that having increased enrollment led to the need for teaching faculty who changed how the course is taught. Other drivers identified were the addition of courses for non-majors and the need to address a new student population.

> "Because of the different cohorts of students physically separated, I think that it provides a good opportunity for faculty to become engaged in how to change how they are teaching and what they are teaching, you know, gives us a good reason to embrace that. I think faculty are fairly receptive to that, because they understand there's going to be an impact with having distinct cohorts of students in different locations, and how do we address that? So, I think anything you can do that helps make us better in our delivery of our educational program in that vein will be embraced readily by the faculty." (Chair 210).

Discussion

While national reports have called for continual improvements in undergraduate STEM education (President's Council of Advisors on Science and Technology (PCAST), 2012), the associated transformation efforts have faced numerous challenges arising from the complex factors and cultural elements that shape instructional decisions and course delivery (Lee, 2007; Miller and Fairweather, 2015; Shadle et al., 2017). For this reason, undergraduate STEM education has been increasingly considered through an organizational approach, with a key focus on academic departments since they serve as the focal structure dictating how instructors implement courses and degree programs (Kezar, 2018; Reinholz et al., 2019; Stavrianeas et al., 2022). By virtue of their position within the institutional system (Coleman et al., 2019; Freeman et al., 2020), chairs have a unique perspective from which to understand their department as well as unique opportunities to shape departmental teaching culture (Lee, 2007; Bystydzienski et al., 2017). Thus, leaders of instructional transformation efforts need to understand how chairs perceive their teaching culture and what leverage points chairs see within their unit.

Overall, our interviews indicated that chairs have awareness and experience with the obstacles described in the instructional change literature. This creates an opportunity for change initiatives because it means that they might find in chairs natural partners with first-hand experience of the culture and challenges around a department's teaching mission. Chairs have a distinct position from which to help change agents understand the current needs of a department (Wieman et al., 2010; Reinholz et al., 2017) and develop the vision, values, and community needed for a change initiative to succeed (Lee et al., 2007; Shadle et al., 2017; Reinholz et al., 2021). Indeed, any efforts to change departmental structures would presumably involve the chair (Lee et al., 2007). While chairs may have developed an intuitive sense of how to achieve systemic change, they face a variety of challenges and often need support for understanding education research and improving teaching (American Academy of Arts and Sciences, 2017; Maddock, 2023).

The four frames model provides a way to think about how to build departmental teaching culture

Departmental teaching culture emerges from a complex array of internal and external factors, and the four frames allow change agents to situate system components and visualize the interplay between

frames (Stavrianeas et al., 2022). Multi-framing (i.e., the ability to consider multiple frames at once) enables change agents to consider the department with a system approach and to negotiate complex and conflicting departmental needs (Vuori, 2018), and this approach aligns with the finding that change initiatives often implement an array of strategies targeting different institutional and departmental components (Feola et al., 2023). Building on this framework, we synthesize the most salient insights on the challenges that emerged from our chair interviews then highlight ways in which chairs overcame these challenges, including how actions aligned with one frame potentiated change in other frames.

Insight 1: Chairs view disciplinary research as significant and competing with instructional investment

Perhaps the most prominent theme voiced by chairs pertains to the structural and symbolic tensions between research and teaching. Chairs recognized the primary importance of research productivity to institutional stature, departmental success, and individual faculty advancement, and they understood that this emphasis had the potential to lead to explicit or implicit subordination of teaching. The research-teaching tension has been raised as a challenge throughout the institutional change literature (Lester and Kezar, 2012; Parker et al., 2015; Chasteen et al., 2016), and our interviews confirmed that chairs view this as a fundamental challenge. The chairs also viewed this issue as intertwined with how faculty allocate their time, effort, and resources (Borrego et al., 2010; Shadle et al., 2017; Lindstrøm et al., 2022), and they had seen first-hand how junior faculty are advised to prioritize their research programs. Finite limits on the amount of time and effort that faculty can give to their appointment leads to interpretation of the research-teaching tension as a zero-sum game where efforts to improve teaching generally detract from achieving more pressing research goals. This tendency to prioritize research over teaching may be difficult to overcome at a departmental level, since it stems from broader factors associated with how agencies award research funding, how institutions finance their research operations, and how institutions compete for top research investigators.

Insight 2: Chairs view existing evaluation approaches as insufficient for capturing effective instruction

As expected for leaders of academic units, our chairs generally expressed symbolic value and interest in undergraduate teaching. However, they also felt that they lack the structural means to recognize and measure effective teaching. This led to a misalignment between a department's stated teaching values and their associated evaluation practices (Dennin et al., 2017; Shadle et al., 2017). Consistent with prior literature, chairs saw a variety of intrinsic and practical challenges associated with the available options (Wieman, 2015; Shi and Stains, 2021). For example, chairs saw issues with the subjective nature of student evaluations; the coordination, effort, and training required for peer observations; and the lack of available instruments to assess learning across different courses. Furthermore, chairs understood how teaching evaluation systems could lead to either a lack of incentive or even a disincentive for instructors wanting to implement new teaching practices (Connor and Raker, 2023). While the change literature has emphasized the need to adjust teaching evaluations systems to promote instructional engagement and innovation (Dennin et al., 2017; Coleman et al., 2019), these chairs did not see how this could be readily accomplished without a significant investment of time and resources, which contradicts the overarching need for efficient evaluation processes.

Insight 3: Chairs value instructional pluralism and autonomy

Many chairs recognized that certain teaching practices have a demonstrated potential to promote student success, consistent with previous research finding that chairs have high awareness of research-based instructional strategies (Borrego et al., 2010). However, the recognition and acceptance of research-based practices did not necessarily coincide with a symbolic devaluing of other teaching practices. Chairs cited how instructors could be effective with a variety of approaches based on their personalities and noted how a teaching practice that worked for one instructor might not work for another instructor. This viewpoint resonated with their concern about teaching evaluation metrics: if chairs see no way to measure effective teaching, then it makes sense that they would also see a certain equivalence across different teaching approaches. This pluralism connected to the perception that instructors should have the autonomy to teach in the manner they see fit and that, unless serious issues occur, departments have little role in guiding how individual faculty teach their courses (Walter et al., 2014; Landrum et al., 2017; Shi and Stains, 2021). Prior work on course coordination has found that instructors view this autonomy as critical to enabling them to implement their preferred instructional approaches and achieve their instructional goals (Couch et al., 2023). The values of instructional pluralism and autonomy justify chairs taking a distant role with respect to instructional decision-making (Gibbs et al., 2008).

The current faculty reward system prioritizes research while leaving instructional investment up to individual instructors

The above insights help explain how the current faculty reward system functions and why this system resists meaningful change. Departments place significant value on research and they have limited means to recognize effective teaching. This leaves departments with little reason or means to question the norms of instructional pluralism and autonomy. As a result, faculty evaluation systems (e.g., annual evaluation, promotion and tenure) prioritize research accomplishments while accepting a baseline level of teaching proficiency. This leaves instructional investment up to the discretion of each individual instructor. Instructors conduct a risk calculation as they choose whether or not to invest in teaching; faculty are often deterred from pre-tenure teaching investments, since those who make the greatest contributions to teaching innovation may be the most disadvantaged by the current system (Borrego et al., 2010; Lindstrøm et al., 2022). Chairs cited some ways that the institution and departments incentivize and support teaching, but these mechanisms tend to be voluntary and non-systematically incorporated into core evaluation processes. In the absence of structural revisions to the reward system to better recognize instructional investment, change initiatives face the existential obstacle of asking instructors to work against their better interests, which ultimately decreases the likelihood that a change initiative will succeed (Borrego et al., 2010; Matz and Jardeleza, 2016; Lindstrøm et al., 2022).

While chairs identified several challenges to instructional transformation imposed by institutional and departmental structures and historic attitudes toward research and teaching (*structure-symbol*

frames), many chairs saw avenues by which they could influence change within the *people-power* frames. Here, we describe how the four-frames model enables chairs to take specific actions that foster a positive teaching culture. Particularly, chairs can harness their influence during the hiring process and their ability to support faculty with teaching expertise as well as faculty seeking to build expertise with high impact teaching practices.

Opportunity 1: Chairs can support and elevate people who hold positions outside the pre-tenure research-teaching tension

Chairs reported supporting senior faculty, DBER faculty, and teaching faculty as people with the potential to influence change. Within the current promotion and tenure structure in which research is typically emphasized over teaching pre-tenure, faculty may hesitate to invest time and resources in improving their teaching or using EBIPs. Chairs reported that post-tenure senior faculty may present challenges, but chairs also identified senior faculty with positive perceptions of teaching who can have a key role in building the department's teaching culture. These senior faculty have already established their research credibility and are not subject to tenure reward structures, so they may be able to take the "risk" of investing more time into teaching. Senior faculty may also hold prestige within the department and serve in leadership roles that influence decision-making. Embracing this interplay between the *people* and *symbols*, engaging senior faculty in teaching endeavors can signal to junior faculty that teaching is valued by the department (Lee et al., 2007), and these senior faculty can also mentor early-career faculty.

Tenure-line faculty with a DBER focus may still experience the tensions between research and teaching. However, they are able to conduct research and lead teaching professional development that aligns with current reward structures while contributing to improved teaching. Within departments, DBER faculty are recognized for their expertise in education and contributions to departmental change through mentoring and co-teaching (Andrews et al., 2016). They are sought out by their colleagues to share knowledge of EBIPs and education research (Andrews et al., 2016; Lane et al., 2020). Chairs can also work closely with DBER scholars to become more versed in EBIPs. Chairs knowledgeable about EBIPs may be better prepared to create and support teaching transformations. For example, they may be prepared to leverage the *structure-symbols* frames by creating structures that support and demonstrate value for knowledge sharing between DBER and other faculty, such as mentoring opportunities, co-teaching partnerships, and regular department-wide teaching discussions (Coleman et al., 2019; Lane et al., 2022).

Also outside the research-tenure tension are faculty who may have a small or no research appointment. These faculty may hold titles such as Professor of Instruction, Professor of Practice, Teaching Professor, or Instructor. These teaching-focused faculty do not experience the research-teaching tension in terms of time allocation. However, they may experience this tension in the form of an inequitable department culture (Culver et al., 2022). Teaching-focused faculty may feel like "a separate class within the department" if research is highly valued over teaching and their expertise, rights, responsibilities, and reward structures are not equally recognized (Haviland et al., 2017). Chairs can recognize teaching-focused faculty, support their status by demonstrating the value of teaching, and elevate teaching to an equal plane alongside department research. For example, one chair sought to raise teaching to equal status as each of the research concentrations within the department. Such symbolic change may require revisions of promotion and reward structures to reflect this equitable culture. Chairs should consider whether teaching-focused faculty have equal voice in department governance (Coleman et al., 2019) and opportunities for leadership and mentorship. More equitable distribution of power can symbolize the importance of teaching faculty in establishing a strong teaching culture. Chairs can also support change initiatives that align with such efforts to boost the stature of teaching-focused faculty and empower them to be change leaders.

Opportunity 2: Chairs can increase the focus on teaching during hiring decisions

Key aspects of the *people* frame are faculty attitudes and motivations toward teaching. Faculty's individual values and beliefs impact their engagement with teaching innovations (McCourt et al., 2017; Gibbons et al., 2018). Thus, transformation can be augmented by selecting individuals with high teaching motivation. Chairs play an instrumental role in the hiring process by identifying departmental lines, advising the search committee, and influencing or making the hiring decision (Lee et al., 2007). Hiring faculty with a demonstrated commitment to innovative teaching reinforces the culture around teaching as these faculty are more likely to share teaching knowledge (Lane et al., 2020). The job announcement, application materials, interview conversations, and teaching demonstrations can all be leveraged to articulate the value of teaching within the department to potential hires (Dennin et al., 2017). Conveying the department culture may attract applicants with strong teaching interests and backgrounds. Once hired, the success and impact of these faculty will be magnified in departments that also provide structures and policies that value teaching. Encountering a promotion and tenure system that does not reflect a similar recognition for teaching may provide conflicting messages and may hamper the success of faculty who dedicate time and resources to teaching.

Opportunity 3: Chairs can support and normalize participation in teaching professional development

Teaching professional development can help faculty expand their instructional expertise. For example, faculty who participate in teaching-focused professional development are more knowledgeable about EBIPs (Henderson, 2008) and are more likely to use EBIPs rather than lecturing (Yik et al., 2022a,b). Some chairs provided travel funds to support participation in professional conferences and other teaching workshops outside the department. Some well-established external programs include the Summer Institutes (Pfund et al., 2009) and the PULSE program (Stavrianeas et al., 2022) in biology, the physics and chemistry New Faculty Workshops (Henderson, 2008; Baker et al., 2014), and the Cutting Edge workshops in the geosciences (Manduca et al., 2017). These discipline-specific teaching workshop help contextualize teaching within the context of each discipline and foster a broader disciplinary culture that values instructional excellence. Faculty participating in these workshops increased their knowledge and use of student-centered approaches, shared teaching professional development with colleagues, and collected data on student learning (Henderson, 2008; Pfund et al., 2009; Stains et al., 2015; Manduca et al., 2017; Durham et al., 2020; Stavrianeas et al.,

2022). However, faculty need continued support to build self-efficacy in using these practices (Chasteen and Chattergoon, 2020). Depending on departmental resources, chairs can provide support for individuals, pairs, or teams to participate in these types of teaching professional development activities.

Chairs may also support professional development within the department or institution. Chairs in our study brought in DBER speakers to present and/or lead workshops on specific teaching innovations. Support may take the form of honoraria or coordination with other units on campus to increase participation (e.g., other STEM departments, Teaching & Learning centers, undergraduate success units) to raise the profile and increase the impact of these activities.

Another form of professional development around teaching are faculty learning communities, which are collaborative groups of faculty who through discussion, shared goals, and reflection work together in-person or online to improve student learning (Cox, 2004; Dancy et al., 2019). Participation in faculty learning communities brings faculty into contact with other faculty with shared teaching values and philosophies. They can provide avenues for sharing teaching knowledge, receiving validation, and building teaching values (Pelletreau et al., 2018; Lane et al., 2020, 2022).

In the case of workshops, seminars, and faculty learning communities, chairs may provide support through stipends that acknowledge the time that faculty dedicate to these efforts (Soto and Marzocchi, 2021). Chairs may also show recognition in other ways such as by giving faculty who participate in teaching professional development priority in classroom selection or by providing service credits (Soto and Marzocchi, 2021).

Efforts to promote a culture of teaching professional development require interaction between the *structure-symbol* and *people-power* frames. Rewards and evaluation systems, including tenure and promotion, must recognize the value of teaching professional development for faculty to invest their time in this activity without it being in tension with research. Including teaching professional development as criteria for "good" teaching allows faculty to receive credit for this activity and the time allotted to it. Including leadership roles in teaching professional development (e.g., facilitating workshops, giving seminars, leading faculty learning communities) as part of teaching or service responsibilities can also allow faculty who engage in these activities to count these as valued activities toward promotion and tenure.

Conclusion

By virtue of their departmental position and purview, department chairs hold unique insights into the policies, processes, values, motivations, and influences that shape teaching in their departments, and these factors align with the four frames for organizational change. While individual STEM disciplines have unique cultural features arising from their histories, idiosyncrasies, and communities, our research sought to identify prominent cultural elements that transcend STEM disciplines. Our research analyzed chair interviews collected previously in advance of a change initiative to gain insights into how chairs view elements of their department's teaching culture. Chairs see significant challenges in *structures-symbols* related to how research and teaching are incentivized, the metrics available for measuring instructional effectiveness, and how feedback can be provided to faculty. Chairs find opportunity to advance teaching culture through the *people-power* frames by increasing the prominence of teaching in the hiring process, supporting faculty with teaching interests, and normalizing faculty involvement in professional development. These findings do not encapsulate more recent changes in undergraduate education (e.g., disruption due to the COVID-19 pandemic), but they provide a comprehensive snapshot that illustrates the elements, complexity, and opportunities for cultural change within a STEM department. The insights and recommendations emerging from this research provide value to the broader field because they are based on the experiences of STEM department chairs and they provide a comprehensive guide to support their teaching-related decision-making. While inroads can be made through one of the frames, change initiatives will be most effective at promoting cultural change by taking steps to address all four frames.

Data availability statement

The datasets presented in this article are not readily available because of the sensitivity of the data and to protect participants. Requests to access the datasets should be directed to the corresponding authors.

Ethics statement

The studies involving humans were approved by University of Nebraska and University of Virginia. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

BC: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Writing – original draft, Writing – review & editing. LP: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. MS: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Writing – original draft, Writing – review & editing. AM: Data curation, Formal analysis, Methodology, Writing – review & editing. BW: Data curation, Formal analysis, Writing – review & editing. JH: Conceptualization, Data curation, Methodology, Writing – review & editing. AS: Conceptualization, Data curation, Methodology, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1383711/full#supplementary-material

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