Instructional Influencers: Teaching Professors as Potential Departmental Change Agents in Diversity, Equity, and Inclusion

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Abstract

At many research-intensive universities in North America there is a disproportionate loss of minoritized undergraduate students from STEM majors. Efforts to confront this diversity, equity, and inclusion (DEI) challenge, such as faculty adoption of evidenced-based instructional approaches that promote student success, have been slow. However, instructional and pedagogical change efforts at the academic department-level have been demonstrated to be effective at enacting reform. One potential strategy is to embed change agent individuals within STEM departments that can drive change efforts. This study seeks to assess whether tenure-track, teaching-focused faculty housed in STEM departments are perceived as influential on instructional and pedagogical domains of their colleagues. To do this, individuals across five STEM departments at large, research-intensive campuses identified faculty who were influential upon six domains of their instruction and pedagogy. Social network analysis of individuals housed in these departments revealed heterogeneity across the instructional domains. Some, like the teaching strategies network, are highly connected and involve the majority of the department; while others, like the DEI influence network, comprise a significantly smaller population of faculty. Importantly, we demonstrate that tenure-track, teaching-focused faculty are influential across all domains of instruction, but are disproportionately so in the sparsely populated DEI influence networks.

Introduction

Despite increasing institutional commitments to diversify recruitment and enrollment practices for undergraduate students, departmental cultures, faculty attitudes, and campus climates have not necessarily embraced these goals to promote diversity, equity, and inclusion (DEI). In Science, Technology, Engineering, and Mathematics (STEM) fields, a particularly stark divide has emerged between institutional, departmental, and instructional commitments to DEI efforts (Mayhew & Grunwald, 2006; Park & Denson, 2009; Marchiondo et al., 2021). These misalignments have contributed to continued minoritization and inequitable outcomes for large groups of undergraduate students, including Latine, Black, Indigenous, and People of Color; lesbian, gay, bisexual, or queer (LGBQ+); and transgender and gender nonconforming students (Chang et al., 2014; Estrada et al., 2016; Hughes, 2018; Riegle-Crumb et al., 2019; Maloy et al., 2022). Even after controlling for prior academic performance, minoritized students are disproportionately likely to leave STEM fields, citing chilly academic environments, lack of representation, and decreased sense of belonging in their classrooms and departments (Riegle-Crumb et al., 2019; Khan et al., 2020). To combat STEM student attrition, education research has highlighted multiple approaches that can promote academic equity in STEM undergraduate majors. Bridge programs, immersive undergraduate research programs, student mentorship and sponsorship, as well as student-centered academic and social supports have all been demonstrated to reduce disparate academic outcomes for minoritized students (as summarized in National Academies of Science, Engineering, and Medicine, 2019). Evidence-based classroom teaching strategies in STEM, including active learning (Felder and Brent, 2009), have been repeatedly demonstrated to promote student academic equity amongst a diversity of undergraduate students (Haak et al., 2011; Steinfeld & Maisel, 2012; Eddy and Hogan, 2014; Freeman et al., 2014; Ballen et al., 2017; Gavassa et al., 2019; McNair et al., 2020; Theobald et al., 2020). Despite the demonstrated impact of these approaches, STEM faculty still predominantly perform classroom instruction by traditional lecture (Stains et al., 2018).

Adoption of evidence-based instructional approaches on promoting academic equity amongst diverse students remains slow in STEM fields. Multiple studies investigating instructor decisions regarding the development and implementation of equity-centered teaching strategies and structures have highlighted that individual faculty characteristics and local departmental contexts both play central roles in shaping undergraduate instruction within specific STEM majors at different institutions (Dancy & Henderson, 2008; Sturtevant & Wheeler, 2019; McConnell et al., 2020a). The interplay between these factors are evidenced by the explanations of this pedagogical intransigence including perceptions of departmental cultures that prioritize research or time constraints on instructional revision (Michael, 2007; Walczyk et al., 2007; Ebert-May et al., 2011; Hora, 2012; Brownell and Tanner, 2012; Shadle et al., 2017). To the extent that STEM faculty do engage in explicit efforts to promote equitable outcomes, these efforts often happen at the level of individual faculty or intra- and interdepartmental collaborations between isolated equity-focused individuals, resulting in stunted discussions regarding DEI and glacial and sporadic reform efforts (Lee, 2007; Liera & Dowd, 2019).

Embedding Change Agent Faculty in STEM Departments as a Instructional Change Strategy

To promote the implementation of evidenced-based instructional approaches, varied theories have been leveraged to design and enact pedagogical change strategies (Henderson et al., 2011; Borrego and Henderson, 2014; Kezar et al., 2015; Kezar, 2018; Reinholz and Apkarian, 2018; Reinholz et al., 2021). Assessment of the impact of the varied approaches demonstrates that not all interventions produce similar outcomes: some resulted in failure, while others led to varying degrees of reform resulting in faculty adoption of evidenced-based pedagogical approaches (Henderson et al., 2011; Quardokus and Henderson, 2015). Importantly, insights from this research highlighted that many successful pedagogical change efforts focus on the departmental level. This result is perhaps not altogether surprising, given that academic departments are often siloed, share common cultural values, enable faculty interactions, and are resistant to externally, top-down imposed change (Kezar et al., 2015; Lane et al., 2019; McConnell et al., 2020a).

A potential strategy in the adoption of evidenced-based instructional approaches is the embedding of pedagogical *change agents* within STEM departments (Andrews et al., 2016; MacDonald et al., 2019; O'Connell et al., 2022). These individuals may be capable of generating departmental change because they are integrated amongst their colleagues, enabling them to influence their peers in a sustained, long-term fashion (McConnell et al., 2020). Although these change agents can potentially be any STEM faculty member interested in driving instructional reform, there has been a growing trend toward the hiring of STEM faculty who specialize in teaching and pedagogy as the focus of their professional efforts (Bush et al., 2008; Rawn and Fox, 2018; Bush et al., 2020; Harlow et al., 2022).

Perhaps the best characterized faculty specialization where scholarship overlaps with instruction and instructional change efforts is the Science Faculty with Education Specialties (SFES; Bush et al., 2008; Bush et al., 2011; Bush et al., 2013; Bush et al., 2016; Bush et al., 2019; Bush et al., 2020). Although the SFES have diverse scholarship activities, the vast majority of these faculty identify their greatest impact in reforming undergraduate STEM education, while also playing roles in discipline-based education research or K-12 education (Bush et al., 2008; Bush et al., 2011). The mechanism of change reported by most SFES was the influencing of (1) faculty colleagues' teaching practice through instructional collaborations, instructional practice, and/or cultivating faculty interest in teaching, (2) curricular change via development or revision of materials and, (3) Graduate Teaching Assistant training and support (Bush et al., 2016; Bush et al., 2019).

UC Teaching Professors as potential Departmental Change Agents

The University of California (UC) system also utilizes a unique teaching-focused faculty position, the Teaching Professor (TP; Harlow et al., 2020; Xu & Solanki 2020) While teaching-focused, TPs are expected to engage in teaching, scholarly activities, and service (University of

California Office of the President, 2018; Molinaro et al., 2020). For scholarship, many TPs engage in DBER, evidence-based curriculum development, outreach, education-focused professional development, and/or student mentorship (Harlow et al., 2020). In contrast to non-tenure-track lecturers hired on a fixed-term contract (American Association of University Professors, 2014, 2018; Carvalho & Diogo, 2018), the TP position has the security of tenure and individuals in this position are voting members of the Academic Senate.

Similar to the SFES positions, UC STEM TPs are embedded within STEM departments and thus are situated to influence undergraduate STEM education in their local context. Research into the characteristics of the TP faculty demonstrates their impacts as instructional leaders and innovators: These faculty are more likely to implement evidence-based approaches in the classroom, have more advanced conceptions of teaching and learning, are expected to be educational leaders, and are viewed as instructional experts by their colleagues and administrators (Harlow et al., 2022; Denaro et al., 2022; Rozenkhova et al., 2023; Grunspan et al., forthcoming). Collectively, these results suggest that teaching-focused faculty may have the potential to act as change agents who might be capable of influencing their departmental colleagues' approaches to instruction and pedagogy.

Theoretical Framework: Departments as Communities of Practice

The Community of Practice theory has been often used to conceptualize change efforts (CoP; Lave and Wenger, 1991). Originally, CoP was conceived as a social learning theory situating learning as a process that occurs between individuals in a larger social structure (Lave and Wenger 1991; Wenger, 1998). A CoP is defined by (1) a shared domain of interest, (2) a community of joint engagement, and (3) a shared repertoire of practices (Wenger, 1998). These factors constitute a social network through which ideas and expertise are collectively developed and shared (Wenger, 2004).

Since the original theoretical proposal of the social learning CoP framework, it has expanded to a more applied framework and been adopted by diverse groups from business and management to academic and journalistic organizations (Lesser and Storck, 2001, Weiss and Domingo, 2010, Meltzer and Martik, 2017). Studies across these groups show that CoPs aid in knowledge transmission and professional development within organizations (Wenger et al., 2002; Omidvar and Kislov, 2013). Within academia, this applied view of CoPs has been adopted to differing extents to help conceptualize and/or drive pedagogical change (Reinholz et al., 2021). The CoP theory has been used to characterize temporary faculty learning communities that organize individual participants and galvanize change efforts around a shared goal of pedagogical change (Tomkin et al., 2019; Kandakatla & Palla, 2020). Other grant or initiative motivated change efforts have also leveraged CoP theory to characterize varying levels of success of pedagogical change over time (Ma et al., 2019; Quardokus Fisher et al., 2019). Thus, we posit that the CoP theory might be applied to academic STEM departments (community of joint engagement) as they are composed of faculty who have shared disciplinary expertise (domain of interest) who interact and are organized to accomplish the educational mission (shared practices) of the university.

Given that STEM departments could potentially be an organizing locus for pedagogical change efforts, can one conceptualize how pedagogical change agents might affect their colleagues' instructional approaches? Academic departments are frequently considered a critical unit for pedagogical change because they maintain agency over curricular decisions, have their own culture, and include a community of members who discuss their instructional views in both formal and informal venues (Edwards and Hensien, 1999; Gibbs et al., 2008; Wieman et al., 2010; Quardokus and Henderson, 2015, Reinholz and Apkarian, 2018; Johnson et al., 2021). Faculty who comprise departmental communities shape and influence the learning processes, beliefs, and values of those who interact with them, as well as with new members who enter this community (Borrego and Henderson, 2014). However, this only occurs to the extent that faculty have meaningful interactions about a shared practice, leading to a collective understanding and repertoire of resources centered on that practice (Wenger et al., 2002).

In the STEM departmental context, meaningful interactions between faculty colleagues can center on any number of relevant skills or practices, including various pedagogical practices. Further, an individual department may form a strong CoP in one domain while engaging minimally in other domains; for example, faculty may foster a collective understanding of departmental policies surrounding research through frequent interactions, but lack the same level of engagement when it comes to strategies that promote equitable undergraduate academic outcomes.

Faculty Social Networks

Given how interactions within CoPs can impact the individuals within, a growing number of studies have examined the relationships of faculty housed in university STEM departments. These studies apply social network analysis (SNA), a methodological approach, to address how relational patterns between individuals influence their colleagues across multiple domains, including faculty pedagogy (Wasserman and Fause, 1994; Marin and Wellman, 2011; Quardokus and Henderson, 2015; Henderson et al., 2018). Specifically, several studies describe how information about instruction may disseminate within a university through faculty interaction networks (Quardokus and Henderson, 2015; Henderson et al., 2018; Lane et al., 2019; Quardokus-Fisher et al., 2019), explore whether faculty who teach similarly tend to associate with one another (Lane et al., 2019), and whether any individual faculty are particularly important in these networks (Andrews et al., 2016, Grunspan et al. under review).

Limited research into the importance of individual faculty within university social networks has highlighted that faculty with pedagogical expertise, such as discipline-based education researchers (Andrews et al. 2016) and teaching professors (Grunspan et al., under review) are exceptionally influential on their colleagues' pedagogy. This suggests that embedding faculty in these types of positions into STEM departments may help build intradepartmental CoPs surrounding undergraduate instruction and ultimately drive pedagogical change (Andrews et al., 2016; Bush et al. 2016; Rawn and Fox, 2018).

This Study

While faculty with pedagogical expertise may influence their peers' instructional practice, a more descriptive account of the specific instructional domains they influence is lacking. To assess this, we investigated the structure of social interaction networks across STEM departments to determine (1) are TP influential in these discussions and (2) which domains of instruction and pedagogy do PoTs influence?

Specifically, we sought to answer the following questions:

1. To what extent do faculty in different STEM departmental communities discuss teaching and influence each other's instruction and pedagogy across five different pedagogical domains?
2. In STEM departmental networks, how do interaction networks vary across domains of pedagogy and instruction?
3. Are UC teaching professors more influential in the instructional and pedagogical networks relative to non-TP faculty?

Materials and Methods

Study setting and data collection

To answer these questions, we collected faculty social network data across five STEM departments at three public, minority-serving, research-intensive institutions (instrument is included in Supplemental Materials). This survey instrument asked faculty to identify colleagues within their departments who they have discussed instruction with over the past year. Upon selection of colleagues, the survey respondent then is piped to identify whether the identified individuals are influential in terms of various domains of instruction and pedagogy (see Supplemental Materials for survey instrument). These domains included teaching philosophy, instructional strategies, course logistics, materials, concerns, and topics on diversity, equity, and inclusion (DEI). Social network analysis enables us to build and characterize pedagogy and instruction networks that identify faculty within STEM departments who are influential; Further, this approach has the resolution to identify structural differences between the six influence networks as well as across departments.

Survey instruments were distributed in 2020 via Qualtrics and respondents were directed to answer solely focusing on pre-COVID-19 pandemic context to capture the in-person instructional experience. For each department, survey responses were collected over a four week period with each department obtaining greater than 70% response rates. Response rates and the number of teaching professors in each department (D) at each of the three universities (U) can be found in Table 1.

Department	Respondents	Total	% Response	# Teaching Professors
U1D1	29	32	90.6	3
U2D1	17	21	81.0	0
U2D2	25	30	83.3	3
U2D3	26	29	89.7	1
U3D1	29	41	70.7	1
Total	126	153	82.4	8

Social network analysis

We examined differences in departmental influence networks by domain across several Graph-level indices. For each department and influence network, we examined 1) *Mean indegree:* the total number of influence ties divided by the number of individuals in the department. This captures the average level of engagement in each department surrounding each domain; 2) *Percent Isolates:* the percent of faculty within a department who are neither influential or, nor influenced by, any colleagues. This captures disengagement among faculty in each department surrounding each domain, and 3) *Edgewise Reciprocity:* The percent of dyads (pair of individuals *i* and *j*) where there is a tie from *j -> i*, given that there is a tie from *i -> j*. This captures the tendency of collegial conversations to be mutually constructive as opposed to more unidirectional in the flow of influence.

For each instructional domain, we calculated the conditional probability that an influence tie exists between two individuals given the number of other domains where at least one person in a dyad was identified as influential over the other. Thus we examined five conditional probabilities for each domain: one where no influence ties exist in any of the five other domains, and then conditional probabilities for when an influence tie exists in one, two, three, four, or all five other teaching domains. Conditional probabilities were calculated independently for each department before aggregating results as means and standard deviations.

The statnet suite of packages in R, including ‘sna’ and ‘network’ were used to perform social network analyses, including the creation of sociographs (Handcock et al., 2008; R Studio Team, 2024).

Mixed-effect models

Generalized linear mixed-effects models were used to test whether teaching professor and non-teaching professor faculty differed in the number of colleagues they influenced in each instruction and pedagogy network, and whether these potential differences were greater in the DEI network. The dependent variable in these models was total indegree. We used a mixed-effects model because of the nested nature of the data; each individual has an in-degree for each of the six domains and is also nested within a department. Thus, we included random effects for participant ID and department. Because indegree measures are count data that follow a Poisson distribution, we used a log link function.

Four different models were specified. The most complex model included the following fixed effects as predictors: a binary variable indicating whether a faculty was a teaching professor or not, a categorical variable indicating which of the six domains the indegree comes from (Network), and an interaction term between teaching professor and network. The three other models were nested versions of this model. One model included teaching professor and network as predictors without the interaction term, while the other two included just teaching professor or just network as predictors. Akaike Information Criteria (AIC) were used to determine the best fit model, with a difference of 2 used as a cut-off to determine best model fit (Posada and Buckely, 2004). Models were fit using the lme4 package in R (Bates et al., 2014).

Results

Variation in pedagogical and instructional influence networks

All five departments have densely connected influence networks regarding instruction in general, with densities ranging from 0.22 to 0.66 (Figure 1, left column *Talk* heading, Supplemental Table 1). With the exception of University 2 - STEM Department 2 (U2D2) which had two faculty who were not indicated in any discussions with their colleagues about teaching, all departmental discussion networks were made up of one component, where all nodes share a path to each other. Influence networks on specific domains of pedagogy and instruction were necessarily less dense than the general instruction networks as a result of data collection methods (Supplemental Table, Figure 1). An examination of these networks indicates that teaching professors tend to be fairly central within their departments, with the one teaching professor in U3D1 the exception.

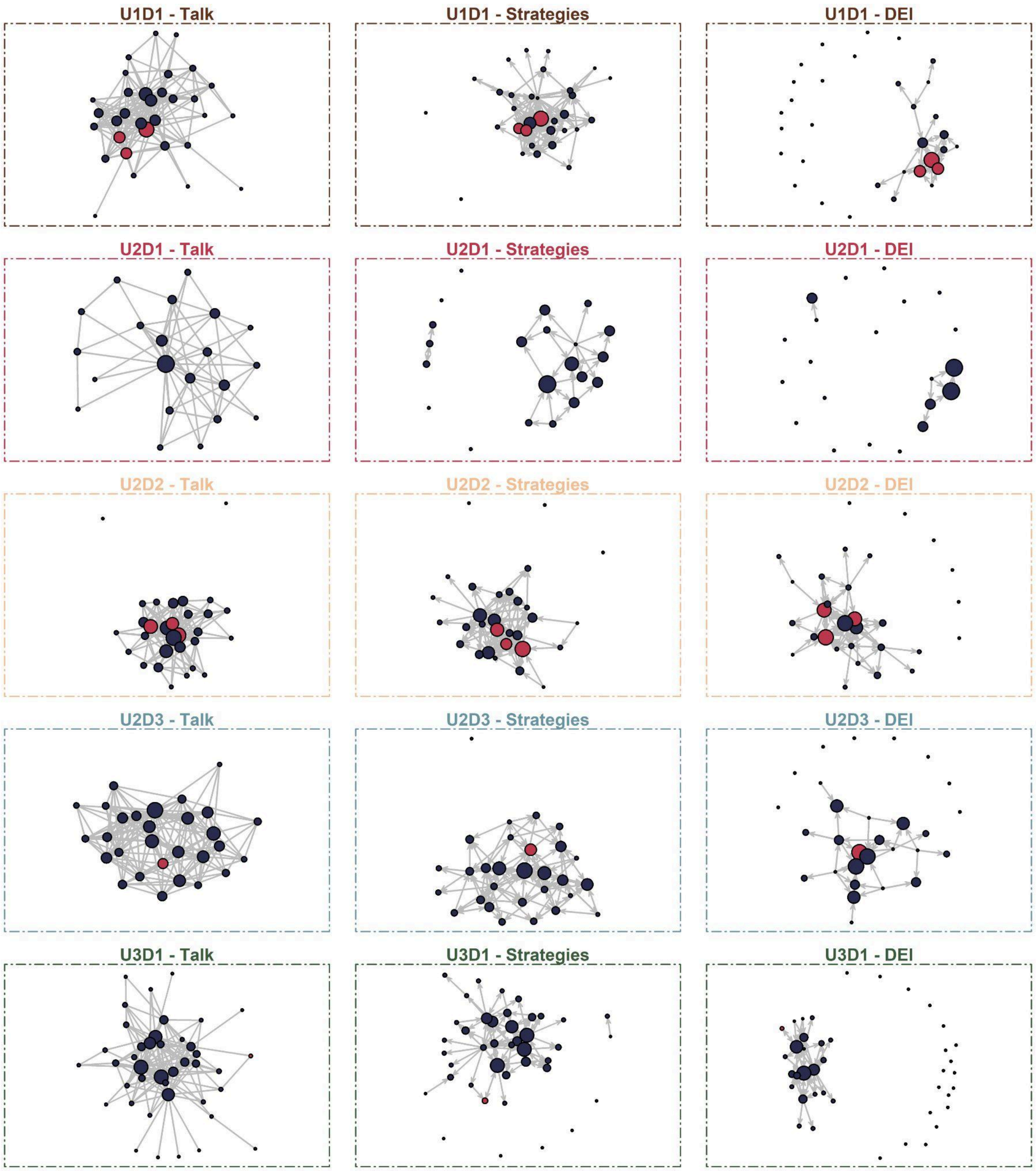

Figure 1

Sociographs of general instruction, strategies, and DEI influence networks for each of the five STEM departments. Nodes (circles) represent individual faculty members where larger node sizes correspond to more edges (grey lines indicative of an individual being nominated as influential) directed to the individual (more influential). Color of the node denotes research track faculty (blue) or teaching professor (red).

Compared to other domains, the DEI influence networks tended to be the sparsest, with faculty influencing fewer departmental colleagues on average compared to other pedagogical topics (Figure 1, Figure 2A, Supplemental Table). This result is partially driven by the large number of isolated individuals across the DEI networks (Figure 2B), who neither influenced DEI-related teaching matters of any colleagues nor indicated being influenced by any colleagues regarding this domain.

The level of reciprocity within departmental DEI influence networks showed more variance. In two departments, U2D1 and U2D3, the DEI influence network was completely asymmetrical. In every case where there was a tie from faculty member 1 to faculty member 2, there was never a reciprocal tie from faculty member 2 to faculty member 1. Of note, these departments exhibited higher levels of reciprocity in all of the other five domains of pedagogy and instruction and also include either zero or one teaching professor. Conversely, for the remaining three STEM departments, reciprocity in the DEI influence network appeared comparable to that of the other domains of pedagogy and instruction.

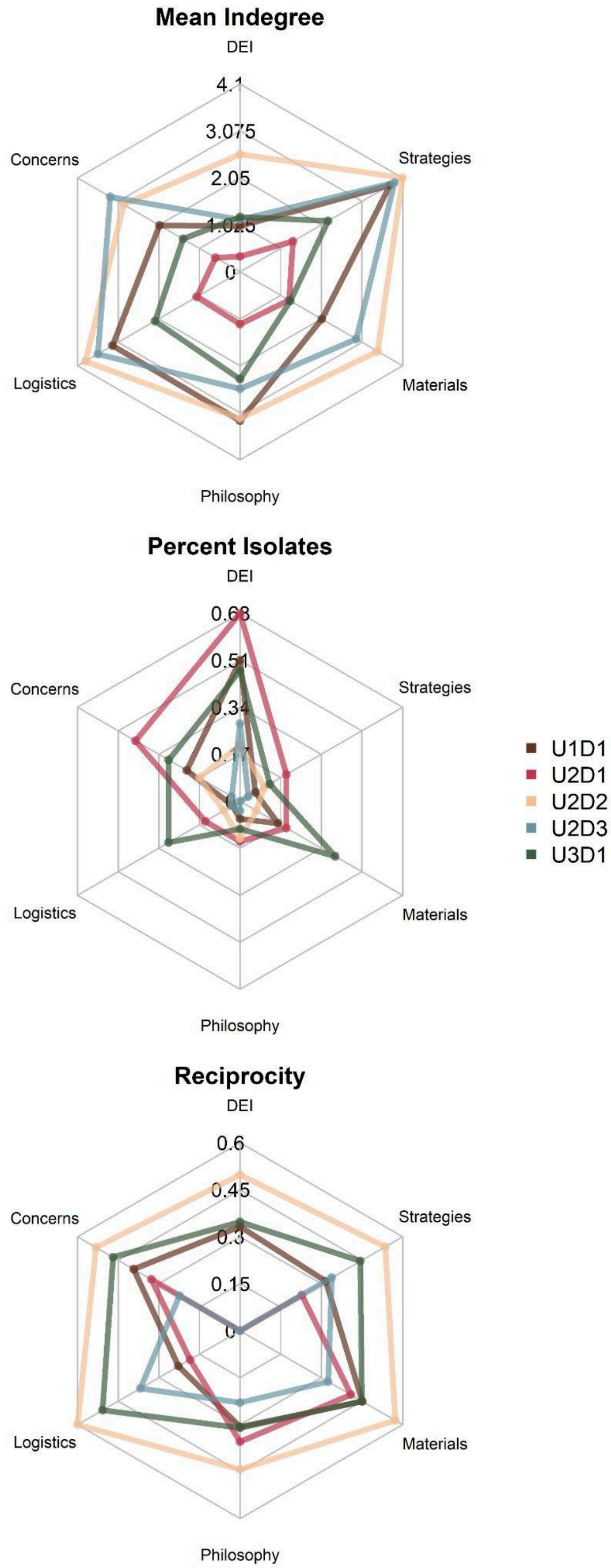
Mean Indegree
DEI
4.1
3.075
2.05
1.025
0
Strategies
Materials
Philosophy
Logistics
Concerns
Percent Isolates
DEI
0.68
0.51
0.34
Strategies
Materials
Philosophy
Logistics
Concerns
U1D1
U2D1
U2D2
U2D3
U3D1
Reciprocity
DEI
0.6
0.45
0.3
0.15
0
Strategies
Materials
Philosophy
Logistics
Concerns

Figure 2

Graph-level indices for each of the six domains of instruction and pedagogy across five STEM departments. Each department is represented by different lines across each radar plot.

Instructional and pedagogical influence on topics of diversity, equity, and inclusion requires multiple interaction ties between faculty

Given the sparse nature of connections between faculty in the DEI influence network relative to the other domains investigated, we further examined this relationship within the context of the other domains of instruction and pedagogy networks. Utilizing the multiplex nature of the social network data, we examined the conditional probability of a DEI influence tie from one faculty to another given that those faculty had no, one, two, three, four, or five other influence ties across the five other influence networks. We calculated similar conditional probabilities for the five other influence networks and averaged over the five departments (Figure 3).

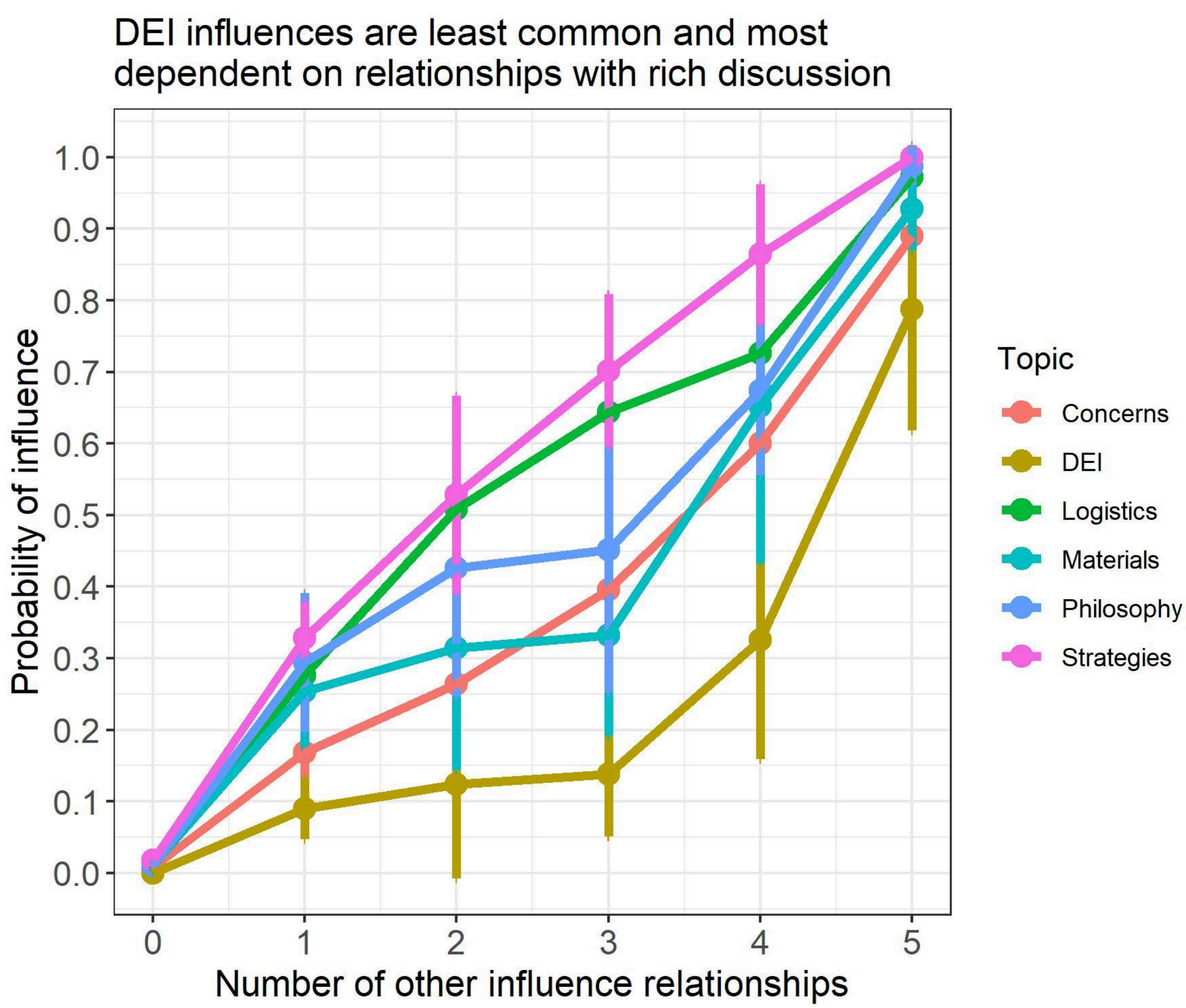

Figure 3

The conditional probabilities of faculty influencing one another across six domains of instruction and pedagogy. The probability of influencing a colleague in DEI remains low unless the individual already shares multiple influence ties with a given colleague.

When considering the probability that a faculty member influences a colleague in any one of the six domains, if no influence relationship exists between those faculty in any of the other five topics, then there was no chance that there was an influence tie in the sixth (Figure 3); alternately, whenever a faculty member was indicated as being influential on a colleague, it was always in two or more topics.

Comparing across domains of instruction and pedagogy, DEI influence ties had a higher threshold of dependence on overall tie strength as measured by the number of influence relationships between any two faculty. For example, given that two faculty exchange influence on four domains other than DEI, they have a probability just over 0.3 of also exhibiting a DEI influence tie. For any other topic, this probability would range from 0.6 to 0.85. It isn't until a faculty dyad has influence ties in the five other domains of instruction and pedagogy that it becomes likely that a DEI influence between any two faculty would exist.

UC teaching professors are influential across instruction and pedagogy in STEM departments

Use of mixed-effects models enabled us to test whether TPs were considered influential by a greater number of colleagues than non-teaching professor faculty, and whether this difference was disproportionate in any of the six domains of instruction and pedagogy. The full model that included teaching professor, network, and an interaction between these terms was the best fitting model (Table 2). Compared to non-teaching professor faculty, the log odds of a teaching professor being listed as influential on a colleague in the DEI network is significantly greater ($B = 1.81$, $p<0.001$). Controlling for whether or not a faculty is a teaching professor, the log odds of influencing a colleague on their DEI practices is significantly lower than influencing them in any other of the five domains; however, this difference between how many departmental colleagues an individual influences in the DEI network relative to the other domains not equivalent between teaching professor and non-teaching professor faculty. Instead, a greater disparity between DEI and the other domains exists for non-teaching professor faculty compared to teaching professors. This indicates that the greater influence of teaching professors in their departments is disproportionately large when it comes to discussing DEI. This is indicated by the log odds coefficients <1.0, with the strongest evidence coming from the Logistics and Materials influence networks which have significantly lower interactions with teaching professor status, relative to the interaction between teaching professor status and nomination as influential in the DEI influence network.

Link to Table 2

Table 2. Mixed-effects regression analysis of influence across faculty type and instructional and pedagogical domains. Values (B) presented are the log-odds.

	Dependent variable: In-degree				
Independent Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
(Intercept)	1.38	0.97	0.87	0.82	1.43 ***
Teaching professor					
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	4.35 ***		4.35 ***	6.12 ***	4.45 ***
Influence Network					
DEI		*Reference*	*Reference*	*Reference*	*Reference*
Concerns		1.45 ***	1.45 ***	1.54 ***	1.54 ***
Logistics		1.89 ***	1.89 ***	2.08 ***	2.08 ***
Materials		1.46 ***	1.46 ***	1.60 ***	1.60 ***
Philosophy		1.67 ***	1.67 ***	1.75 ***	1.75 ***
Strategies		2.02 ***	2.02 ***	2.14 ***	2.14 ***
Teaching Professor + Influence Network (interaction term)					
DEI				*Reference*	*Reference*
Concerns				0.72	0.72
Logistics				0.58 **	0.58 **
Materials				0.58 **	0.58 **
Philosophy				0.80	0.80
Strategies				0.72	0.72
Random Effects					

σ^2	0.50	0.50	0.50	0.50	
τ_{00}	0.81 $_{ID}$	0.98 $_{ID}$	0.81 $_{ID}$	0.81 $_{ID}$	
	0.32 Department	0.27 Department	0.32 Department	0.32 Department	
ICC	0.69	0.71	0.69	0.69	
N	192 $_{ID}$	192 $_{ID}$	192 $_{ID}$	192 $_{ID}$	
	15 $_{Department}$	15 $_{Department}$	15 $_{Department}$	15 $_{Department}$	
Observations	1152	1152	1152	1152	1152
Marginal R^2 / Conditional R^2	0.067 / 0.712	0.029 / 0.721	0.094 / 0.720	0.100 / 0.722	0.419
AIC	4002.099	3888.731	3867.365	3864.411	5442.787
AICc	4002.134	3888.857	3867.522	3864.780	5443.061

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

Note: The best fitting model included teaching professor status, instruction and pedagogical domains, and an interaction between these two variables.

Discussion

This study contributes further evidence that embedding teaching-focused faculty within STEM departmental contexts may be an effective strategy for instructional and pedagogical reform. Specifically, this work contributes to a growing body of research by 1) demonstrating variation of influence networks across STEM departments as well as instructional and pedagogical domains; 2) providing evidence that DEI influence networks critically lag behind other domains of instruction and pedagogy; and 3) highlighting that UC teaching professors are perceived as influential individuals across all domains of instruction and pedagogy, but disproportionately so in areas involving DEI.

Variation in pedagogical and instructional influence networks: a dearth in diversity, equity, and inclusion

Within academic departments, faculty may form CoPs in research, service, and instruction. This study focuses on the instruction CoP and demonstrates that faculty in STEM departments are forming robust networks of influence related to teaching strategies or logistics, but discussions are more limited in the DEI domain of undergraduate education (Figure 1). This result corroborates prior research that across several instructional domains faculty could discuss, issues related to DEI are among the least likely to be discussed (Quardokus-Fisher and Henderson, 2018). In our social network analysis, the limited discussion surrounding DEI issues was largely driven by a greater number of faculty who did not engage with any colleagues regarding this topic, appearing to be isolates (Figure 2). The lack of influence on the DEI domain across most of the study departments may suggest little co-construction of DEI knowledge within the analyzed STEM departments.

But what might underlie this observation? Evidence suggests that the meritocratic and colorblind ideologies embedded within the current culture of STEM academic fields may be, at least in part, the answer (Carter et al., 2019). Indeed, research into the genesis and persistence of these ideologies reveals heterogeneity amongst individuals in how they perceive the meritocratic judgements of eligibility and academic performance as levers for success and navigation through STEM spaces (Slaton, 2015; Seron et al., 2018; Carter et al., 2019; Grindstaff and Mascarenhas, 2019; Bird and Rhoton, 2021); in the context of instruction in academia, many STEM faculty hold color-blind and color-evasive ideologies that purport an attempted STEM neutrality and objectivity without directly confronting the underlying reasons for equity disparities in the undergraduate classroom context (Russo-Tait, 2022; Suarez et al., 2022; Imad et al., 2023; King et al., 2023). Thus, if certain faculty believe that STEM disciplines are meritocratic and colorblind, it is perhaps unsurprising that the instructional domain related to DEI is not the most interconnected networks of influence across the study departments (Figure 2). This is a critical challenge as evidence highlights that faculty conceive of equity (or relatedly meritocracy and colorblindness) in the context of instructional and pedagogical approaches ultimately influences STEM undergraduate student educational experiences (Aragón et al., 2017; Suarez et al., 2022; Russo-Tait, 2023).

Instructional and pedagogical influence on topics of diversity, equity, and inclusion requires multiple interaction ties between faculty

In a large national survey, most faculty respondents across disciplines indicated that DEI is clearly articulated as a high priority value at the institutional level, but did not indicate that the same was true within their department (Maruyama & Moreno, 2000; Mayhew and Grunwald, 2006; Lattuca and Stark, 2009). Further, although individual faculty largely agreed that a diverse and equitable campus climate provides a host of benefits for students, faculty, and the campus community, less than a third indicated that they had adjusted their course syllabus or made changes to course structures or teaching practices to reflect changing student populations or promote equity among students (Maruyama et al., 2000). This reflects a disconnect between stated institutional goals and individual faculty instructional priorities. These insights might inform interpretation of our results wherein discussing instructional topics related to DEI requires a deeper relationship with considerable trust, which may be unnecessary for discussion of the other domains of instruction and pedagogy (Figure 3). This conjecture is bolstered by evidence that shows that some faculty are unsure of, or even anxious about, how to discuss and/or implement instructional practices in the DEI domain (Wing et al., 2009; Aster et al., 2021; Erby et al., 2021; Thomas et al., 2022; White et al., 2022; White et al., 2023; Williams et al., 2023).

Given that the conditional probability of faculty influence on the DEI domain improves with increased extant faculty-faculty ties, this result suggests a potential path to addressing this challenge: promoting socialization across domains of instruction and pedagogy within academic departments may eventually contribute to positively influencing faculty beliefs about the relative importance of advancing equitable student outcomes (Biglan, 1973; Braxton, 1995; Bernal & Villalpando, 2002). Indeed, this approach of providing opportunities to engage faculty in discussions or professional development centered on topics of DEI in instruction is a strategy that has been previously demonstrated to promote faculty change (Harrison-Bernard et al., 2020; Erby et al., 2021; Macdonald et al., 2019; Kennedy et al., 2021; Williams et al., 2023).

UC teaching professors are influential across instruction and pedagogy in STEM departments

This work contributes to the growing literature on the potential instructional and pedagogical impacts of the teaching professor faculty line at the University of California. Our results reinforce a parallel body of literature that focuses on characterizing the science faculty with education specialities (SFES) at the California State Universities. Like SFES, teaching professors are a growing and evolving population of education-focused faculty who are embedded in STEM departments on their respective campuses (Bush et al., 2008; Bush et al., 2019; Harlow et al., 2020). Prior research demonstrates that SFES perceive their greatest impact in reforming undergraduate education (Bush et al 2016; Bush et al., 2019). This aligns closely with our results where teaching professors are disproportionately nominated as influential in discussions on instruction and pedagogy (Table 2), and like SFES have been described as leaders in these professional domains by administrators and colleagues (Bush et al., 2019; Bush et al., 2020; Harlow et al., 2020; Harlow et al., 2022). The perceptions of teaching professors as instructional and pedagogical experts may be warranted given that recent evidence points to these faculty as more likely to hold complete conceptions of teaching and learning that emphasized student ownership of learning and are more likely to use evidence-based instructional practices (Denaro et al., 2022; Rozhenkova et al., 2023). Thus, like SFES, UC teaching professors are positioned within departments to be potential change agents who may be influencing their colleagues on instruction and pedagogy.

Embedded in STEM departments, teaching professors may be leveraging social networks within the instructional CoP to promote this instructional and pedagogical change (Wasserman and Faust 1994; Burt, 2000; Kezar, 2014; Andrews et al. 2016; Henderson et al., 2018; Lane et al., 2019; McConnell et al. 2019; Skvoretz et al., 2023). This would account for the significant nomination of teaching professors as individuals sought out for discussions on teaching and pedagogy (Table 2). Prior work demonstrates that peer interactions facilitate the exchange of information, ideas, and awareness of instructional practices, and provide sustained interactions required to promote change (Andrews and Lemons, 2015; Lund and Stains 2015; Quardokus and Henderson 2015; Dancy et al. 2016; McConnell et al., 2020a). Although evidence suggests that faculty may influence colleague’s instructional decision-making process by (1) sharing information about instruction and pedagogy, (2) reinforcing or changing peer attitudes, and (3) shaping and communicating instructional climate (McConnell et al., 2020b), our results do not distinguish amongst these three approaches.

Limitations & Future Research

Our results should be interpreted cautiously given the limitations of our study design. Although our overall response rate was 82.4%, with a greater than 70% response rate across all five departments, it is possible that these social networks are context-specific since they represent only five across the dozens of STEM departments housed at these three campuses. Additionally, the represented institutions are large enrollment, public, research-intensive universities. Although we found that teaching professors are loci of pedagogical influence in their departments (Table 2), this doesn't preclude research-oriented faculty who are deeply engaged in DEI conversations from being equally influential and enacting change within their communities of practice. This limitation is reflected in our data: one department had no teaching professors while the others varied between one and three of these teaching-focused faculty (Figure 1).

Communities of Practice can be conceptualized to evolve over time and include stages (Wenger et al., 2002) that can ultimately result in transformation of the individuals within this social learning structure. Our results highlight existing instructional and pedagogical influence networks between individual faculty; however, whether these networks represent a robust STEM department instructional CoP is uncertain. Further, if these analyses do indeed characterize instructional and pedagogical CoPs across the departments, at what stage are each department? And to what extent are TPs driving change? To this point, the influence that TPs have within the various pedagogical networks, especially on topics of DEI, does not necessarily suggest a causal connection between embedding teaching faculty in departments and shifts in faculty values or practices. Further, whether reported influence of TPs promotes faculty change *over time* still remains to be characterized. Last, how faculty conceptualize influence, and the limits to which influence might be able to generate instructional and pedagogical change needs to be defined. These questions are important to address as prior social network analyses of STEM departments illustrate that nomination as a leader does not always correlate with the number of ties to other faculty, nor is simply the presence of faculty leaders in instruction and pedagogy a sufficient driver of instructional change (Knaub et al., 2018; Reding et al., 2022).

Recommendations

Prior studies have found that meaningful discussions about the DEI domain in undergraduate education require faculty to not only share values surrounding DEI efforts, but also to have the professional trust of their colleagues (Martinez-Acosta and Favero, 2018). Communities of practice that form between members of an academic department necessarily involve both shared values and professional trust. Our results indicate that teaching professors embedded within STEM departments may provide a promising avenue to promote change by utilizing existing departmental structures to build robust new communities of practice surrounding DEI efforts in undergraduate education. Given the need to accelerate change to better promote equity in undergraduate STEM education, we recommend centering tenure-track teaching focused faculty members in departmental structures to influence discussions and form robust communities of practice surrounding pedagogy and DEI efforts in undergraduate education. Considering the influence they can have on colleagues' instructional approaches, these faculty could foster discussions in these departmental structures about DEI issues in the classroom to better serve the next generation of scientists.

However, in order to achieve this goal, it is important to recognize that many University of California teaching professors are trained in disciplinary PhD programs and likely do not have scholarly training in DEI (Harlow et al., 2020). Previous research suggests that promoting change on topics of DEI relies on embedding and training leaders on these topics through targeted professional development opportunities (Jemal and Frasier., 2021). Given the influence networks of the analyzed STEM departments, tenure-track teaching focused faculty are already situated as central hubs and are viewed as influential on their peers' instructional approaches. Thus, we recommend targeting professional development opportunities to these potential change agents to allow these uniquely positioned individuals to exert even greater influence on their colleagues.

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In case:
Pedagogy

Faculty pedagogy and their approach to instruction of undergraduate STEM students is influenced by their conceptions of educational theory and the principles of teaching, as well as their values and experiences in the practice of teaching. Faculty pedagogical values shape their use of instructional practice. pedagogy.

Philosophy - influenced your teaching philosophy and how you understand teaching in general
Strategies - helped you implement a specific teaching strategy, e.g. iClickers, classroom discussions, etc.
Logistics - discussed teaching assignment logistics, e.g. time, location, exam times, grading, TA assignments, etc.
Materials - shared instructional materials with you, e.g. slides, syllabi, previous exams, etc.
Concerns - helped you address student concerns or issues
DEI - discussed issues of diversity, equity, and inclusion in undergraduate classrooms

For discussion:

Bush paragraphs:
Bush 2008
Summary: overview of survey sent out to the CSU. Started to characterize SFES, with about half being hired into that role and the other half transitioning into it (n= 31 and 28 respectively). Evidence that hiring rate has been increasing where more than half have been hired since 2000 vs all time before. SFES typically have more formal training in ed than nonSFES (this likely relates to PoTs). Transitioned SFES still do basic research while hired SFES more likely to do education research.

Bush 2013
Summary: in introduction they cite their older papers as a mechanism to advance three domains of educational change: k-12 education, DBER, and undergraduate science education reform - Bush 2008 and 2011. Three key findings: 1) SFES is a growing role with more SFES hired in last 10 years than all years prior, 2) tremendous variation in terms of their training and roles fulfilled as SFES, and 3) regardless of training, SFES were similarly likely to receive research funds to advance educational scholarship

Bush 2016
Summary: most SFES (82%) report that they have most impact in reforming undergraduate education relative to science ed research or k-12 research. Most common report on how they are doing this is by influencing their colleagues. Quote: natural science faculty who incorporate innovations may successfully disseminate either improvements through dynamic interactions with their colleagues

Method: interview study among a randomized, stratified sample of US SFES across STEM and institutions. Data reported is only from SFES that relate to professional impacts on undergraduate science education (50 folks).

Results: 62% reported *influencing faculty teaching practice (62%) with mechanisms were often instructional collaborations with other faculty, extended implementation of a particular instructional practice, and/or cultivating faculty interest and conversation in teaching more generally.*
1 .their perceived influence on faculty teaching practices occurred through instructional collaborations that ranged from informal coplanning to more formal co-teaching.

Second area of change was changing curriculum with 40% (20/50). Instead of influencing people above (who), this focused on curricular change on development or revision of materials "what" was been taught.

Third area was supporting Teaching Assistants (26%, 13/50)

Wieman, Deslauriers, and Gilley 2013
Summary: The direct support of the faculty member by a trained science education specialist in the discipline during the initial implementation of the new strategies is a particularly notable factor.

Reinholz DL, Ngai C, Quan G, Pilgrim ME, Corbo JC, Finkelstein N. Fostering sustainable improvements in science education: An analysis through four frames. *Science Education*. 2019; 103: 1125–1150. https://doi.org/10.1002/sce.21526 his money was used primarily to hire science teaching fellows (STFs), postdocs with PhDs in a STEM (science, technology, engineering, and math) discipline who received training in education research and development from SEI Central. STFs served as educational experts, directly embedded in the departments, who could help faculty in their course transformation efforts; thus, departments had some agency in determining how they wished to use their STFs. Nevertheless, the main job of an STF was to help faculty to design learning goals and assessments for their courses and to implement active learning techniques in their classrooms. Each department also identified a “departmental director,” a faculty member who could serve as a liaison with SEI Central and as the immediate supervisor of an advocate for the STFs. None of the authors of this paper were directly involved with the SEI.

Skvoretz, J., Kappelman, K., Marcy, A., McAlpin, J. D., Lewis, J. E., Ziker, J. P., ... & Stains, M. (2023). Social Networks and Instructional Reform in STEM: The Teaching-Research Nexus. *Innovative Higher Education*, 1-22.
Instructional reform in STEM aims for the widespread adoption of evidence based instructional practices (EBIPS), practices that implement active learning. Research recognizes that faculty social networks regarding discussion or advice about teaching may matter to such efforts. But teaching is not the only priority for university faculty – meeting research expectations is at least as important and, often, more consequential for tenure and promotion decisions. We see value in understanding how research networks, based on discussion and advice about research matters, relate to teaching networks to see if and how such networks could advance instructional reform efforts. Our research examines data from three departments (biology, chemistry, and geosciences) at three universities that had recently received funding to enhance adoption of EBIPs in STEM fields. We evaluate exponential random graph models of the teaching network and find that (a) the existence of a research tie from one faculty member to another enhances the prospects of a teaching tie from to , but (b) even though faculty highly placed in the teaching network are more likely to be extensive EBIP users, faculty highly placed in the research network are not, dimming prospects for leveraging research networks to advance STEM instructional reforms.

Lane, A. K., Skvoretz, J., Ziker, J. P., Couch, B. A., Earl, B., Lewis, J. E., ... & Stains, M. (2019). Investigating how faculty social networks and peer influence relate to knowledge and use of evidence-based teaching practices. *International Journal of STEM Education*, *6*(1), 1-14.
We report that tie strength and tie diversity vary between departments, but that mean indegree is not correlated with organizational rank or tenure status. We also describe that teaching discussion ties can often be characterized as strong ties based on two measures of tie strength. Further, we compare peer influence models and find consistent evidence that peer influence in these departments follows a network disturbances model. Our findings with respect to tie strength and tie diversity indicate that the social network structures in these departments vary in how conducive they might be to change. The correlation in teaching practice between discussion partner and peer influence models suggest that change agents should consider local social network characteristics when developing change strategies. In particular, change agents can expect that faculty may serve as opinion leaders regardless of their academic rank and that faculty can increase their use of EBIPs even if those they speak to about teaching use EBIPs comparatively less.

Molinaro, M., Finkelstein, N., Hogan, K., Mendoza, N., & Sathy, V. (2020). Scholarly teaching for all, research for some: On the roles of research and scholarship of education in the disciplines. *Change: The Magazine of Higher Learning*, *52*(5), 17-24.

Bush, S. D., Stevens, M. T., Tanner, K. D., & Williams, K. S. (2019). Evolving roles of scientists as change agents in science education over a decade: SFES roles beyond discipline-based education research. *Science advances*, *5*(6), eaav6403.
Demonstrated growin impact of SFES over 10 years - increased hiring in this position. Dean's perspective familiar with sfes phenomenon, hired SFES recently, and overwhelming positive about SFES. Then surveyed SFES and asked if they have success fostering change in science teaching in department and vast majority said yes/strongly agreed.

Bush, S. D., Stevens, M. T., Tanner, K. D., & Williams, K. S. (2020). Disciplinary bias, money matters, and persistence: Deans' perspectives on science faculty with education specialties (SFES). *CBE—Life Sciences Education*, *19*(3), ar34.
The phenomenon of embedding Science Faculty with Education Specialties (SFES) in science departments is well documented. However, the perspectives of academic leaders have not been systematically studied. To investigate these perspectives, we conducted an interview study of college of science deans in the California State University system, which offers a defined higher education context in which to sample across a range of institution types and cultures. While deans were aware of and positive about SFES as potential change agents, most deans also evidenced casual bias against science education efforts and experts. Deans mentioned that education reform efforts by SFES were primarily driven by external policy and funding mandates, causing concern that support for such positions and scholarly work could evaporate if external pressures recede. The majority of deans stated that the SFES phenomenon had persisted over the last decade and continued to grow. Findings reported here document tacit assumptions that science education efforts may not count as science and reveal a lack of cultural integration of science education efforts into the sciences in higher education. Such findings should give biology educators, reformers, and researchers pause, as well as fresh incentive to engage more fully and regularly with administrators about their work.

Reding, T., Moore, C., Pelton, J. A., & Edwards, S. (2022). Barriers to Change: Social Network Interactions Not Sufficient for Diffusion of High-Impact Practices in STEM Teaching. *Education Sciences*, *12*(8), 512.
We examined the relationship between faculty teaching networks, which can aid with the implementation of didactic high-impact practices (HIPs) in classroom instruction, and the actual implementation of said practices. Participants consisted of STEM faculty members that teach introductory courses at a USA research university. A total of 210 faculty were invited to complete the Teaching Practices Inventory (TPI), which measures the use of classroom-based HIPs, and were then directed to a follow-up survey to gather teaching network data if they qualified. A total of 90 faculty completed the TPI, with 52 respondents completing the network analysis portion. Ego-level data, as well as network structural position data, were collected through roster format listing all invited faculty. No correlations were found between these network metrics and TPI score. Furthermore, respondents with similar TPI scores showed no preference for interactions within their group. For example, faculty with widely varying TPI scores interacted with each other with no indications of HIPs diffusion. Although the literature suggests strong teaching networks are a necessary condition for broad diffusion of HIPs, these results indicate that such networks are not a sufficient condition. This has implications for the diffusion of HIPs specifically and institutional change generally. Engaging individuals that possess both structural positions and pedagogical knowledge may be needed to help strategically diffuse HIPs in their own networks, with institutional support and guidance most likely also required.

McConnell, M., Montplaisir, L., & Offerdahl, E. G. (2020a). A model of peer effects on instructor innovation adoption. *International Journal of STEM Education*, *7*(1), 53.

A considerable body of evidence demonstrates that active, student-centered instructional practices are more effective than lecture-based, transmissionist approaches in improving undergraduate STEM learning. Despite this evidence and extensive reform initiatives, the majority of STEM instructors continue to teach didactically. Awareness of teaching innovations is widespread in some STEM disciplines, and instructors report trying new instructional approaches, yet the majority of them fail to continue using active learning strategies. Recent work suggests that the decision to experiment with and persist in using a teaching innovation is influenced more by instructors' perceived supports (e.g., access to curricular resources, supportive colleagues, positive departmental climate toward teaching) than perceived barriers. This commentary expands on the notion that the instructional decision-making process is personal and influenced by both individual and contextual factors to explicitly model the potential mechanisms by which peers encourage or discourage adoption of teaching innovations. We also discuss implications of this work for future research. We hope that this model will be helpful for work related to increasing the prevalence of active, student-centered instruction in undergraduate STEM.

Instructors interacting within an academic unit form a social network through which information and opinions can be shared (Andrews et al. 2016; Burt 2000; Grunspan et al. 2018; Kezar 2014; McConnell et al. 2019; Wasserman and Faust 1994). An individual's social network is known to be an influential factor in human behavior; the decisions an individual makes are heavily influenced by relationships and interactions (Dancy et al. 2016; Lane et al. 2019; Van Waes et al. 2015). Academic peer interactions facilitate the exchange of information, ideas, and awareness of teaching innovations, and provide encouragement and/or discouragement that can ultimately support or inhibit instructional change (Andrews and Lemons 2015; Dancy et al. 2016; Henderson 2005; Lund and Stains 2015; Rogers 2003). The nature and frequency of interactions are influenced by the departmental and institutional context. Further, peer interactions also shape perceptions of context through communication of beliefs and practices (Grunspan et al. 2018; Pataraia et al. 2015; Roxå and Mårtensson 2009; Thomson and Trigwell 2018), thereby affecting perceptions of departmental supports and barriers and ultimately the likelihood of adopting teaching innovations (Bathgate et al. 2019; Kezar 2014; Lane et al. 2019; Shadle et al. 2017).

According to McConnell et al., peers influence one another's instructional decision-making process in three ways: (1) sharing information, (2) reinforcing or changing attitudes, and (3) shaping and communicating teaching climate [**19**]. At the departmental level, teaching climate is defined as "an emergent property of a department's prevailing culture, disciplinary history, interactions between members of the department, and outside influences such as institutional context and external stakeholders" [**19**]. All three ways of instructional practice influence are interdependent and are rooted in faculty member interactions.

Lane, A. K., Skvoretz, J., Ziker, J. P., Couch, B. A., Earl, B., Lewis, J. E., ... & Stains, M. (2019). Investigating how faculty social networks and peer influence relate to knowledge and use of evidence-based teaching practices. *International Journal of STEM Education*, *6*(1), 1-14.

Calls for science education reform have been made for decades in the USA. The recent call to produce one million new science, technology, engineering, and math (STEM) graduates over 10 years highlights the need to employ evidence-based instructional practices (EBIPs) in undergraduate STEM classes to create engaging and effective learning environments. EBIPs are teaching strategies that have been empirically demonstrated to positively impact student learning, attitudes, and achievement in STEM disciplines. However, the mechanisms and processes by which faculty learn about and choose to implement EBIPs remain unclear. To explore this problem area, we used social network analysis to examine how an instructor’s knowledge and use of EBIPs may be influenced by their peers within a STEM department. We investigated teaching discussion networks in biology and chemistry departments at three public universities.

Results

We report that tie strength and tie diversity vary between departments, but that mean indegree is not correlated with organizational rank or tenure status. We also describe that teaching discussion ties can often be characterized as strong ties based on two measures of tie strength. Further, we compare peer influence models and find consistent evidence that peer influence in these departments follows a network disturbances model.

Conclusions

Our findings with respect to tie strength and tie diversity indicate that the social network structures in these departments vary in how conducive they might be to change. The correlation in teaching practice between discussion partner and peer influence models suggest that change agents should consider local social network characteristics when developing change strategies. In particular, change agents can expect that faculty may serve as opinion leaders regardless of their academic rank and that faculty can increase their use of EBIPs even if those they speak to about teaching use EBIPs comparatively less.

DEI Articles

1. https://onlinelibrary.wiley.com/doi/full/10.1002/tea.21775
   Russo 2022
   Thematic analysis showed that while many faculty members implicated systemic racism in their sense making about the underrepresentation of racially minoritized students in STEM, the majority used color-blind frames (abstract liberalism, cultural racism, and minimization of racism) by focusing on individual behaviors and choices, cultural deficits, under-preparation, and poverty. Consistent with the research on color-blind ideology, professors were able to explain racial phenomena without implicating race/racism, which allowed them to absolve themselves from responsibility in addressing racial inequality issues in higher education. Faculty members who made sense of underrepresentation through systemic racism framings tended to recognize that they had a role to play in ameliorating these issues for students of color. These findings have implications for future research and professional development efforts

2. https://www.lifescied.org/doi/10.1187/cbe.22-06-0104
   King et al., 2023

Using frameworks of racial noticing and color-evasive racial ideology, we conducted qualitative content analysis of instructor responses. Color-evasive racial ideology was pervasive, with most responses (54%) avoiding any discussion of race, and few responses acknowledging race or racism in more than one event (10%). We characterized six forms of color-evasiveness. This study adds to a growing body of literature indicating that color-evasion is pervasive in STEM culture. Instructors would benefit from professional development that specifically aims to counter color-evasiveness and anti-Blackness in teaching. Furthermore, STEM disciplines must pursue systemic change so that our organizations value, expect, promote, and reward the development and enactment of a critical racial consciousness.

3. https://search.library.ucsb.edu/discovery/openurl?institution=01UCSB_INST&vid=01UCSB_INST:UCSB&rft.aulast=McNair&rft.aulast=Bensimon&rft.aulast=Malcom%3FPiqueux&rft.pub=Josey%3FBass&url_ver=Z39.88-2004&rft.date=2020&rfr_id=info:sid%2Fwiley&rft.btitle=From%20equity%20talk%20to%20equity%20walk:%20Expanding%20practitioner%20knowledge%20for%20racial%20justice%20in%20higher%20education&rft.genre=book&rft.aufirst=T.%20B.&rft.aufirst=E.%20M.&rft.aufirst=L.
McNair, T. B., E. M. Bensimon, and L Malcom?Piqueux. *From Equity Talk to Equity Walk: Expanding Practitioner Knowledge for Racial Justice in Higher educationFrom Equity Talk to Equity Walk : Expanding Practitioner Knowledge for Racial Justice in Higher Education /*. Hoboken, New Jersey : Josey?Bass, 2020. Print.

4. Chesler, M. and Young, A.A. Jr. (2007).
Faculty members' social identities and classroom authority. New Directions for Teaching and Learning 111: 11–19.
Research has demonstrated that faculty members' social identities mediate how they experience the classroom and their curricular approaches and pedagogical practices, their interaction with students, and their relationships with colleagues (Chesler and Young 2007

5. https://search.library.ucsb.edu/discovery/openurl?institution=01UCSB_INST&vid=01UCSB_INST:UCSB&rft.aulast=Killpack&rft.aulast=Mel%EF%BF%BDn&rft.volume=15&url_ver=Z39.88-2004&rft.date=2016&rfr_id=info:sid%2Fwiley&rft.jtitle=CBE%3FLife%20Sciences%20Education&rft.genre=article&rft.aufirst=T.%20L.&rft.aufirst=L.%20C.&rft.issue=3&rft.atitle=Toward%20inclusive%20STEM%20classrooms:%20What%20personal%20role%20do%20faculty%20play%3F
Killpack, T. L., & Melón, L. C. (2016). Toward inclusive STEM classrooms: what personal role do faculty play?. *CBE—Life Sciences Education*, *15*(3), es3.
However, in our experience, faculty professional development programs often

limit discussions of diversity to “comfortable” topics (such as learning styles) and miss opportunities to explore deeper issues related to faculty privilege, implicit bias, and cues for stereotype threat that we all bring to the classroom. In this essay, we present a set of social science concepts that we can extend to our STEM courses to inform our efforts at inclusive excellence. We have recommended strategies for meaningful reflection and professional development with respect to diversity and inclusion, and aim to empower faculty to be change agents in their classrooms as a means to broadening participation in STEM fields.

6. https://search.library.ucsb.edu/discovery/openurl?institution=01UCSB_INST&vid=01UCSB_INST:UCSB&rft.aulast=Joseph&rft.aulast=Haynes&rft.aulast=Cobb&rft.pub=Peter%20Lang&url_ver=Z39.88-2004&rft.date=2015&rfr_id=info:sid%2Fwiley&rft.btitle=Interrogating%20whiteness%20and%20relinquishing%20power:%20White%20faculty%27s%20commitment%20to%20racial%20consciousness%20in%20STEM%20classrooms&rft.genre=book&rft.aufirst=N.%20M.&rft.aufirst=C.&rft.aufirst=F.
7. Denaro, K., Kranzfelder, P., Owens, M. T., Sato, B., Zuckerman, A. L., Hardesty, R. A., ... & Lo, S. M. (2022). Predicting implementation of active learning by tenure-track teaching faculty using robust cluster analysis. *International journal of STEM education*, *9*(1), 49.”

   We observed 125 science, technology, engineering, and mathematics (STEM) undergraduate courses at three University of California campuses using the Classroom Observation Protocol for Undergraduate STEM to examine active-learning strategies implemented in the classroom. Tenure-track education-focused faculty are more likely to teach with active-learning strategies compared to tenure-track research-focused faculty. Instructor and classroom characteristics that are also related to active learning include campus, discipline, and class size. The campus with initiatives and programs to support undergraduate STEM education is more likely to have instructors who adopt active-learning strategies. There is no difference in instructors in the Biological Sciences, Engineering, or Information and Computer Sciences disciplines who teach actively. However, instructors in the Physical Sciences are less likely to teach actively. Smaller class sizes also tend to have instructors who teach more actively.

8. Tait 2022 https://onlinelibrary.wiley.com/doi/full/10.1002/sce.21781

   Russo-Tait, T. (2023). Science faculty conceptions of equity and their association to teaching practices. *Science Education*, *107*(2), 427-458.

Thematic analysis showed that faculty conceptualized equity in three ways—“equality,” “inclusion,” or “justice”—and these conceptions were associated with instructor-centered or student-centered practices. Professors with “equality” conceptions of equity tended to report teaching mostly via lecture, while those with “inclusion” conceptions reported using active learning and/or inclusive teaching practices. Most professors with a “justice” conception went beyond active learning and inclusive practices to also include an emerging critical pedagogy. Conceptions of equity appear to inform how university science faculty see their roles in advancing equity in their classrooms. These findings provide a foundation for future research that seeks to support college science faculty's understandings of equity issues in higher education and the pedagogical practices necessary to ameliorate them.

9. https://search.library.ucsb.edu/discovery/openurl?institution=01UCSB_INST&vid=01UCSB_INST:UCSB&rft.aulast=Annamma&rft.aulast=Jackson&rft.aulast=Morrison&rft.epage=162&rft.volume=20&url_ver=Z39.88-2004&rft.date=2017&rfr_id=info:sid%2Fwiley&rft.spage=147&rft.jtitle=Race%20Ethnicity%20and%20Education&rft.genre=article&rft.aufirst=S.%20A.&rft.aufirst=D.%20D.&rft.aufirst=D.&rft.issue=2&rft.atitle=Conceptualizing%20color%3Fevasiveness:%20Using%20dis%2Fability%20critical%20race%20theory%20to%20expand%20a%20color%3Fblind%20racial%20ideology%20in%20education%20and%20society

   Annamma, S. A., D. D. Jackson, and D. Morrison. “Conceptualizing Color?Evasiveness: Using Dis/Ability Critical Race Theory to Expand a Color?Blind Racial Ideology in Education and Society.” *Race Ethnicity and Education* 20.2 (2017): 147–162.

   Color-blind racial ideology has historically been conceptualized as an ideology wherein race is immaterial. Efforts not to ‘see’ race insinuate that recognizing race is problematic; therefore, scholars have identified and critiqued color-blindness ideology. In this paper, we first examine Gotanda’s (1991) identification and critique of color-blind racial ideology, as it was crucial in troubling white supremacy. We then explore literature in both legal studies and education to determine how scholars have built upon Gotanda’s intellectual theoretical foundations. Finally, using a Dis/ability Critical Race Theory (DisCrit) framework, we end by expanding to a racial ideology of color-evasiveness in education and society, as we believe that conceptualizing the refusal to recognize race as ‘color-blindness’ limits the ways this ideology can be dismantled.

10. Aragón, O. R., Dovidio, J. F., & Graham, M. J. (2017). Colorblind and multicultural ideologies are associated with faculty adoption of inclusive teaching practices. *Journal of Diversity in Higher Education*, *10*(3), 201.
Professional workshops aimed at increasing student diversity typically urge college-level science, technology, engineering, and math (STEM) educators to implement inclusive teaching practices. A model of the process by which educators adopt such practices, and the relationship between adoption and 2 ideologies of diversity is tested here. One ideology, colorblindness, downplays differences based on gender or color. The other, multiculturalism, embraces differences. Pathway modeling revealed reliable, discrete steps in the process of adoption. Independently, greater endorsement of colorblindness predicted adoption of fewer inclusive teaching practices, and multiculturalism predicted adoption of more practices. These findings inform national-level intervention efforts about the process by which educators adopt inclusive teaching practices, and suggest that interventions might consider educators' personal beliefs and approaches to diversity.

11. https://search.library.ucsb.edu/discovery/openurl?institution=01UCSB_INST&vid=01UCSB_INST:UCSB&rft.aulast=Baber&rft.epage=26&rft.volume=117&url_ver=Z39.88-2004&rft.date=2015&rfr_id=info:sid%2Fwiley&rft.spage=5&rft.jtitle=Teachers%20College%20Record&rft.genre=article&rft.aufirst=L.%20D.&rft.issue=14&rft.atitle=Examining%20post%3Fracial%20ideology%20in%20higher%20education
Baber, L. D. "Examining Post?Racial Ideology in Higher Education." *Teachers College record /* 117.14 (2015): 5–26.
the continued retreatment from race-conscious admissions policies and the persistence of race-neutral, universalist perspectives of knowledge. In light of continuing racial stratification for postsecondary opportunities in the United States, contesting post-racialism is critical for scholars and policy makers interested in educational equity and justice.

12. Carter, D. F., Razo Dueñas, J. E., & Mendoza, R. (2019). Critical examination of the role of STEM in propagating and maintaining race and gender disparities. *Higher Education: Handbook of Theory and Research: Volume 34*, 39-97.

At a time when underrepresented and racial/ethnic populations in the U.S. are growing rapidly, it is critical to examine the historical roots of why they continue to be underrepresented in science, technology, engineering and math (STEM) fields. This chapter reviews the literature regarding how race and racism have contributed to modern-day STEM cultures utilizing a conceptual framework guided by critical race theory and Hurtado, Alvarez, Guillermo-Wann, Cuellar and Arellano's (2012) Model of Diverse Learning Environments. Science is a key contributor to the historical construction of racial differences, and this logic continues to the present day in the way merit is constructed and evaluated in

STEM. The lack of progress toward substantially lessening gender and race disparities in many STEM fields can be partially attributed to the culture of the STEM academic fields. We draw connections between science's role in the construction and application of race in society to the culture of STEM, which can feel exclusionary and isolating to underrepresented students. The chapter concludes with a discussion of interventions that have been shown to have an impact on the transformation of institutional (and disciplinary) cultures to better support the educational outcomes of underrepresented students.

13. https://search.library.ucsb.edu/discovery/openurl?institution=01UCSB_INST&vid=01UCSB_INST:UCSB&rft.aulast=Carter&rft.aulast=Skiba&rft.aulast=Arredondo&rft.aulast=Pollock&rft.epage=235&rft.volume=52&url_ver=Z39.88-2004&rft.date=2017&rfr_id=info:sid%2Fwiley&rft.spage=207&rft.jtitle=Urban%20Education&rft.genre=article&rft.aufirst=P.%20L.&rft.aufirst=R.&rft.aufirst=M.%20I.&rft.aufirst=M.&rft.issue=2&rft.atitle=You%20can%27t%20fix%20what%20you%20don%27t%20look%20at:%20Acknowledging%20race%20in%20addressing%20racial%20discipline%20disparities
    Carter, P. L., Skiba, R., Arredondo, M. I., & Pollock, M. (2017). You can't fix what you don't look at: Acknowledging race in addressing racial discipline disparities. *Urban education*, *52*(2), 207-235.

14. https://pubmed.ncbi.nlm.nih.gov/34265575/
15. https://ieeexplore.ieee.org/abstract/document/10343445/references#references
    White, L., Pedersen, R., Stanley, C., Hammond, T., & Watson, K. (2023, October). Uncomfortable Conversations Can Lead to Better Faculty Preparation and Engineering Pedagogy Centered on Humanity. In *2023 IEEE Frontiers in Education Conference (FIE)* (pp. 1-6). IEEE.

L. L. A. White, T. A. Hammond, S. Ray, D. Jaison and C. A. Stanley, "Uncomfortable conversations with faculty and students in zoom: Ex-periences with diversity and inclusion spurred by police brutality and racial injustice in the us", *2022 CoNECD (Collaborative Network for Engineering & Computing Diversity)*, 2022.

This initial work revealed that the majority (72.2%) of participants had never participated in an experience where they could freely discuss difficult topics relating to DEI at Texas A&M University. The major themes revealed during qualitative analysis of the focus groups were the following: Exposure to social justice issues, expansion of participants' mindset and understanding of social justice issues, and the creation of a trustworthy environment

16. E. A. Cech, "The (mis) framing of social justice: Why ideologies of depoliticization and meritocracy hinder engineers' ability to think about social injustices", *Engineering education for social justice: Critical explorations and opportunities*, pp. 67-84, 2013.

16. https://link.springer.com/article/10.1007/s43683-022-00074-3
17. St. Denis, V., & Schick, C. (2003). What Makes Anti-Racist Pedagogy in Teacher Education Difficult? Three Popular Ideological Assumptions. *Alberta Journal of Educational Research*, *49*(1). https://doi.org/10.11575/ajer.v49i1.54959
The article identifies three common ideological assumptions about the production of inequality frequently held by these students: race does not matter; everyone has equal opportunity; and through individual acts and good intentions one can secure innocence as well as superiority. These preservice teachers are required to examine the dominant identifications and power relations through which they are produced and unwittingly implicated in reproducing the status quo.

Aster, E. M., Bouwma-Gearhart, J., & Fisher, K. Q. (2021). Contextualizing communities in an instructional improvement initiative: exploring STEM faculty engagement in teaching-related conversations. *Disciplinary and Interdisciplinary Science Education Research*, *3*(1), 1-22.

frequently cited strategy for fostering science, technology, engineering, and mathematics (STEM) instructional improvements is creating communities where faculty can share and learn evidence-based teaching practices. Despite research-documented benefits, little is known about why (and with whom) faculty engage in teaching-related conversations, including those fostered by initiative communities. We explored how STEM faculty engage in teaching-related conversations, via analysis of faculty interviews and discussion networks, to identify factors potentially influencing teaching-related conversations over the life of an initiative. Our results suggest aspects that might inhibit STEM faculty from engaging in teaching-related conversations, including: 1) faculty members' autonomy with teaching practices; 2) faculty members' varied interests in teaching improvements; 3) varied degrees of support to engage in teaching-related conversations; and 4) a lack of inclusive and non-judgmental spaces to talk about teaching. We suggest that those fostering STEM faculty communities consider working with others across the institution to map the instructional improvement opportunities faculty may already take part in and attend to areas lacking support. Initiative leaders and designers should also elicit and build off faculty members' teaching-related knowledge and concerns. We further suggest making conversational spaces inclusive and safe, to help faculty honestly share teaching-related challenges and insights. We recommend creating and fostering spaces that bring faculty together across department boundaries. Our study echoes prior research by drawing attention to administrative support for instructional improvement initiatives, which can foster and sustain opportunities for faculty to talk about teaching and learn instructional improvements.

Sue, D. W., Rivera, D. P., Watkins, N. L., Kim, R. H., Kim, S., & Williams, C. D. (2011). Racial dialogues: Challenges faculty of color face in the classroom. *Cultural Diversity and Ethnic Minority Psychology*, *17*(3), 331.

Research on the experiences of faculty of color in predominantly White institutions (PWIs) suggests that they often experience the campus climate as invalidating, alienating, and hostile. Few studies, however, have actually focused on the classroom experiences of faculty of color when difficult racial dialogues occur. Using Consensually Qualitative Research, eight faculty of color were interviewed about their experiences in the classroom when racially tinged topics arose. Three major findings emerged. First, difficult racial dialogues were frequently instigated by the presence of racial microaggressions delivered toward students of color or the professor. Dialogues on race were made more difficult when the classrooms were diverse, when heated emotions arose, when there was a strong fear of self-disclosure, and when racial perspectives differed. Second, all faculty experienced an internal struggle between balancing their own values and beliefs with an attempt to remain objective. This conflict was often described as exhausting and energy-depleting. Third, faculty of color described both successful and unsuccessful strategies in facilitating difficult dialogues on race that arose in the course of their teaching. These findings have major implications for how PWIs can develop new programs, policies, and practices that will aid and support colleagues of color.

Wing Sue, D., Torino, G. C., Capodilupo, C. M., Rivera, D. P., & Lin, A. I. (2009). How White faculty perceive and react to difficult dialogues on race: Implications for education and training. *The Counseling Psychologist*, *37*(8), 1090-1115.

Using consensual qualitative research, the perceptions and reactions of White faculty to classroom dialogues on race were explored. Difficult racial dialogues were characterized by intense emotions in both professors and their students, most notable anxiety, that interfered with the ability to successfully facilitate a learning experience for participants. Among the major obstacles that interfered with teaching competence were fears of revealing personal biases and prejudices, losing classroom control, inability to understand or recognize the causes or dynamics of difficult dialogues, and lack of knowledge and skills to properly intervene. A number of potentially effective teaching strategies were identified: (a) acknowledging emotions and feelings, (b) self-disclosing personal challenges and fears, (c) actively engaging the classroom exchanges, and (d) creating a safe space for racial dialogues.

Williams, M. T., Faber, S., Nepton, A., & Ching, T. H. W. (2023). Racial justice allyship requires civil courage: A behavioral prescription for moral growth and change. *American Psychologist, 78*(1), 1–19. https://doi.org/10.1037/amp0000940

In racialized societies, race divides people, prioritizes some groups over others, and directly impacts opportunities and outcomes in life. These missed opportunities and altered outcomes can be rectified only through the deliberate dismantling of explicit, implicit, and systemic patterns of injustice. Racial problems cannot be corrected merely by the good wishes of individuals—purposeful actions and interventions are required. To create equitable systems, civil courage is vital. Civil courage differs from other forms of courage, as it is directed at social change. People who demonstrate civil courage are aware of the negative consequences and social costs but choose to persist based on a moral imperative. After defining allyship and providing contemporary and historical examples of civil courage, this paper explains the difficulties and impediments inherent in implementing racial justice. To enable growth and change, we introduce ten practical exercises based on cognitive-behavioral approaches to help individuals increase their awareness and ability to demonstrate racial justice allyship in alignment with valued behaviors. We explain how these exercises can be utilized to change thinking patterns, why the exercises can be difficult, and how psychologists and others might make use of them to expand the capacity for civil courage in the service of racial justice.

Williams, M. T. (2019). Adverse racial climates in academia: Conceptualization, interventions, and call to action. *New ideas in Psychology*, *55*, 58-67.

Racial conflict at universities across the US has been the focus of academic concern and media attention, yet often administrators and faculty do not understand the problems or know how to approach solutions. Drawing from many branches of psychological science, this paper describes how an oppressive academic climate results in negative outcomes for students and faculty of color, such as psychological distress, grievances, discrimination lawsuits, faculty turnover, and student dropout. Described are some empirically-supported actions departments can employ to improve the racial climate and thereby promote racial healing and diversity, including forums to facilitate conversations about inequity, experiential diversity trainings, removal of environmental microaggressions, recruitment and retention of minority faculty and advisors, repairing biased curricula, and addressing bias in teaching evaluations. Also advanced is a call to action for administrators to improve receptivity to those suffering as a result of an adverse climate, responding to racism when needed, and taking action on a larger scale, with an emphasis on the role of psychologists.