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Remote teaching as the catalyst for change in teaching values and practices: experiences of instructors within one chemistry department during the COVID-19 pandemic

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This study examines the unique challenges and transformations in higher education instruction during the COVID-19 pandemic, focusing on a strategic response from one chemistry department. The COVID-19 pandemic created many obstacles to providing quality instruction. To support chemistry instructors during the challenging transition to remote teaching, the leadership within one chemistry department created an initiative to ease feelings of isolation and support instructors in undergraduate teaching. Within this manuscript, we triangulate recordings of instructors' discussions about remote teaching, course syllabi, and open-ended surveys to understand the teaching experiences of the instructors within this department during the COVID-19 pandemic. Our findings expose various points of tension instructors faced and demonstrate how the pandemic and the departmental initiative changed instructors' teaching values. Despite the unfortunate context of the pandemic, these data reveal how this department-wide initiative has impacted the instructors and the department's climate around teaching, which underscores the importance of collaborative efforts in navigating unprecedented educational challenges.

KEYWORDS

chemistry, postsecondary education, digital education, remote teaching, chemistry education research

1 Introduction

The onset of the COVID-19 pandemic was a challenging time for instructors and students. Abruptly, instructors were expected to tailor their instruction from in-person to online to meet the requirements posed by their institutions and the government (Gonzalez and Knecht, 2020; Johnson et al., 2020; Abraham et al., 2022; Simmons and Mistry, 2023). One must acknowledge the resilience and determination of the instructors who quickly adjusted to remote teaching. However, most instructors had to facilitate online instruction without comprehensive experience or training, which might have resulted in lower-quality instruction. Ultimately, the

pandemic catalyzed "change as adaptation" as instructors had to adapt their practices to constantly changing conditions (Clarke and Hollingsworth, 2002). This manuscript aims to explore the proactive measures taken by a Chemistry and Biochemistry Department in the Southeastern United States in response to the demand for emergency remote instruction. Before delving into this case study and examining the collaborative efforts undertaken to overcome the pandemic-induced challenges, we first review the existing literature on the experiences of chemistry instructors during the pandemic and the varied responses of departments to the shift towards remote teaching.

1.1 Prior research on departmental initiatives and pedagogical transformations during the COVID-19 pandemic

Studies on the shift to remote instruction due to the pandemic have highlighted not just the obstacles faced by individual instructors and departments, but also, more significantly, the resilience and innovative problem-solving that emerged, fostering both personal and collective growth. Instructors navigated numerous hurdles, including the selection and application of effective digital tools for teaching, with the dual challenge of ensuring both they and their students could adeptly use these technologies (Aguirre and Selampinar, 2020; Carpendale et al., 2020; Rupnow et al., 2020; Villanueva et al., 2020; Simmons and Mistry, 2023). The issue of maintaining academic integrity became prominent, prompting the development of new strategies to counteract cheating (Burnett et al., 2020; Gonzalez and Knecht, 2020; O'Carroll et al., 2020; Rupnow et al., 2020). Another challenge was the noticeable drop in attendance at virtual office hours and synchronous class sessions (Burnett et al., 2020; Perets et al., 2020; Reinholz et al., 2020), alongside difficulties in sustaining effective teaching amid diminished communication with colleagues (Rupnow et al., 2020). Amid these challenges, some faculty members saw an opportunity for deep reflection and reevaluation of their pedagogical approaches, contemplating significant shifts in their educational objectives and the practices they employ. This period of introspection also led to discussions on the need for enduring support mechanisms to facilitate and maintain these transformative changes in the long run (Chan et al., 2020; Rupnow et al., 2020).

Building on this momentum for change, departmental initiatives emerged as a pivotal structure for facilitating adaptation to the remote learning environment. At its onset, various departments swiftly implemented plans and organized weekly meetings to bolster support for students and faculty (Johnson et al., 2020). Some departments, already in the midst of pedagogical transformation, leveraged this period to sustain and adapt their initiatives to the remote learning context. For instance, a study highlighted that faculty members participating in a professional learning community focused on fostering equitable student participation in face-to-face settings had to pivot their efforts to accommodate the shift to remote learning in Spring 2020. This transition to the remote setting was associated with a notable decline in student engagement (Reinholz et al., 2020). However, employing discussions within the professional learning community allowed faculty to exchange strategies for enhancing participation. This collaborative approach facilitated a transition towards evidence-based teaching practices, ultimately leading to an increase in student attendance. Another department invoked its institutional theory of change as a compass for instructional decision-making during remote instruction due to the pandemic. This theory emphasized an empathetic understanding of students' holistic needs, the adoption of a diversified pedagogical toolkit, and the establishment of a shared language, values, and recognition of students' and faculty's responsibilities (Chan et al., 2020). By centralizing these principles, encouraging the adoption of consistent pedagogical approaches among faculty, and fostering open dialogues within the department, there was a marked improvement in student experiences. These examples underscore the potency of departmental initiatives and structured approaches in guiding instructional adaptation and enhancing the educational environment, even amidst the challenges posed by the transition to remote learning.

Herein, we describe the proactive measures taken by another science department in response to the demand for emergency remote instruction. We capture and characterize the experiences of chemistry instructors in this department through the lens of the Interconnected Model of Professional Growth.

1.2 The strategic response to emergency remote instruction from the chemistry and biochemistry department in this study

To support chemistry instructors in adapting to the changing instructional environment, the leadership within one chemistry department developed the Student Learning Enhancement (SLE) initiative. Specifically, at the onset of the pandemic, the departmental leadership recognized that instructors felt isolated and needed support as they adjusted to teaching in an online or hybrid format (note that by the onset of the pandemic, we refer to the time from Spring 2020 through Spring 2021 when instructors primarily taught remotely). As a result, this department created the SLE initiative to help the instructors adapt and support the students. As part of this initiative, the instructors within the same division (e.g., general chemistry, organic chemistry) met bimonthly via Zoom to discuss their teaching – what worked well, what problems had arisen, and what strategies would improve instruction and assessment. Two communities of practice were created: the community of instructors teaching Introductory/General Chemistry courses and the community of instructors teaching Organic Chemistry/Biochemistry courses.

As shown, the department demonstrated a strategic and innovative response to emergency remote instruction by establishing instructor communities of practice (Lave, 1991). The development of this department-wide initiative presented a valuable and compelling case study for exploring the impacts of this intervention on remote teaching practices and departmental climate during the pandemic teaching. These attributes made the department a compelling subject for studying the effects of collaborative efforts on navigating the challenges posed by the pandemic, including the lasting changes this had on the department post-pandemic. Therefore, we have captured and characterized the experiences of chemistry instructors within this department while teaching during the COVID-19 pandemic, as well as how the participation in the communities of practice to support remote instruction impacted the instructors' teaching values and practices.

To provide context on how this department compares with other science departments, we describe its characteristics. The Department

of Chemistry and Biochemistry in this study (hereon referred to as the Department) is one of the University of North Carolina at Greensboro (UNCG) departments. UNCG is a public, high research activity (R2), a minority-serving institution in the Southeastern United States. UNCG was a Women's College until 1964, and still today, most of its students are female. The Department offers Bachelor of Arts (B.A.), Bachelor of Science (B.S.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.) degrees. Additionally, the B.S. in Chemistry is certified by the American Chemical Society's Committee on Professional Training. At the time of this study (Spring 2020 – Spring 2021), depending on the semester, the Department included 332–385 majors, of which 35–38 were graduate students and 294–349 were undergraduate students. Of these students, depending on the semester, 60–63% self-identified as women. The Department is racially and ethnically diverse, where 59–70% of students self-identified as non-white (25–32% as Black or African American and 11–13% as LatinX). Half of the students were Pell Grant eligible, and almost half were first-generation college students. At the time of this study, the Department included about 25 faculty (52% tenured, 12% tenure-track, and 36% professional-track). Of these faculty, 36% identified as women. Professional-track faculty were primarily responsible for teaching Introductory and General Chemistry lecture and laboratory courses, as well as Organic Chemistry laboratory courses, whereas the tenured and tenure-track faculty were primarily responsible for teaching the remaining chemistry courses. The course enrollment varied, with course sizes set not to exceed 100–120 students in large undergraduate lecture courses, reflecting the Department's emphasis on maintaining manageable class sizes for effective teaching and learning.

Due to the pandemic, in March 2020, the Department held a meeting to discuss the transition of all the lecture and laboratory courses to an online format for the rest of the Spring 2020 semester. In Fall 2020, some courses returned to face-to-face instruction with capacity limitations, whereas many others were still taught in online or hybrid formats. The Department did not return to entirely in-person instruction until Fall 2021.

2 The interconnected model of professional growth as the guiding framework

This work is grounded in the Interconnected Model of Professional Growth, which contains four distinct change domains that encompass the teacher's world (Figure 1A): (1) the domain of external information or stimuli, (2) the personal domain (e.g., knowledge, beliefs, and attitudes), (3) the domain of practice (e.g., teaching experimentation), and (4) the domain of consequence (e.g., student or instructor outcomes) (Clarke and Hollingsworth, 2002). The last three domains are internal factors within the instructor's personal world. The arrows within this model indicate how the change in one domain promotes change in another through reflection and enactment. Reflection is an active, persistent, and careful consideration. Enactment involves putting into action a new idea or a new belief. Each domain and the mechanisms of change between domains are situated within a change environment. The change environment is the context in which the instructors work that can constrain or afford change. This framework has been used across disciplines to describe the factors and contexts that lead to change over time (Witterholt et al., 2012; Chan et al., 2019; Moore et al., 2021). In this work, we use the Interconnected Model of Professional Growth to comprehensively capture the change in the Department's climate around teaching during the pandemic. Below we further describe how we captured and characterized each domain in the context of this study.

2.1 External domain – communities of practice created to support remote instruction

The external domain (green box in Figure 1B) includes the shift to remote teaching due to the COVID-19 pandemic (external stimulus) and the two communities of practice within the Department created to support the instructors (external sources of information) (Farnsworth et al., 2016; Dancy et al., 2019). Lave described communities of practice as a "group of people who share an area of expertise and learn from each other through interactions among group members" (Lave, 1991). Communities of practice can support teaching by creating a community where members exchange knowledge, troubleshoot teaching challenges, and learn from peers and experts (Dancy et al., 2019). Three tenents define communities of practice. First, the community must have a joint enterprise or shared purpose to learn and develop competence in a domain. For the SLE, this shared domain of interest was quality teaching of undergraduate chemistry in an online or hybrid format. Second, there must be mutual engagement and trust so community members can effectively learn from one another. The bimonthly Zoom meetings became the space in which the instructors supported each other and shared tips and insights. Third, a shared repertoire of jointly constructed resources (e.g., language and artifacts) is needed to negotiate meaning in the community. Instructors used what they learned from each other to improve their remote instruction.

2.2 Personal domain – instructors' values

The personal domain represents an instructor's knowledge, values, and beliefs (Clarke and Hollingsworth, 2002). Values are a subset of beliefs associated with desires and acceptable standards of conduct. Beliefs and values serve as a filter for making decisions about learning goals, instructional strategies, and content organization (Bauer, 2005; Gess-Newsome, 2015; Flaherty, 2020). Teaching values, specifically, are known to drive decision-making in the classroom (Zagallo et al., 2019). During the Zoom meetings, instructors shared their knowledge and values and described situations when their competing values made it difficult to make an instructional decision.

2.3 Domain of practice – instructional practices to provide remote instruction

Instruction is shaped not only by what the instructor knows, values, and believes but also by classroom context (Gess-Newsome, 2015). The classroom context is affected by the mode of instruction, class size, time available for preparing lessons and class materials, service and research responsibilities outside of the classroom, and

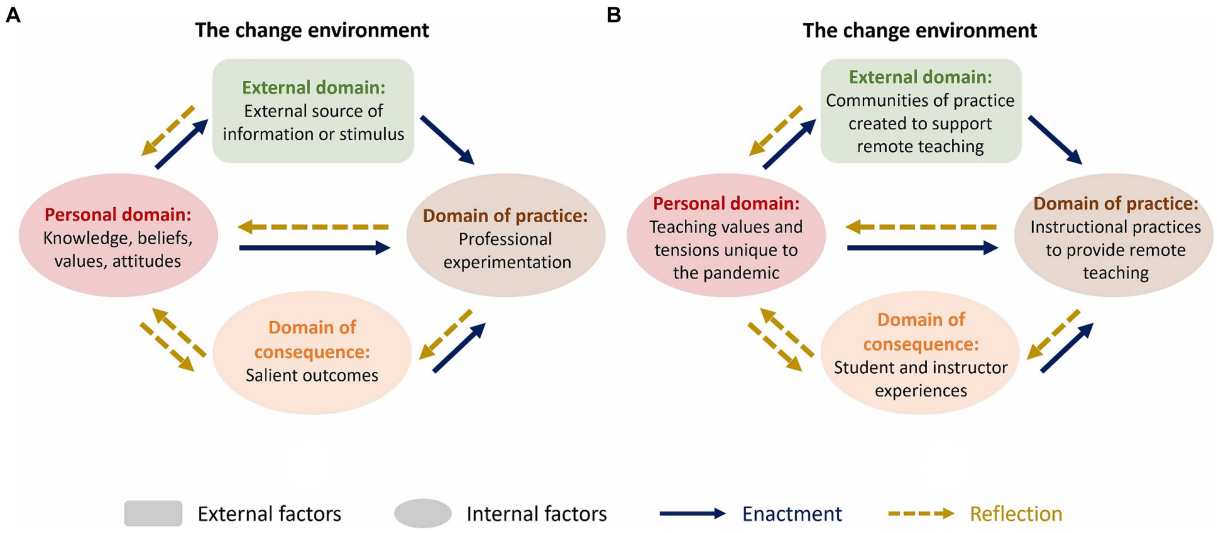

FIGURE 1
The interconnected model of professional growth **(A)** and its use to frame this study **(B)**. Panel **(A)** has been modified from Teaching and Teacher Education, 18, Clarke and Hollingsworth (2002), Elaborating a Model of Teacher Professional Growth, 947–967, Copyright 2002, with permission from Elsevier.

other factors that impact instruction. In this study, the main factor that impacted faculty instructional practices was the mode of instruction (i.e., the transition to remote teaching). In our work, the domain of practice describes instructional practices during remote teaching. These practices include facilitating interactions between the instructor and the students and selecting activities and materials used within the classroom.

2.4 Domain of consequence – student and instructor experiences

This domain explores the inferred consequences of instructor actions. For example, increased student–student in-class discussions may be interpreted as a salient positive outcome for one instructor but indicative of a loss of control for another. Thus, salient outcomes are unique to the instructor and are closely tied to their values. In this project, we characterized the domain of consequence through instructors' explicit discussions about what worked and did not work in their remote classrooms.

This study uses the Interconnected Model of Professional Growth (Clarke and Hollingsworth, 2002) to characterize the instructional landscape (i.e., teaching values, practices, and experiences) in a single department during the pandemic. This work adds to the body of literature that investigated how instructors adapted to online instruction and what challenges they encountered while teaching online while characterizing a departmental initiative to support instruction during the pandemic. We documented the real-time experiences of instructors at multiple time points when teaching remotely during the onset of the pandemic. We address the following research questions:

1. What were the experiences of chemistry instructors while teaching during the onset of the COVID-19 pandemic?
2. How did the participation in the communities of practice to support remote instruction impact the instructors' teaching values and practices?

The first research question aims to provide a broad characterization of the four domains that encompass chemistry instructors' experiences within the change environment (Clarke and Hollingsworth, 2002), whereas the second research question examines how the change in one domain promoted a change in another through instructors' reflection and enactment (Figure 1A). Specifically, we examined how the changes in the external domain (e.g., participation in communities of practice to ensure quality remote teaching) catalyzed changes in the personal domain (e.g., teaching values) and in the domain of practice (e.g., instructional practices to provide remote instructions) (Figure 1B).

3 Methods

When the departmental leadership (M.P.C. and J.W.) developed and implemented the SLE initiative, they recognized the importance of objectively evaluating its impact. To achieve this, they enlisted the expertise of a chemistry education researcher, M.P., who is also a faculty member within the Department. Understanding the potential for bias given their internal roles, they appointed L.W., a non-teaching postdoctoral scholar specializing in chemistry education research, to spearhead the analysis. L.W.'s external perspective was complemented by J.H., a post-baccalaureate student with training in qualitative research methods. Together, L.W. and J.H. took on the critical tasks of coding, categorizing, and theme development, ensuring an unbiased and rigorous analysis of the initiative's impacts. M.P. met weekly with L.W. and J.H. to provide feedback and guidance on data analysis, with all data being fully de-identified. L.W. and J.H. chose all the representative codes for inclusion in the paper, ensuring that the selections accurately reflected the data and enhanced the narrative's richness and authenticity.

L.W. wrote the first draft of this manuscript. M.P., M.P.C., and J.W. edited the manuscript. This collaborative process was instrumental in preserving the integrity and reducing bias within the analysis.

3.1 Sample and data collection

Institutional Review Board (IRB) approval was obtained before collecting any data. Multiple data sources were collected to comprehensively capture instructor experiences and ensure the trustworthiness of our findings (Oliver-Hoyo and Allen, 2006): course syllabi, Zoom recordings of divisional meetings during which instructors discussed their teaching, and open-ended surveys.

On a bimonthly basis in Fall 2020 and Spring 2021, the instructors met via Zoom in unstructured divisional meetings to discuss their experiences teaching online. We collected the Zoom recordings of three divisional meetings of introductory/general chemistry instructors ($n=6$) and two divisional meetings of biochemistry/organic chemistry instructors ($n=7$). In total, we collected five videos that included 13 instructors. The instructors in our sample represented different academic ranks, including teaching-track professors, tenure-track assistant professors, and tenured associate and full professors. Gender-neutral pseudonyms were created for all instructors who participated in this study. Since the meetings were unstructured, instructors provided varying insight into their courses. To clarify their intended course formats, we collected each instructor's course syllabus.

In addition to the rich insight into instructor experiences captured via the group discussions during the divisional meetings, we also wanted to allow the instructors to share their experiences individually. To do so, we designed an open-ended survey (see Supplementary material) grounded in the Seven Principles of Good Practice for the Online Environment (Sorensen and Baylen, 2009; Fiock, 2020) and the community of inquiry (CoI) framework (Garrison et al., 2000; Garrison, 2007). The first survey section asked each instructor to select an online or hybrid course to reflect on. The second survey section asked the instructors to reflect on the extent they implemented the Seven Principles of Good Practice for the Online Environment in their course. These principles include (1) student-teacher contact; (2) cooperation among students; (3) active learning; (4) prompt feedback; (5) time on task; (6) communication of high expectations; and (7) respect toward diverse ways of learning. The third survey section used the CoI framework as a lens to provide additional insight into the challenges instructors encountered. The CoI framework has been used to characterize the effectiveness of online teaching and learning (Garrison et al., 2000; Garrison, 2007; Arbaugh et al., 2008; Shea et al., 2010; Akyol and Garrison, 2011; Flener-Lovitt et al., 2020; Tan et al., 2020; Shaaban, 2021). The framework is grounded in social constructivism (Garrison, 2007; Kozan and Caskurlu, 2018) and comprises three main presences: the extent to which the learners construct meaning through sustained communication and reflection (cognitive presence), the ability of the students and instructors to project themselves socially and emotionally as 'real people' (social presence), and instruction, including content selection, organization, and presentation (teaching presence). When all three presences overlap, there is an environment that can foster a meaningful educational experience. The third survey section asked instructors about the challenges they might have encountered in creating cognitive, social, and teaching presences and how they used technology to address these challenges. To collect this data, we sent an email to all instructors in the Department, inviting them to participate in the survey. This email included a brief overview of the study's purpose, an assurance of confidentiality and anonymity for all respondents in alignment with the obtained IRB approval, and a link to the Qualtrics survey.

All instructors teaching undergraduate chemistry lecture courses were invited to participate in the survey. Nine instructors completed the survey. We acknowledge that some instructors who completed the survey were also in the divisional meetings. However, we did not attempt to connect the instructors across the data sources to preserve anonymity. Instead, we focused on capturing shared and unique experiences across various data sources.

3.2 Data analysis

Data analysis began with all the Zoom transcripts of the recorded videos being cleaned up by the first two authors. This process also included removing any names or other identifying information from the transcripts. The first and second authors collaboratively analyzed the surveys, syllabi, and video transcripts. The data were inductively coded to capture the instructors' experiences. Two types of inductive coding were utilized: value coding – identifying a person's values representing their perspective, and versus coding – identifying, in dichotomous terms, the individuals, groups, or phenomena in direct conflict with each other (Saldaña, 2013). These coding methods were selected because, upon transcribing the recordings, the researchers noticed a large prevalence of difficult choices the instructors described having to make. When the instructors explained their choices and the uncertainty they experienced, we identified the values underlying their decision-making and the points of tension they encountered. Ultimately, inductive coding helped us characterize the teaching values and tensions unique to the pandemic teaching (personal domain, Figure 1B). The data were also deductively coded using provisional codes from the Seven Principles of Good Practice in the Online Environment and CoI framework (Section 3.1). These codes helped us characterize the instructional practices used to provide remote teaching (domain of practice, Figure 1B).

Upon creating the codebook, the authors engaged in constant-comparative analysis to evaluate each code and build hierarchies of codes and categories according to each domain in the Interconnected Model of Professional Growth (Saldaña, 2013). The authors discussed each case of disagreement in their coding until a 100% inter-rater agreement was reached. In addition, the authors wrote memos after coding each prompt to capture their reflections on the data throughout the analysis. In the final phase, the researchers synthesized the central ideas in the data to form themes. The themes emerged through reflection on all codes, categories, and analytical memos (Glasser and Strauss, 1967). Peer debriefing, investigator triangulation, data triangulation, code-recode strategy, and memo-writing were the methodological strategies employed to ensure the credibility, dependability, and confirmability of the findings (Shenton, 2004; Anney, 2014).

4 Limitations

This study presents a characterization of the instructional landscape within one Chemistry Department during the onset of the COVID-19

pandemic. While the experiences of chemistry instructors from this Department may be similar to what instructors encountered at different institutions, we do not claim that the results from this sample are generalizable to all institutional contexts. Additionally, the unique characteristics of this Department and the discipline of chemistry more generally may limit the applicability of our findings to other contexts.

Second, despite eliciting thorough responses due to the open-ended nature of the survey prompts, surveying does not enable additional probing questions. Thus, responses depend upon the instructor's interpretation of the prompts without the opportunity for researchers to request further explanation. Nonetheless, the multiple scaffolded questions in the survey (see appendix) encouraged instructors to elaborate. Similarly, the researchers were unable to ask questions during the divisional meetings. However, these unstructured meetings enabled instructors to discuss the important things to them without intrusion.

Third, even though the partipants were informed that the sessions would be recorded for research purposes in strict adherence to the ethical guidelines outlined by our IRB (which included detailed information on the recording, the confidentiality measures in place to protect participants' identities, and their rights as research subjects), we acknowledge that the act of recording might still have influenced the dynamics of the discussions to some degree.

Finally, we provide a thorough discussion of instructors' *intended* instructional practices. Video observations of their *enacted* instructional practices are not included in these data. However, since the divisional meetings occurred at multiple time points, we have insight into instructors' reflections on some of their *enacted* practices.

5 Results and discussion

We present the findings organized according to three themes. Theme 1 is primarily situated in the personal domain of the Interconnected Model of Professional Growth: Conflicting values created points of tension for the instructors that were unique to remote teaching during the pandemic. Theme 2 corresponds with the domain of practice: Instructors used technology to create educational environments that enabled student–instructor contact but did not prioritize student–student contact. This theme describes how instructors' values impacted their instructional practices. Finally, theme 3 reflects change sequences between the external and personal domains: Both the pandemic and the communities of practices adjusted instructors' values.

Quotes are used to describe the instructors' experiences in their words. The quotes are accompanied by a pseudonym and a descriptor of that instructor's class (i.e., 'online class' or 'hybrid class') and the data source (i.e., 'survey' or 'divisional meeting'). Regardless of class format, similar patterns emerged in the instructors' experiences.

5.1 Theme 1: personal domain – conflicting values created points of tension for the instructors that were unique to remote teaching during the pandemic

Something very common in instructors' discussions was the difficult choices they had to make when adjusting to teaching in online or hybrid formats. To explain their choices, the instructors often described the values underlying their decision-making. Eleven values were identified among the instructors. Table 1 contains the definition of each value and exemplary quotes.

The values are not necessarily unique to the conditions created due to the pandemic; during pre-pandemic times, instructors still valued things like student attendance or academic integrity. However, with the sudden shift to remote learning, instructors experienced and expressed multiple conflicting values when making instructional decisions. These points of tension are summarized in Table 2. Five points of tension were identified: the first three are conflicts between two different conditions of the classroom environment and how students access content, and the last two points of tension are conflicts between groups of individuals. While a point of tension may have multiple associated values, the key values that create this conflict are underlined. Neither option is correct nor always suitable, as conflicting values are nuanced and contextual (Saldaña, 2013). Below, we describe each point of tension in instructor values in more detail.

5.1.1 Asynchronous versus synchronous instruction

Instructors found it difficult to identify the best format for their instruction. They described an asynchronous class as a flexible, self-driven class in which students view recorded lectures on their own time, whereas in a synchronous course, students must attend classes with the instructor (either online or in-person). These course designs created tension as instructors struggled to balance the best format for their students' learning and well-being. This tension was rooted in instructors wrestling with valuing both student attendance and wanting to create a flexible environment to support the needs of their students (Table 2).

Several instructors preferred synchronous courses as they felt that increased attendance would increase engagement and better academic performance. Sam (online class, divisional meeting) expressed this when they said, "*I have a very biased opinion that it would be much better to hold a synchronous course just because it will force students to come, hopefully… I think I've also seen a little bit of research that suggests that some students do not deal well with this sort of more open-ended environment. And so, it can be easy for them to fall into bad habits….*"

However, other instructors prioritized flexibility when choosing an asynchronous course. Jamie (hybrid class, divisional meeting) stated, "*So that's why I made it asynchronous and not, you know, demanding that they tune in at certain times with their different work schedules.*"

Though instructors selected a format for their course, many questioned their decision and integrated elements of each. For example, recognizing the affordances of both asynchronous and synchronous methods, Harper (online class, divisional meeting) was curious if they could incorporate aspects of both formats (Table 2). Taking advantage of each format might be worthwhile as previous research shows that students prefer a hybrid asynchronous/synchronous format over either method exclusively (Petillion and McNeil, 2020; Accettone, 2021).

5.1.2 In-person versus online instruction

Like the previous tension, instructors constantly reflected on which course design was best for students. Some instructors believed that students were more likely to complete assignments and participate when required to attend in-person courses. Instructors also felt there

TABLE 1 Instructors' values that drive their decision-making and illustrative quotes.

Value	Definition	Quotation
Academic integrity	Students should not cheat on assessments	*"Academic integrity was a challenge. Many students did not know how to navigate studying together while not copying from each other. I learned that my class of about [number] students had a Discord account and a GroupMe account. Although I was happy that they were supporting each other by interacting on these platforms, I wasn't happy that they were not adhering to the academic integrity policies."* – Finn (online class, survey)
Active learning	Teaching strategies that push students to cognitively engage in meaningful learning activities	*"[My] face-to-face sessions focus on interactive problem-solving."* – Alder (hybrid class, survey)
Assessment integrity	Quality assessment practices	*"So when you are putting a lot of difficult questions like, there's like a chunk of exam where there's like one after another. It can result in fatigue, I guess."* – Brooks (online class, divisional meeting)
Attendance	Students being present in class	*"I do not require [attendance] because there's, you know, they are kind of skittish about coming on campus with COVID. That's why I'm kinda happy with [course number]. It's like 75–80% of them that come."* – Jordan (hybrid class, divisional meeting)
Clear communication	Consistent support and open lines of communication between (a) students and instructors, (b) multiple instructors, (c) instructors and administration	*"It was only one student over [course capacity], but I was just wondering if it ever can be, you know, like five or six over? I did not like that I wasn't informed; I felt like someone overstepped me. So it's just like, I felt like it was the communication to me."* – Logan (online class, divisional meeting) – describing that the administration increased their course capacity without notifying the instructor
Equitable access to resources	Diminishing financial, physical, or technological barriers for students to access course materials	*"I do tell them [students] when they purchased the information for [course number one], they are all set for [course number two] if they have me again. So essentially, you are paying for [course number one] and [course number two] if you choose to enroll in my class for [course number two]. So, I do tell them that so they are not going to have to pay again."* – Logan (online class, divisional meeting)
Flexibility	Supporting the needs of students based on their unique identities	*"I want to give my students the ability to make some choices about how the course is run. And so, I think one of the big questions is going to be back to that asynchronous [or] synchronous…"* – Sam (online class, divisional meeting)
Relevant instruction	Emphasize applications of chemistry in everyday life or to students' professional goals	*"I'm going to have each student post a comment about some aspect of chemistry in their life. It could be something like, well, uh, baking cookies; what kind of chemistry or physical changes are involved in baking cookies? So, each student will do a couple of entries on a particular topic that the student has identified as an application of chemistry in their everyday experience."* – Carter (hybrid class, divisional meetin)
Quality instructional resources	Resources used for instruction that effectively promote learning	*"There's some security in having publisher materials, supplemental materials, question banks, presentations, and links. So, we are not starting from scratch. Now, there might be some really good open-access resources that have kind of a package, but um, the reliability of those may not be as high."* – Alex (online class, divisional meeting)
Safety	Navigating university COVID-19 guidelines while contesting unwarranted policies	*"Um, I got an email. My interpretation was that we were going to get our hands slapped [in] the labs because the university had to put people in quarantine because they had been within six feet of people for more than 15 min in the labs. I responded, and I sent them a document from the association that like studies fume hoods and stuff like that. And they had a nice sentence saying that because of how the labs with few hoods are designed… the air within the space is turned over quite frequently, compared to a normal lecture space. And that is, generally speaking, a more safe environment."* – Julian (hybrid class, divisional meeting)
Student engagement	Students participating in the course	*"I do not know if they are paying attention, of course. I am doing participation points where they have to, like I'll ask an easy question, and I do not even care what they put as the answer and honestly [TA's] not even grading them. He's just like everybody come, but like I am telling them I'm giving participation points. Like periodically, I'll ask a question, and they have to put it in the chat to make sure that they are staying engaged. I think it's better than the engagement I had last semester."* – Morgan (hybrid class, divisional meeting)

would be greater academic integrity in an in-person course. Most instructors, like Alex (online class, divisional meeting), believed students "want to be with their peers learning together. I do not think the majority of students want to be learning virtually." Other instructors preferred virtual courses to provide students with a more flexible and accommodating educational experience in which students would feel safer. Sam (online class, divisional meeting) expressed this when they stated, "*I teach the evening section, and so I have probably more post-baccalaureate [students]. I'm sure that some of them actually enjoy the flexibility of not having to drive on campus to come to class*."

5.1.3 Paid versus open-access resources

This point of tension emphasizes the conflict around what resources are most effective for students. This tension evolved as

TABLE 2 Points of tension experienced by the instructors and illustrative quotes.

Tension	Definition and values	Quotation
Asynchronous versus synchronous instruction	Instructors debated between asynchronous and synchronous instruction as they struggled to find the best format for content delivery (flexibility versus attendance)	*"Something new I'm trying this semester is rather than typical office hours… discussion sessions… I'll have scattered sessions throughout the week, and students can just drop in. Otherwise, the course is set up to be self-paced. So I'm going to assign some points to it, to, so students actually, to encourage [them] since the course is asynchronous, but as long as they can just show up, even if it's for 5 or 10 min… Since the course is asynchronous, I cannot technically force them to really attend… I was kind of battling with it. Can we ask students to show up for a few minutes for one of those sessions? Or is that, would that not be allowed at all in an asynchronous course?"* – Harper (online class, divisional meeting)
In-person versus online instruction	Instructors were uncertain about the best way for students to attend class (attendance and/or academic integrity versus flexibility and/or safety)	*"You all have me thinking… back in the day, you know, I would have my lecture notes, and people would ask for me to post what I filled out on my note sheets, right? And I said no, you got to either come to class or get it from a classmate… [Now] I made it asynchronous and not, you know, demanding that they tune in at certain times with their different work schedules that they have they have gotten and things like that… It's all up to them, and so the most important part of the course is what they are doing on their own at home. So why am I forcing them to come into the lecture? That's my philosophy there. Why is it important that they are there in person? You know it's easy to say that yeah, you are gonna come to lecture, it's important, but now I do not know if I believe that after this experience."* – Jamie (hybrid class, divisional meeting)
Paid versus open-access resources	Struggle to balance the reliability, cost, accessibility, and duration of course materials when determining what is optimal for students (quality versus equitable access to resources)	*"Uh, you know, one thing to think about, uh, is in terms of [the] effectiveness of learning as well as the economics [of] open-source textbooks. We're pretty much tied to the commercial textbooks. Uh, but if there are other utilities out there that would be [just] as effective, um, and certainly more effective.. Um, then we might not be as tied to the, uh, commercial textbooks and the expenses associated with that."* – Carter (hybrid class, divisional meeting)
Instructor versus students	Instructors perceived that some students were at odds with instructor course policies and believed that students perceived that instructors were working against them (academic integrity versus assessment integrity)	*"There are also many more easy ways to cheat in a remote assessment (facetime friends, Chegg,* etc.*). The cheating forces faculty to modify their assessments; instead of focusing assessments on appropriately determining the students' level of understanding, we are writing quizzes and exams so that they do not cheat. The students [then] get upset because the exam/quiz style is changing. This increases the difficulty for them and throws them off. They understand that the faculty member is doing this change to prevent cheating, but it still stinks for them. The next consequence for the atmosphere in the classroom is that there is a "faculty* vs. *students" mentality. Faculty are overly focused on catching cheaters, and students feel that the faculty are accusing everyone. Or the students no longer feel that they are innocent until proven guilty. Students who do not trust or respect the faculty member will not work as hard in their course."* – Max (online class, survey)
Instructor and student versus others	Other people or platforms operated in conflict with the goals of instructors and students (clear communication versus flexibility)	*"Students have been having difficulty with overrides… more guidance from the registrar would be helpful.."* – Alex (online class, divisional meeting)

instructors struggled to balance equitable access to resources (as measured by the cost, accessibility, and/or duration of access to course materials) with the quality of instructional resources (Table 2) when determining what is optimal for students. Students who use paid resources often purchase course materials (e.g., textbooks, external homework systems) for a finite period. In contrast, open-access resources are freely accessible to use indefinitely. At the same time, some instructors were concerned that free resources might not be reliable (see Alex, online class, divisional meeting, Table 1).

During the divisional meetings, instructors had in-depth conversations about how they could ensure students could equitably access and finance their instructional materials. This value was demonstrated differently across instructors. Some instructors would recommend older editions of textbooks because they are often less expensive than new editions. Others used electronic textbooks or adaptive learning packages. Some were concerned about how content was presented in textbooks and did not require them. Instructors like Logan (online class, divisional meeting, see Table 1) encouraged their students to take their section of the class for two semesters to prevent them from purchasing a new textbook and online homework for the second semester. Reagan (online class, divisional meeting) stated, "*I never asked the students to purchase a textbook because I'm the kind of person who will always go for the free ones, the older version. I also asked my students at the end of each semester do they really need a textbook. Right now, they can just go to YouTube or anywhere to find a video explanation. They do not really need, you know, to sit there and read.*" *When asked if they have a specific list of videos for students, Reagan responded, "I do not have any, but I think students, they just go to YouTube and type the topic, type in 'concentration.' And I listened to a couple of them, and I think they were doing a very good job.*" Reagan's experience is not uncommon; in another study, over 60% of students reported using YouTube as supplemental instruction in remote learning (Krishnamurthy, 2021).

Instructors' care and concern for students to equitably access quality instructional materials was reflected in many creative solutions that they brainstormed together. For example, Sam (online class, divisional meeting) suggested a financial support system for students that the other instructors quickly esteemed: "*I had one student who*

had a financial hardship case, and so I was able to get [textbook company] to provide homework access for free for this one student. I think this is something that we should consider… You know these subscription services are getting increasingly more expensive… and so we should consider asking for them to give us like maybe 1% of potential hardship access."

5.1.4 Instructor versus student

This point of tension explores the conflict between instructors and students. Instructors felt that violations of academic integrity compromised assessment integrity. For example, Finn (online class, survey, Table 1) described their students as not adhering to academic integrity policies by collaborating on individual assignments on Discord or GroupMe platforms. Even though the instructor was happy that students "*were supporting each other by interacting on these platforms*," academic integrity was of concern. Max described how tension developed between students and instructors and resulted in hostile classroom environments (online class, survey, see Table 2). Max highlighted that "*students who do not trust or respect the faculty member will not work as hard in their course*." This conflict was very challenging for most instructors who worried that students perceived instructors were working against them. They felt they constantly had to outthink their students and mitigate cheating. Instructors knew that strategies, such as changing the assessment format, were demanding for their students but thought they were necessary to prevent cheating and ensure assessment integrity. Indeed, previous research shows that online exam proctoring systems and a lack of test-taking flexibility can increase anxiety (Mohammed et al., 2021), especially for historically marginalized students (Arneson et al., 2022).

5.1.5 Instructor and student versus others

Instructors also expressed that other people or platforms operate in ways that conflict with the goals of instructors and students. These 'other' entities include administration, textbook publishers, and technological platforms. For example, the instructors occasionally discussed unclear communication between the administration and the instructors. Logan (online class, divisional meeting) was frustrated by their class being over-registered without their knowledge (see Table 1). Alex (online class, divisional meeting) mentioned that they and their students had challenges working with the registrar's office and expressed that those lines of communication could be more efficient (see Table 2).

The values listed in Table 1 were the drivers behind how courses were structured. Theme 2 describes further how these values (personal domain) influenced instructional choices (domain of practice).

5.2 Theme 2: domain of practice – instructors used technology to create educational environments that enabled student–instructor contact but did not prioritize student–student contact

Five subthemes were captured from the surveys and divisional meetings that describe the teaching experiences of the instructors in this Department during the onset of the pandemic.

5.2.1 Instructors supported student learning in various ways, such as by communicating clear expectations, setting a consistent course schedule, and providing feedback

Two teaching values were essential to this subtheme: student engagement and clear communication between students and the instructor. Instructors wanted students to be engaged in the course by completing assignments and asking questions. To encourage this, all instructors created intentional systems to communicate their expectations and guidelines to students and support student learning when designing their online and hybrid courses. Instructors reported consistently communicating procedural expectations throughout the course by mentioning them in multiple platforms [e.g., syllabus, email, the learning management system (LMS)], and, if possible, restating expectations during class. These expectations often surrounded "Zoom etiquette" and how to complete assignments, take exams, and engage in discussion boards. Almost all instructors also reported setting a consistent course schedule. For example, some instructors' online homework assignments were routinely due on the same day and time each week. The instructors' syllabi reflected this consistent scheduling.

Instructors valued providing feedback to their students. For this reason, they created mechanisms to provide public (e.g., class announcements), private (e.g., email), or impersonal (e.g., automated online homework) feedback to students. Notably, instructors like Monroe (hybrid class, survey) stated that providing prompt feedback was "*more difficult when most work is conducted online. Although, I do try to provide prompt feedback to the class when it is clear that important concepts or learning objectives seem problematic.*"

A few instructors reported creating systems to monitor students' time on task. Jordan (hybrid class, divisional meeting) attempted to support students in time management in their course through the way they presented course materials. Jordan stated, "*I roll [course materials] out by exam.. just to keep it structured.*" Others provided students with a suggested study plan for guidance. Remote learning is strenuous (Accettone, 2021), so it was helpful that a few instructors provided study plans to support students in monitoring their time on task.

5.2.2 Most instructors supported diverse learners by creating a flexible and accommodating learning experience or providing various instructional resources

The values essential to this subtheme were flexibility, attendance, and quality instructional resources. Many students at this institution are post-baccalaureate students who work in preparation for professional schools. Instructors were mindful of students' life circumstances when deciding the course structure and format. For example, some instructors used polls to solicit student preferences about aspects of the course structure. The instructors demonstrated empathy for the students and their various circumstances. Morgan (hybrid class, divisional meeting) exemplifies this when trying to coordinate with a military student, "*I have one woman who emailed me to take my class. She said she's in the army or something. And she's going to be in California.. [I'm] trying to be as flexible as possible…*."

Attendance was a value shared among the instructors, but their attendance policies varied. Most instructors made attendance optional to prioritize creating a flexible and accommodating learning experience. Others required and checked attendance daily because

they were concerned that student performance would be negatively impacted if they did not attend class. Even if optional, all instructors preferred students to be present in class (see Jordan, hybrid class, divisional meeting, Table 1). Instructors reported other accommodations, such as refraining from enforcing participation or adjusting deadlines and course format to be more flexible with student schedules and their other priorities.

Instructors provided a variety of resources to students. They created or utilized others' content videos, problem sets, and PowerPoint presentations to give their students different ways to engage with the course content. Most instructors shared videos of the synchronous lectures to reach a larger student population and support student schedules (Aguirre and Selampinar, 2020; Krishnamurthy, 2021). Others felt it could discourage students from attending class and only shared class recordings if requested. It is important to note that some instructors intentionally included a wide variety of resources to support the needs of diverse learners, whereas others did this without an explicit goal to support diverse learners. For example, when asked how they supported diverse ways of learning, Tanner (hybrid class, survey) said, "*I never gave this much thought*." Though they were not intentional about supporting diverse learners, they still used various instructional resources in their course.

As described in subtheme 1 and 2, the organized and consistent course structure and elements of flexibility provided clear guidelines for learning remotely and likely decreased student anxiety during the pandemic (Simon et al., 2020; Youmans, 2020; Mohammed et al., 2021).

5.2.3 While a few instructors had an inaccurate view of active learning, the rest reported engaging their students in active learning activities

Activities in which instructors emphasize *cognitive* engagement were considered active learning activities (Chi and Wylie, 2014). Active learning facilitates student-content interactions and emphasizes higher-order cognitive engagement through activities that often include group work (Chi and Wylie, 2014; Theobald et al., 2020). Within this subtheme, we distinguish between values and practices that facilitate active learning and those that facilitate student engagement because there were instances when active learning was not the primary goal. For example, Morgan (hybrid clas, divisional meeting, Table 1) mentioned using polls or questions to get students to participate; their emphasis was not on whether students *cognitively* engaged with content, just whether they were paying attention.

Similar to findings from other studies (Henderson and Dancy, 2009; Sciuchetti et al., 2016), a few instructors were unfamiliar with active learning strategies. When asked about active learning strategies in the survey, three instructors reported that their students took notes or used reading guides as their form of active learning. Neither activity is considered an active learning strategy or an evidence-based instructional practice (Henderson and Dancy, 2009). However, most instructors described at least one active learning strategy implemented in their online or hybrid classes. Most often, these included completing practice problems or polling questions. Instructors who incorporated active learning did so periodically throughout the course and usually reported implementing only one strategy. Only one instructor mentioned using more than two active learning strategies. This finding shows a potential area for professional development, as previous research found that the more ways students engage with the content, the better their performance (Miltiadous et al., 2020). As described in the next subtheme, the active learning practices primarily encouraged independent work.

5.2.4 While student–instructor contact was low despite the instructor's efforts to engage with students, student–student contact was not prioritized

Four teaching values were essential to this subtheme: active learning, attendance, relevant instruction, and flexibility. Each instructor incorporated multiple examples of student-instructor interactions in their courses. Asynchronous contact methods such as email or LMS posts were frequently used to maintain student-instructor interactions. A few instructors stated that they purposefully designed their courses to have little synchronous contact (i.e., asynchronous courses where the instructors and students met only during office hours). Synchronous student-instructor interactions primarily occurred through polling questions and office-hour discussions. The instructors who intended to have frequent synchronous interactions often reported that student-instructor contact was lower than expected despite the instructors' efforts. As other studies have reported (Aguirre and Selampinar, 2020; Burnett et al., 2020; Perets et al., 2020; Youmans, 2020), there was poor student attendance and participation in the course activities; this existed even for classes that required attendance. Furthermore, many instructors observed that attendance and engagement decreased throughout the semester. Carter (hybrid class, divisional meeting) mentioned to the other instructors that "*the past few weeks, fewer and fewer students [are] showing up in the classroom, down to two or so these days. And it seems like fewer are actually zooming in or logging into the Zoom session, as well. Um, I try to have numerous activities in the class to try to get everybody engaged. Are you feeling anything similar?*" The other instructors responded with a similar sentiment; Harper (online class, divisional meeting) even stopped taking attendance because it was "*all over the place*." Despite instructors' efforts, they were disappointed in the number of student-instructor interactions and felt disconnected from their students.

While most instructors reported putting effort into creating avenues for student-instructor interactions (public and private, synchronous and asynchronous), the same effort was not described for student–student interactions. More than half of the instructors said they designed their courses without creating avenues for student–student contact. Two instructors reported that although they did not initiate student–student interactions, students independently formed online study groups. Those who incorporated student–student interactions did so periodically. One instructor, Carter, reported engaging students in providing feedback to other students in discussion board activities in the LMS. They stressed allowing students to bring their unique experiences into the classroom to make the chemistry instruction relevant to their lives (see Table 1, Carter, hybrid class, divisional meeting).

A few instructors who purposefully designed their classes to have student–student interactions stopped this practice as the semester continued. Reagan (online class, divisional meeting) knew the value of group work but deprioritized it to increase content coverage: "*I do not do any breakout rooms anymore. I did that at the beginning of the semester, but now I feel like both of my classes are going much slower*

than I expected. So, to save some time, I just maybe give them 30 s [or] 1 min to think about how they would solve the problem instead of actually asking them to solve the problem."

5.2.5 While technology enabled instructors to mitigate the magnitude of challenges, it also created new challenges

Five teaching values were essential to this subtheme: academic integrity, assessment integrity, clear communication, flexibility, and quality instructional resources. The LMS, Zoom, online textbooks, and other technology eased the transition to remote learning. Instructors stressed that Zoom and the LMS enabled them to communicate with their students and deliver content through prerecorded narrated videos. These videos permitted students to study and learn at their own pace. Students who could not attend class could receive comparable instruction to those attending class in a face-to-face format. Furthermore, online homework systems gave students automatic feedback, and online exams made grading easier.

However, technology posed a challenge for the instructors as well. Some instructors struggled to decipher between media platforms and avoid overwhelming themselves and their students. Max (online class, survey) explained why they felt instructors struggled to implement student–student interactions with technology when they wrote that "*discussion is very hard with a remote/hybrid [format]. Many virtual meeting platforms only allow for one person to talk at a time, so that makes for awkward discussions. Group work is also hard since it is more cumbersome to share work or ideas. When face-to-face, students can write on paper or a white/blackboard. Online, there are ways to annotate and share info, but it is not as easy to draw/write, which leads to confusion. This confusion slows down the process, which can lead to frustration (which leads to students checking out)*." As previously reported (Villanueva et al., 2020), deciding which platforms were appropriate, learning the new platforms, and ensuring seamless integration were overwhelming tasks for instructors.

Over half of the instructors reported that heavy reliance on technology allowed for increased student cheating and led to the instructor versus student point of tension. Instructors valued their students' academic integrity; however, like in other studies (Burnett et al., 2020; Kolack et al., 2020; Rupnow et al., 2020), instructors were concerned about academic dishonesty (see Finn, online class, survey, Table 1). Almost all instructors administered online multiple-choice exams. To prevent cheating on these exams, instructors implemented strategies similar to those suggested by Burnett and colleagues (Burnett et al., 2020). They would randomize exam questions, deliver one question at a time, set time constraints, use online proctoring systems, and prevent students from returning to previous questions. These solutions reduced cheating but limited students' flexibility while taking tests. Brooks (online class, divisional meeting) expressed this when they stated, "*I do feel for my students [who] feel more anxious around the assessment. They do not know how long each question will take them, how complicated it will be, and they know that there's time ticking. They do not know what's coming up. I think it adds to the stress*." Regarding cheating, technology solved some problems and created additional challenges.

The five subthemes presented above provide an overview of the instructors' experiences teaching during the pandemic. Overall, instructors used technology to create educational environments that enabled student-instructor contact but did not prioritize student–student contact. When there are little to no student–student interactions, there are very few opportunities for students to support each other in learning (Shea et al., 2010). Whole class discussions or discussion board posts provided some opportunities for students to exchange ideas, but these tools put the teaching responsibility exclusively on the instructors.

The theme above described how instructors' values impacted their instructional practices. In the final theme, we outline how instructors' values changed due to engaging in a community of practice to support each other in teaching remotely during the pandemic.

5.3 Theme 3: both the pandemic and the communities of practices adjusted the values that instructors prioritized

The pandemic and the shift to remote teaching created a lot of changes for the instructors that resulted in several change sequences (i.e., a change in one domain that causes a change in another domain via reflection and enactment) (Clarke and Hollingsworth, 2002). To explore these changes in more detail, we explore the case of Jamie (hybrid class, divisional meeting), Logan (online class, divisional meeting), and Max (online class, survey). The varied perspectives provided by these cases offer nuanced insights into the challenges and adaptations experienced by instructors in both hybrid and fully online environments.

For many instructors, the pandemic and the shift to remote teaching impacted the values they prioritized. Jamie illuminates this change sequence when they discuss the importance of having students attend in person (see Table 2). Before the pandemic, Jamie required students to attend class. The shift to remote teaching prompted Jamie to enact (flow 1, Figure 2) a consistent course schedule and a flexible learning environment with optional attendance. Upon reflection (flow 2, Figure 2), Jamie recognized a change in the salient outcomes in their course: there was poor attendance, but students appreciated the consistency and flexibility. Upon further reflection (flow 3, Figure 2), Jamie's teaching philosophy and values began to shift from focusing on student attendance to student engagement. This shift, catalyzed by teaching remotely during a pandemic, is well illustrated in the following Jamie's statement: "*It's easy to say that yeah, you are gonna come to lecture, it's important [for students], but now I do not know if I believe that after this experience*."

Jamie's change sequence resulted from the overall shift to remote teaching caused by the pandemic. Other instructors' change sequences resulted from the information they learned from their colleagues when meeting together as a community of practice. Logan enacted an instructional practice shared with them during one of the divisional meetings but discontinued it because it was too difficult to facilitate, and student buy-in was very low. Logan stated: "*Um, I do, you know, activity sheets, and I decided to not do the Zoom breakout rooms that we talked about because I took a poll of the students, and they opt not to do breakout room sessions because when I break up in the rooms, no one's talking. I did try to tell them to introduce themselves as an icebreaker, and I would check in, and they are just sitting there, or their cameras are off, or they are muted, so no one is interacting. And so, based on the poll of the students, they prefer that we just stay out in the main session and we work through it together. Like I'm leading the discussion, but then I am calling on people, or they are raising their hand to*

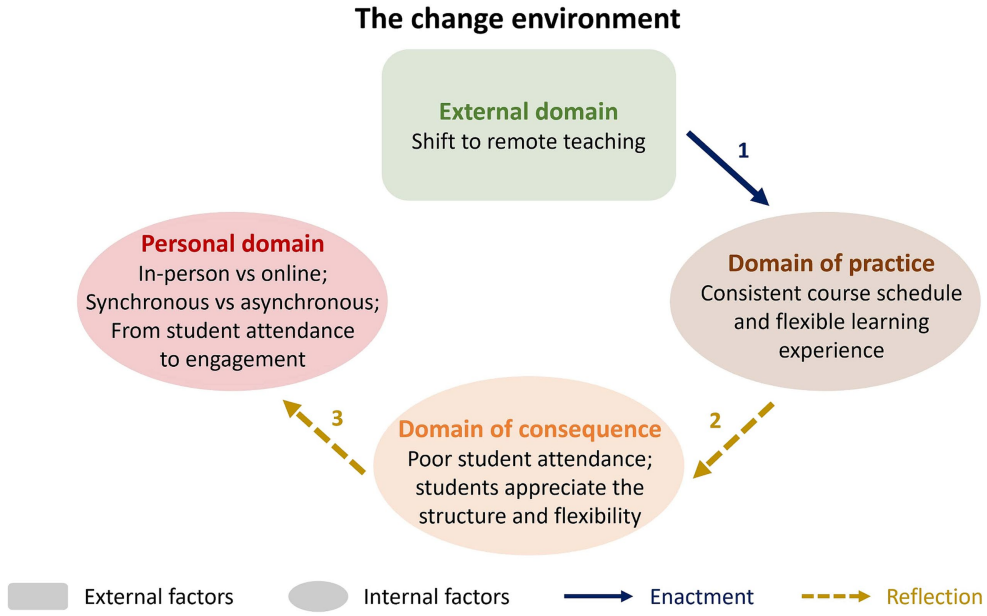

FIGURE 2
A change sequence expressed by Jamie. The numbers above the arrows represent flow in the various change sequences.

volunteer. I know in person when I did the activity sheets, they would talk amongst themselves. In the classroom, they are able to do it. So that's one thing I noticed."

Logan enacted their colleagues' recommendation (flow 1, Figure 3) to use breakout rooms in their course to create student–student interactions. After reflecting on the salient outcomes (flow 2, Figure 3), Logan realized that students were not engaging with each other in the breakout rooms. This corroborates research on student perceptions of remote lectures (Accettone, 2021) which found that only about half of the students valued student–student interactions. This is problematic because effective implementation of group work can support learning gains and build community (Johnson and Johnson, 2002; Chi and Wylie, 2014; Flener-Lovitt et al., 2020; Reinholz et al., 2020; Arneson et al., 2022; Ng et al., 2022). As an outcome of this reflection, Logan stopped using breakout rooms (flow 3, Figure 3) and refocused on class discussions with primarily student-instructor interactions. Upon reflection (flow 4, Figure 3), Logan thought that they were more successful in engaging students via the whole class discussions. Upon further reflection (flow 5, Figure 3), Logan deprioritized student–student interactions and prioritized student-instructor interactions in the remote environment. Importantly, Logan also developed a belief that the technology that they used was a barrier to promoting student–student interactions (Shadle et al., 2017).

Max expressed another change echoed by multiple instructors (see Table 2). Due to the shift to remote teaching, instructors enacted online assessments (flow 1, Figure 4), which increased student cheating (flow 2, Figure 4). In their communities of practice (flow 3, Figure 4), instructors discussed and reflected on the issue of cheating and ways to prevent cheating on assessments (e.g., preventing returning to previous problems on assessments). The instructors began to prioritize academic integrity over the integrity of their assessments (flow 4, Figure 4). Because of this shift in priorities, the instructors enacted practices to modify the assessments to decrease cheating (flow 5, Figure 4). Students were frustrated by the assessment changes, and instructors were disappointed they had to make changes, resulting in a distrustful environment (flow 6, Figure 4). Fortunately, the instructors continued to discuss their challenges and frustrations around student cheating (flow 7, Figure 4). Knowing that academic dishonesty was creating a distrustful learning environment, Julian (hybrid class, divisional meeting) proposed shifting away from seeking out cheating students when they said, "*we want to do what we can to increase the barrier to cheating, but we should not obsess over it.*" Instructors reflected on these discussions (flow 8, Figure 4) ultimately decided to deprioritize their focus on academic integrity to ensure assessment integrity and a positive classroom environment. This resulted in the enactment (flow 9, Figure 4) of consistent assessment policies that could minimize cheating while still prioritizing assessment integrity.

6 Conclusion and implications

This study, grounded in the Interconnected Model of Professional Growth, offers an in-depth insight into chemistry instructors' experiences during the unprecedented shift to remote teaching amid the pandemic. By examining their teaching values and instructional practices, and observing the evolution of these values through participation in departmental meetings, we gained nuanced insights into their professional growth and adaptation.

The first theme characterizes instructors' personal domain. Specifically, it summarizes the teaching values of the instructors, including conflicting values that often created points of tension. Most of these points of tension were conflicts created due to the remote learning conditions of the pandemic. They included difficulties

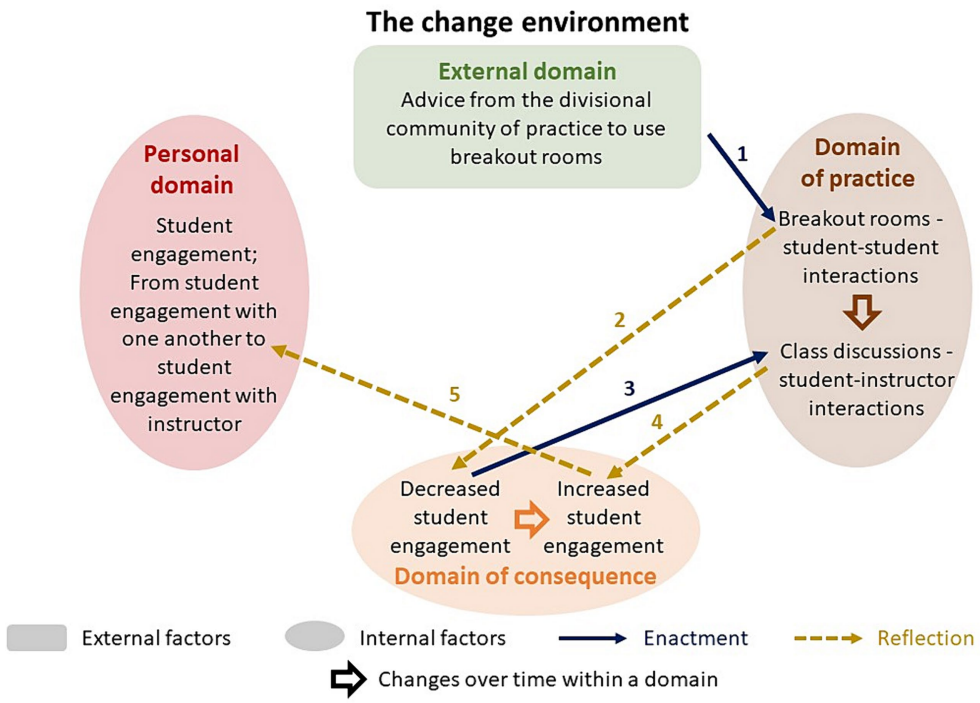

FIGURE 3
A change sequence expressed by Logan. The numbers above the arrows represent flow in the various change sequences. The large arrows within the change domains represent changes over time.

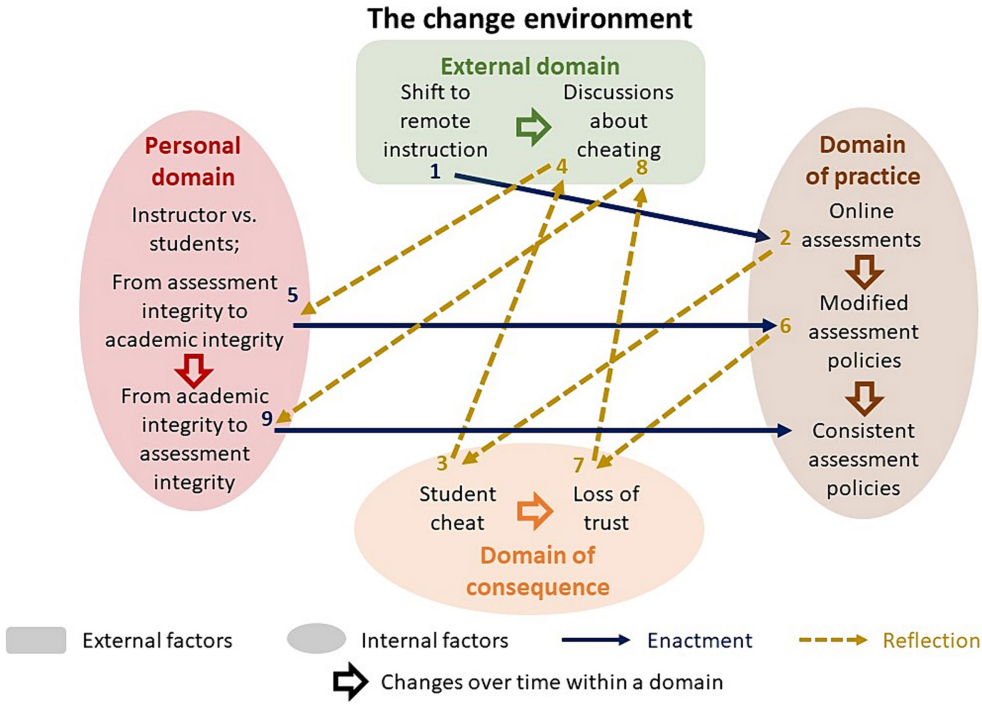

FIGURE 4
A change sequence expressed by Max and multiple other instructors. The numbers above the arrows represent flow in the various change sequences. The large arrows within the change domains represent changes over time.

selecting between two different conditions of the classroom environment - (a) asynchronous versus synchronous instruction, (b) in-person versus online instruction, and (c) paid versus open access resources, as well as perceived tension between different groups of individuals - (d) instructor versus students and (e) instructor and students versus others.

The second theme describes the domain of practice in the Department during the onset of the pandemic and how instructors' teaching values drove their practices. Instructors incorporated aspects of most of the Seven Principles of Good Practice for the Online Environment (Sorensen and Baylen, 2009; Fiock, 2020). For example, the instructors designed multiple avenues for student-instructor interactions, created a flexible and accommodating learning experience, and communicated clear expectations about learning. At the same time, there were few opportunities for student–student interactions, limiting the potential for students to support each other in their learning (Shea et al., 2010; Akyol and Garrison, 2011). This gap highlights the importance of peer support in online learning environments, suggesting that future professional development should focus on fostering collaborative student interactions to enhance learning and community building. In summary, instructors used technology to create educational environments that emphasized the teaching and cognitive presence more than the social presence, especially student–student contact (Garrison et al., 2000; Garrison, 2007).

The third theme uses change sequences to demonstrate how the pandemic and the communities of practice impacted the values that instructors prioritized. These change sequences revealed how instructors reexamined their teaching philosophies and practices. For example, Jamie's values shifted from focusing on student attendance to student engagement as they questioned the utility of in-person classes. However, the change sequences did not always align with the best practices for a student-centered classroom. For example, Logan valued engagement but prioritized student-instructor interactions over student–student interactions in the online environment. This underscores the need for continuous reflection and adaptation in teaching philosophies, especially in crisis contexts.

While instructors should be commended for the many areas in which they were successful, especially considering the sudden shift to online teaching, the data demonstrate three areas in which instructors within this Department could improve their remote instruction through professional development. First, instructors need support with implementing active learning in their courses. Most instructors reported incorporating only 1–2 active learning practices. However, it is critical to incorporate a wider variety of evidence-based instructional practices that facilitate active learning and support diverse learners (Theobald et al., 2020). Our findings suggest that instructors would benefit significantly from professional development focusing on a broader range of active learning strategies.

Second, instructors need support with facilitating productive student–student interactions online. While some instructors did not prioritize student–student interactions, others had difficulties facilitating remote peer learning activities. An absence of student–student interactions can contribute to students feeling isolated and lacking a sense of community. These interactions benefit learning online (Webb, 2015) and are essential determinants for persistence and retention (Boston et al., 2010; Webb, 2015). There is also potential for these instructors to incorporate metacognitive activities for students to reflect on their learning processes. Metacognitive activities combined with active learning can improve student performance better than active learning alone (Mutambuki et al., 2020).

Finally, our data echoes other work recommending that institutions routinely provide professional development to instructors to use technology to facilitate evidenced-based instructional practices (Sorensen and Baylen, 2009; Aguirre and Selampinar, 2020; Carpendale et al., 2020). Instructors were discouraged by poor student attendance and participation. While this was likely due to the global pandemic causing students to feel overwhelmed, it may also be a consequence of the poor facilitation of remote instruction (Petillion and McNeil, 2020). However, previous research shows that student participation increases as instructors learn to engage students in the online environment effectively (Reinholz et al., 2020; Arneson et al., 2022). Therefore, ongoing training is essential for instructors teaching remotely.

In conclusion, our study not only maps the journey of chemistry instructors during the unprecedented context of the unplanned pivot to remote instruction at the onset of the COVID-19 pandemic but also offers a blueprint for enhancing remote teaching effectiveness. The implications and targeted recommendations for professional development extend beyond chemistry education, providing valuable lessons for the broader academic community in navigating and thriving through future challenges in higher education. Higher education institutions should develop clear policies and frameworks for crisis response in teaching and learning. These policies should be informed by the lessons learned during the COVID-19 pandemic and should aim to ensure the quality and continuity of education in any future crises by equipping instructors with strategies, knowledge, and tools to navigate the evolving landscape of higher education.

6.1 Lasting changes that emerged from the emergency pivot to remote teaching and the divisional communities of practice

The COVID-19 pandemic upended the lives of many instructors and students. However, in alignment with Rupnow and colleagues, we posit the "pandemic as a catalyst for change" (Rupnow et al., 2020). The discussions in the divisional meetings encouraged instructors to become more reflective practitioners. The divisional meetings also enabled instructors to provide technological and emotional support to one another. Similar to the findings from Dancy et al. (2019), it was evident that the instructors gained resources, increased knowledge, re-examined their teaching values, and changed implementation due to participating in the community of practice (Lave, 1991). Additionally, when the departmental leadership designated space specifically for discussing teaching, it signaled to instructors that they were not alone and created a climate that prioritizes effective instruction. The experience of being a part of a community of practice transitioned the pandemic context from one that was only "change as adaptation" to one that is "change as growth and learning" (Clarke and Hollingsworth, 2002).

The divisional meetings had long-term impacts on the Department. Even after returning to in-person teaching, the instructors in the Department have continued working collaboratively to improve their courses. For example, the general chemistry and organic chemistry divisions continue to meet as faculty value meaningful discussions about teaching (Rupnow et al., 2020). These meetings resulted in the instructors re-evaluating and changing the

textbooks for their courses, creating shared learning objectives, and working on aligning their assessments and practices with the new learning objectives. In addition to the divisional meetings, the Department periodically allocates time during faculty meetings to discuss teaching (e.g., active learning, inclusive teaching, and grading practices). We encourage the leadership in other departments and institutions to consider creating explicit avenues for instructors to build communities of practice to learn from each other, support one another, and become more reflective practitioners.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by The Institutional Review Board at the University of North Carolina at Greensboro. 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

LW: Data curation, Formal analysis, Investigation, Visualization, Writing – original draft. JH: Formal analysis, Investigation, Writing – original draft. MC: Data curation, Writing – review & editing. JW: Data curation, Writing – review & editing. MP: Conceptualization, Formal analysis, Investigation, Project administration, Supervision, 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.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1371132/full#supplementary-material

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