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Multi-layered mentoring: exemplars from a U.S. STEM teacher education program

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ABSTRACT

This article presents a multi-layered approach to mentoring within an urban secondary teacher education program in the mid-southern United States. The featured case focuses on Science, Technology, Engineering and Mathematics (STEM), although multi-layered mentoring could occur in other subject areas or in general preservice teacher education. The goal is to address the shortage of qualified teachers in the school districts in one of the largest, most diverse American metropolises. This narrative inquiry research captures preservice teachers' experiences of multi-layered mentoring in the form of exemplars. The evidence for the narrative exemplars is produced by the interpretive tools of broadening, burrowing and storying/restorying. Broadening captures the case's research backdrop (i.e., history, events); burrowing digs deeply into individuals' experiential narratives; and storying/restorying captures changes that happened over time and place. Three themes emerged from the case's four exemplars: 1) interactions in knowledge communities, 2) trying on of future selves, and 3) engaging in inquiry. The experience-rich exemplars, along with these common overarching themes, distinguish the multi-layered mentoring approach. In the spotlighted case, 88% of those who graduated from the secondary STEM preservice education program were retained over a 5-year period, which exceeds the retention rates of the participating urban school districts.

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Male undergraduate student: . . . [my mentor/professor] is an incredibly positive person. So even if you are not doing well, she is willing to help you. She always encourages you. Like before I signed up for the research project, I thought to myself that I was not ready for it, but she said to me: 'You are smart.' And I said to myself, 'I am going to be good at this research thing. Right?'

Evaluator: So [your mentor/professor] gave you a story when you did not have one?

Male undergraduate student: Yes, I signed up [for the project]. It turned out well . . . And then sometimes I start to think about me not being able to do stuff, but then I remember

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that someone else believes [I] can. [My mentor] … gets [me] to do things I did not believe I could do ….

This article focuses on how mentoring experiences unfolded in *teach*HOUSTON, a National Science Foundation (NSF)-supported Science | Technology | Engineering | Mathematics secondary (STEM) teacher education programme. The teacher education programme aims to address the shortage of qualified secondary mathematics and science teachers in the U.S (C. Craig et al., 2017). It aligns with *Beyond100K*, the national goal to prepare and retain 150,000 new STEM school teachers, particularly for schools serving majority Black, Latinx, and Native American students by 2032 (100Kin10, n.d.). The need for new STEM teachers is reflected in a recent report from the National Centre for Education Statistics (NCES) (2022) which showed teacher vacancies in 4% of all US public schools as of October 2022. Teacher shortages are particularly impactful in schools located in high-poverty areas and those servicing high-minority student populations (NCES, 2022). Central to the success of the case (Orland-Barak, 2002) we present, and its significance in providing insights into mentoring in teacher education programmes, is the layered way in which formal and informal mentoring occurs (Jacobs et al., 2021; Lunsford et al., 2017). Students work with master and mentor teachers in early/ongoing field-based experiences; attend workshops/conferences; participate in internships on-/off-campus; belong to professional associations alongside peers; attend sessions designed for their parents and themselves; and interact regularly with formative and summative NSF grant evaluators. Moreover, many students matriculate through the *teach*HOUSTON programme in cohorts which create connections with other students and faculty (Evans et al., 2021). Within the cohorts, knowledge communities organically form which create safe spaces for mentoring to occur. During student teaching, preservice teachers meet with faculty, serve as apprentices to their teaching supervisors, and work with district cooperating teachers. With their professors, the preservice teachers design learner-centred 5-E (Engagement-Exploration-Explanation-Extension-Evaluation) lesson plans (Biological Sciences Curriculum Study, 1970; Lawson, 2002) appropriate for all students.

Just as definitions and characterisations of mentoring are wide ranging (Campbell & Campbell, 1997), so also are the mentoring experiences of faculty and students. The development of mentoring relationships, along with the efforts taken to maintain and sustain these connections, underscores the enduring and dynamic nature of the mentoring process (Friday et al., 2004, p. 628).

This article presents a layered form of mentoring as an ongoing discursive practice (Orland-Barak, 2005, 2012) cultivated through knowledge community interactions (Craig, 2007; Curtis et al., 2013). Exemplars involving physics education, parent-student seminars, ongoing mentoring, and formative and summative evaluation processes are spotlighted. Complexities having to do with mentoring within urban school-university partnerships become evident (Chan & Clarke, 2014). While these exemplars focus on STEM teacher education, we envision the potential of layered mentoring occurring in other content areas as well—even within a general teacher education programme.

We now present an overview of the literature, a description of our research methods, along with examples illuminating the layered forms of mentoring associated with our

case. We conclude by reflecting on the mentoring process and its influence on teacher development.

Literature review

Technical rationalism

Technical rationalism is the philosophy underlying the U.S.'s neo-liberal education policies. The technical rationalism philosophy is based on means-end, instrumentalist thinking. When the country's international status was challenged when the Soviets landed a man on the moon, the U.S. vowed to never again put its national security at risk. In 1950, the National Science Foundation (NSF) was created to attract, recruit, and prepare more qualified STEM students. NSF scholarship grants became one of several means the government used to achieve its end-goal of becoming a world superpower. However, education risks becoming 'an anthropocentric project of calculation, strategy, and human mastery' when it is too heavily influenced by means-end thinking. Those who privilege instrumentalist approaches may lose sight of 'the distinction between utility and meaningfulness. . .between in order to and for the sake of' (Arendt & Canovan, 1998, p. 157). The end goal of employment may overtake education as a means for human growth in importance.

Mentoring

Like reflection, mentoring is a ubiquitous practice championed by almost all educational paradigms. It has become a catch-all phrase and an educational approach to programme implementation. The word, Mentor, traces to the advisor, in the Greek myth, *The Odyssey*. Mentoring traditionally has had to do with an older faculty member guiding and supporting the job development of a younger peer or student (Sorcinelli & Yun, 2007). However, this presumed agreement—this 'false sense of consensus' (Wrightsman, 1981, pp. 3–4)—has been repeatedly challenged. By 1991, 15 definitions of mentorship had entered the bloodstream of education. By 2007, that number had increased to over 50 definitions (Crisp & Cruz, 2009). The definitional plurality of mentoring has continued to expand since then.

Two existing literature reviews struck a chord with us: one by Irby (2013), and another by Long et al. (2012). Irby reviewed 500 articles on mentoring and extracted 34 manuscripts relating to developmental relationships in mentoring. Developmental relationships spoke to us because relationships are foundational to narration as a discursive practice, knowledge communities, and the narrative inquiry research method, concepts we elaborate later. For Irby (2013),

> developmental relationships in mentoring [in] a *mentor/mentee dyad* (italics in original) is recognized as an evolutionary process via a recursive stream of progressive consciousness and action that builds support, trust, confidence, risk-taking, and visible positive transformation through dialog[ue]. (includes negotiation, listening, reflecting, challenging, planning) (p. 333)

The second literature review is the Long et al. (2012) one about mentoring and its relationship to early career teacher retention and attrition. This review fit our

research topic as well as the raison d'être for scholarship grant programmes. Long et al. (2012) pointed out that mentoring and induction are often used in 'taken-for-granted' ways without sufficient attention paid to their research bases and 'how problems [are] framed' (p. 8). They determined that mentoring and induction are different concepts that educators collapse into one and use synonymously. For the authors, Neilson et al.'s (2006) distinctions between induction and mentoring are instructive. Neilson et al. defined induction as 'a period when teachers have their first teaching experience and adjust to the roles and responsibilities of teaching' (p. 15). As for mentoring, it is a part of teacher induction programmes, but generally not the entire programme. Neither is mentoring limited to beginning teaching. Mid-career and end-career professionals may also seek mentorship. Mentors themselves can be guided by others as we have seen in cases reported from Israel and Norway (i.e. Orland-Barak, 2012).

Long et al. (2012) favoured a move away from 'narrow, technical and fixed goal-oriented' (p. 19) approaches to mentoring and a move towards mentoring embedded in the developmental process of becoming a teacher. For them, future research needs to be framed around sustaining teachers rather than instrumentally inducting/retaining them. They claimed that autobiographical and biographical research, identity research and continuity of experience research supports this shift in focus. This narrative inquiry is a close cousin of these research strands.

We also include mentoring programmes in this literature review. We opted to do so because the case under study involves many iterations of mentoring, including peer mentoring (i.e. Budge, 2006; Collings et al., 2014), parent mentoring (i.e. Raposa et al., 2019; Stokes, 2023), and the mentoring of underserved populations of students (i.e. Holloway-Friesen, 2021; Zalaquett & Lopez, 2006). Among other researchers, Karcher et al. (2006) focus more on mentoring frameworks than on the mentoring act itself. This shift in attention allows for a 'heterogeneity of mentoring' approaches (Dawson, 2014, p. 137) and 'a diversity of relationships across a variety of contexts' (p. 144). This is an important consideration where our *teach*HOUSTON case is concerned because developmental mentoring takes place within the context of an overarching mentoring framework, which we will describe later.

Narration as discursive practice

Mentors and mentees communicate through telling stories. We more precisely should state that people interact with one another through narrating stories. In a nutshell, mentees narrate their lived situations by positioning themselves in their storied experiences and engaging in mutual conversations with their mentors over time (Davies & Harré, 1990). These narrations form examples of discursive practices because they reflect 'the ways in which [the mentees and mentors] actively produce social and psychological [and we would add—pedagogical] realities' (Davies & Harré, 1990, p. 51). As *homo narrans*, their discursive conversations include 'the braided development. . .of story lines'—which, in turn, reflect their development of *in* situ—embedded knowledge (C. J. Craig et al., 2018). Here, we are referring to practical knowledge as Dewey (1938) conceptualised it—that is, knowledge as an

ongoing sense of knowing carved out of situations via interactions experienced over time.

Knowledge communities

In teaching and teacher education, two different versions of teacher community exist: teachers' knowledge communities (KCs) and professional learning communities (PLCs) (Craig, 2009). Our case takes shape around knowledge communities, which are safe, storytelling places where prospective teachers narrate the rawness of their experiences, negotiate meaning, and authorise their own and others' interpretations of situations (Craig, 1995). Conversations between knowledge community members produce new perspectives, which further refine teacher knowledge and, in turn, influence teachers' or prospective teachers' practices. KCs take shape around commonplaces of experience (Lane, 1988) as opposed to around bureaucratic and hierarchical relations that declare who knows, what should be known, and what constitutes 'good teaching' and 'good schools' (Clandinin & Connelly, 1996), which is what often occurs in assigned PLCs.

Research method

Narrative inquiry

According to Clandinin et al. (2018, p. i),

> narrative inquiry is based on the proposition that experience is the stories lived and told by individuals as they are embedded within cultural, social, institutional, familial, political and linguistic narratives. It represents the phenomenon of experience and constitutes a methodology for its study.

Because narrative inquiry privileges narrative as both a form and method of inquiry, it is a personal experience research method (Clandinin & Connelly, 2006). Its 'ground[ing] in relationships' (Clandinin et al., 2011, pp. 34–35), also makes it a relational form of inquiry. The relationships that narrative inquirers cultivate with their research participants gives them access to more nuanced kinds of knowing. This insider knowledge as an ongoing sense of knowing could be dismissed or go unnoticed and unreported in other methods of research—even in some other qualitative methods. Because narrative inquirers privilege relationships, they seek ongoing feedback from their participants to ensure that their participants' storied experiences are presented in their own terms and are respectful of the boundaries established between the personal and the professional.

For these reasons, narrative inquiry is a difficult research method to explain and an even more complex method to live (Clandinin et al., 2007). It cannot be reduced to steps to be enacted formulaically. In Conle's (2000) words, 'methods of narrative inquiry, rather than being externally defined, emerge out of the inquiry activities' and 'are not as much a means to an end as they are part of the ends achieved' (p. 201). Through this approach, narrative inquirers openly and wakefully attending to prospective teachers'

and teachers' stories are afforded 'better understanding[s] of educational life' (Clandinin & Connelly, 2000, p. 2).

Analytical tools

Narrative inquiry, mirroring human experience itself, is three-dimensional. Consistent with Dewey's qualities of experiences, it has three commonplaces (Schwab, 1973): interaction (personal and social), continuity (past, present, and future), and place (Clandinin & Connelly, 2000). For narrative inquirers to commingle these dimensions of teacher experience in their reporting, they use three analytical tools: broadening, burrowing and storying and restorying. Each of these interpretive devices plays a different function in the unpacking of teachers' 'narratives of experience' (Connelly & Clandinin, 1990).

In this work, we use broadening, our first analytical tool, to discuss U.S. policy making and the backdrop for why the National Science Foundation was formed in the U.S. Burrowing, our second interpretive device, is what happens when we take a fine-grained look at the reconstructed research texts of those participating in the case we feature. As for storying and restorying, it is the vehicle we use to think with stories rather than to talk about them. Through storying and restorying, experiences capturing how the NSF-funded programme became lived as multi-layered mentoring are foregrounded.

Narrative exemplars

Broadening, burrowing, and storying and restorying elicit research texts that can be presented as narrative exemplars. Adopting Bruner's (1986) groundbreaking view that story and argument are different forms of knowledge and drawing on the contributions of Kuhn (1962/1996) in the philosophy of science and Mishler (1990) in social psychology, Lyons and LaBoskey (2002) called for the use of narrative exemplars as a way to show that prospective and practicing teachers know and that they know that they know. These candidate exemplars, in Lyons and LaBoskey's (2002) words, provide '*concrete examples . . . elaborated so that members of a relevant research community can judge for themselves their "trustworthiness" and the validity of observations, interpretations, etc.*' (p. 20, italics in original). Such exemplars share five common characteristics. They:

- capture intentional human actions that not only tell a story, but convey developing knowledge of those involved,
- are lodged in socially and contextually embedded situations,
- draw other people into the mix as the narrative exemplar is unpacked,
- implicate people's identities,
- focus on interpretation, often including different points of view (Lyons & LaBoskey, 2002).

The mentor-mentee text we used to kick off this article, for example, is an abridged exemplar of a prospective teacher's interactions with his mentor/professor within the context of the *teach*HOUSTON case. The student's mentor tells the young adult that he is smart, a perception with which the prospective teacher appears to be struggling. The mentor's encouragement causes the student teacher to re-focus. He begins to self-talk in

a different way: 'I am going to be good at this research thing. Right?' The prospective teacher's concern about him not being ready to conduct STEM research diminishes in importance. He starts to see himself as able to be a STEM researcher, which further strengthens his identity as a soon-to-be STEM teacher. Entering the mix, the evaluation researcher stays with the prospective teacher's experience, further burrows into it and queries: 'So [your mentor/professor] gave you a story [about yourself] when you didn't have one?' The educator-in-the-making then restories his experience by elucidating the positive changes that have transpired. The note to file explains that the prospective teacher was not only 'good enough' to succeed with his research experiences, but he was also 'outstanding enough' to qualify for a summer research internship at Stanford University (a different place). In this truncated text, which was excerpted from a long conversation, the five characteristics of narrative exemplars are present.

Truth claims

Discussing the qualities of narrative exemplars automatically leads to a conversation about truth claims. As Lyons and LaBoskey (2002) earlier asserted, decisions about whether accounts are true or not reside with readers. The 'measuring stick' typically is the degree to which those truths are actionable (Lyons & LaBoskey, 2002) in readers' respective places and situations. Overall, narrative inquiry research privileges narrative truth (Spence, 1984) in that it follows where stories lead rather than being driven by time-ordered historical events. However, we do not mean to suggest that narrative inquirers spurn historical truth (Spence, 1984). On the contrary, time-event correspondence is important to narrative inquirers as well. But the bottom line is that narrative inquirers enter research studies narratively rather than historically. Hence, their research texts are presented narratively rather than historically.

When people communicate, they instinctively tell stories (Baboulene et al., 2019). This is because humans 'weave coherence, meaning and beauty in the spaces between themselves and their social worlds . . . ' (Penwarden, 2019, p. 249). The medium they use in these transactions is story or narrative, two terms used interchangeably in this work. According to Lamott, stories are 'mirrors, mentors, guide dogs . . . They. . .free us from hubris. . .and tunnel vision . . . ' (Lamott, 2018, p. 98). Even more importantly, 'they hold us together' by teaching us 'what is important about life, why we are here and how it is best to behave, and that inside us, we have access to. . .memories [,] . . .observations. . . imagination.' In a nutshell, stories provide 'all that we need to come through . . . ' (Lamott, 2018, p. 179). Some go as far as to claim that humans need stories more than they need food to sustain themselves. Others, like the poet, Muriel Rukeyser (2006, p. 467), maintain that 'the universe is made of stories, not atoms.'

The mentor-mentee story at the beginning of this article can again be used as an example. The featured account travels across time non-sequentially. This shows that it narratively presents data and is not driven by a time-ordered sequence. Also, we purposely included the afterword following the authentic conversation. Why? We wanted to show that the prospective teachers' 'smartness' was not only evident in the *teach*HOUSTON case, but also caused the soon-to-be-teacher to stand out in a competitive applicant pool and be selected for a Stanford internship. We wanted readers to see that the giving of a different story by the mentor and the

taking up of the story by the mentee led to a different 'end' than the student anticipated. This 'ends achieved'—which resulted from the mentor's response to the mentee and the researcher's response to the mentee's story—occurred in two different places. This demonstrated the continuity of ongoing experience so integral to narrative inquiry and strengthens the truth claims of the exemplar in the way Lyons and LaBoskey describe.

Research backdrop

As foreshadowed, the backdrop of this narrative inquiry is *teach*HOUSTON, an innovative secondary STEM teacher education programme that constitutes our multi-layered mentoring case. This article's central concern is not with *teach*HOUSTON per se. Nor is it with STEM teacher education. Rather, our focus is on the layered ways in which formal/informal mentoring occurs within *teach*HOUSTON. Figure 1, which appears below, captures the mentoring framework; that is, the many versions of mentoring that unfurl in our *teach*HOUSTON teacher education case. Readers can extrapolate from the figure that university professors, cooperating teachers, preservice teachers (who are also each other's peers), and parents all contribute to the mentoring mix—with evaluators, a different sort of mentors, interacting with all parties.

Exemplars of mentoring in the *teach*houston case

The compilation of stories that follow are exemplars of the multi-layered mentoring taking place within our *teach*HOUSTON case. To promote understanding and fluidity of form, the representative exemplars are presented from the lens of the plural 'we' rather

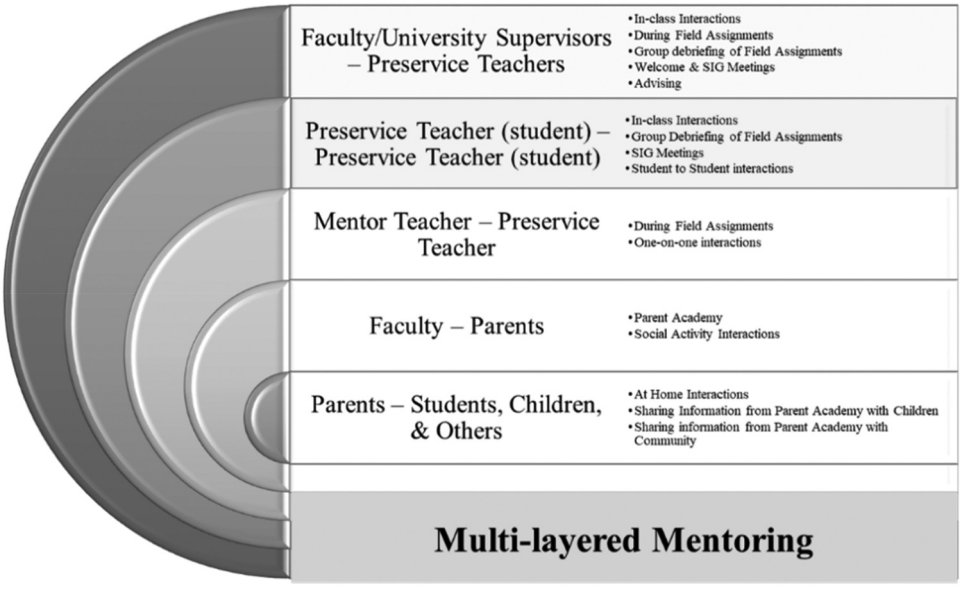

Figure 1. Multi-layered mentoring framework.

than the individual researcher's perspective. It should be noted, however, that the exemplars are from evidenced interactions between faculty members/authors Paige Evans, Donna Stokes, Leah McAlister-Shields, and their students (preservice teachers) and students' parents, as well as the programme evaluators/authors Cheryl Craig and Gayle Curtis and their interaction with the aforementioned individuals. In the Physics Education exemplar, Maria's experiences as a teaching assistant working alongside a clinical physics professor (Paige Evans) highlight faculty-student and student-student mentoring. The Physics Department Parent Academy exemplar centres on Donna Stokes's mentoring of parents whose students are enrolled as STEM majors, including pre-service teachers. This section describes parent responses to the Parent Academy mentoring, as well as how they are then mentoring others—their children at home, friends, family, and co-workers. The third multi-layered mentoring exemplar shows how Leah McAlister-Shields's mentoring of students in Culturally Responsive Pedagogy occurs in both formal and informal settings.

Physics education exemplar

In this exemplar, we illuminate preservice teacher Maria's (pseudonym) experience as a teaching assistant for a physics inquiry course as she worked alongside a physics education professor (Paige Evans) (see Figure 2), which is then followed by her journey co-constructing curriculum with her own students as an in-service physics teacher. Through this experience and mentorship, Maria expanded her understanding of physics content and inquiry-based learning; she also plans to serve as a peer mentor to others in the future. We first depict the background and description of the physics inquiry course followed by Maria's journey as a teaching assistant and subsequent enactment of science

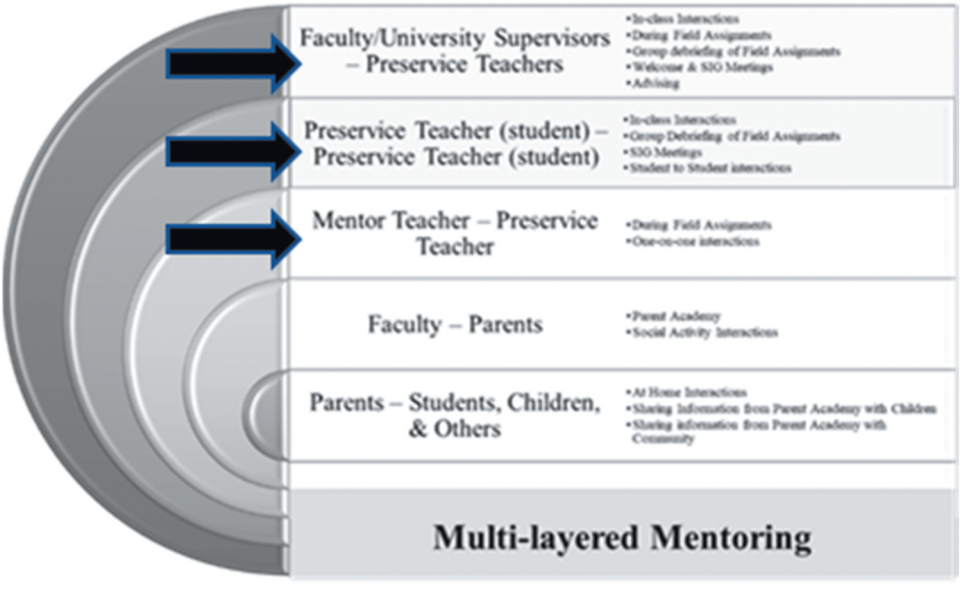

Figure 2. Multi-layered mentoring in physics education.

curriculum-as-lived in her own classroom alongside her students as they, too, inquire into physics.

Background of physics inquiry course

Many teachers have preconceived notions regarding a 'normal' class based on their own experience as a student. To Windschitl (2002), 'If teachers are willing to "re-culture" these kinds of classrooms, their first obstacle is the influence of their own personal histories as learners'(p. 151). Furthermore, studies suggest that teachers who have experienced inquiry are more likely to practice the inquiry method in their own classrooms (Pereira, 2005). According to McDermott et al. (2000), 'Whether intended or not, teaching methods are learned by example. If the ability to teach by inquiry is a goal of instruction, [prospective] teachers need to work through a substantial amount of content in a way that reflects this spirit' (p. 413). Additionally, the notion of separating science instruction from instruction in pedagogy diminishes the value of both for would-be teachers. Therefore, prospective teachers may not be able to adapt a teaching strategy to a novel situation (p. 416). Consequently, learning science content as inquiry will benefit preservice science teachers as this may influence their perception of what a typical classroom should look like and increase their confidence in teaching science as inquiry.

As a result, an undergraduate physics inquiry course was developed in the teacher preparation programme. Its goal was to augment the content knowledge of the preservice teachers through instructional strategies grounded in promising practices and inquiry-based teaching pedagogies, while allowing them to experience the process of inquiry learning.

Maria's background

From an early age, Maria enjoyed helping people and excelled at the sciences. She considered the medical profession which led her to major in biology. Early in her academic career, she tutored some students. According to Maria, 'I enjoyed seeing the thought process that students go through as they learn. I also like to help them when they are struggling.' Through tutoring she realised that building relationships was important to her. Maria stated, 'I started to doubt my ambition of being a doctor because I probably would not have the opportunity to build relationships with people with only seeing patients twice a year.' When one of her friends suggested that she try teaching as a career choice, she enrolled in the STEM teacher education programme. After taking the first class, she was immediately 'hooked' and knew that this was the right career choice.

Maria's experience as a teaching assistant

After experiencing two introductory courses, Maria decided that she wanted to get more involved and work as a teaching assistant to peer mentor others. She explained:

> When I started, I had some doubts about not being successful in the teaching profession. But I did not voice these concerns to anyone as I typically keep things to myself unless they are really bad. I could tell that others had doubts like I did and wanted to mentor them. (*student-student mentoring*)

Maria recounted an example of when she peer-mentored Juan who was also experiencing reservations about teaching: 'I could tell that Juan had doubts about teaching. He was having difficulties with his teaching partner and was considering leaving the programme. I was able to mentor him through this and look at him now!' It should be noted that Juan is now a successful teacher teaching in a high-needs school. He quickly became a leader at his campus, is involved in mentoring other teachers, and attends and presents at conferences. Maria recounts, 'I became a mentor to several students. I wanted to be there for others who are like me and did not speak up for themselves. When I was an undergraduate, I would go with the flow and not say anything until I had enough.' (*student-student mentoring*)

Maria's experience with the physics inquiry course

Maria worked with a professor that teaches both general science education classes and a physics inquiry course. When asked about mentoring, specifically in the physics inquiry course, Maria storied her experiences as a teaching assistant (TA):

> At first, I was concerned about becoming a TA for the physics inquiry course as this was not my major and not my interest. When I took physics at the university, I was not interested. Most of it was solving problems. But I delved into it and went through all the experiments and really got into it.

As a teaching assistant, Maria completed all the physics modules prior to the students to determine (1) how long each module would take, and (2) help troubleshoot any potential problems that students may experience. After each module, she unpacked her learning with the professor and discussed potential ways to strengthen the curriculum and/or make it more relevant to diverse students (faculty-student mentoring). She also set up all the experiments, made the power point presentations, went through the homework, and set everything up on Blackboard (the online classroom content shell). She recalls, 'The first semester was very intense. I persisted and wanted to figure it out.' Having the confidence of the professor was empowering, as she further explained:

> I was allowed to go through the class myself and serving as a teaching assistant for three semesters really helped me to understand the concepts. This got me where I am today. Learning from the preparation and teaching end gave me a different perspective. (*faculty-student mentoring*)

Through her involvement in the physics course, Maria was better prepared to take her teaching certification examinations. Maria was ready to embark on her professional career as a teacher. In Maria's view,

> I felt comfortable with teaching physics and was excited about being able to use some of the materials in the physics inquiry class. Working alongside the professor of the inquiry course gave me confidence, content knowledge, advice as to how to teach the content, and many activities that we strengthened side-by-side when I served as a teaching assistant. I knew that I could always reach out to her [professor] if needed. (*faculty-student mentoring*)

Maria's journey as a physics teacher

Maria is now a physics teacher in a high need school district. When asked how the teaching assistant experience and mentorship impacted her preparation, she recalled:

> It gave me a much better understanding of the material. Having the background at the college level gave me confidence. I was able to take some of the same experiments and activities in class and make them appropriate for the high school level. It refined my content knowledge so I could explain the concepts to my students. (*faculty-student mentoring*)

Maria explained that her first year of teaching was difficult because she was on a team that did not subscribe to inquiry-based learning. In her colleagues' view, inquiry teaching took too long, was too materials intensive, and differed drastically from their teaching styles (the ways they had been taught?). She explained:

> During my first year, I taught on-level physics and AP physics. The on-level physics was perfectly fine. The Advanced Placement side was a struggle because the team did not do many labs. In fact, they only did one each month. The rest of the time was spent on worksheets. I struggled with this and had to explain everything to my students. So, I got whiteboards [a practice she learned from her mentor] and now the students present, which has made it more interactive. At first, the students were uncomfortable but now they are doing the explaining. I am slowly sneaking in more inquiry. I'll have the students teach a concept from the book and make a video for others in the class. It creates more collaboration. (*faculty-student mentoring*)

When asked if the rest of the team of teachers embraced inquiry, Maria candidly replied:

> The rest of the team is a little resistant. But I throw in things here-and-there. I got a grant [using what she learned in her teacher education program] and that helped with getting more materials. I made a station lab out of the materials purchased with the grant and the rest of the team tried it. (*faculty-student mentoring*)

Maria is now in her second year of teaching physics at the same school. She is more comfortable with the content and slowly tweaking what did not work and teaching more imaginatively. She also knows what misconceptions her students have and addresses them earlier. She said that her students' grades are stronger; she is doing more formative assessments and incorporating checkpoints. When asked about her future goals, she replied:

> My future goals include having more labs and I would like my students to create their own lab . . . . like the physics by inquiry class [modeled by her mentor]. It creates higher order thinking and challenges my students. I would like the rigor to expand. (*faculty-student mentoring*)

Overall impact of mentoring

Reflecting on the overall impact of mentorship from her undergraduate experience as a teaching assistant, Maria explained:

> My experience as a teaching assistant who was mentored gave me a lot of confidence in my ability to help students and with my own lesson planning ability. Before that experience, I was unsure of myself and my abilities. Now, my students can see the confidence in me. I am still a part of the *teach*HOUSTON community. I stay in touch, go to conferences [NSF and other national conferences], and keep a positive outlook on teaching. The main reason why teachers become burned out is that they are negative. Being with positive people is uplifting.

When asked if she had advice for upcoming teachers, Maria said that she could 'write a book.' She elaborated:

> There are so many things to tell upcoming teachers. Stay true to what you know and stay true to your teaching style. Don't let anyone talk down about what you want to do such as groups, labs, inquiry, etc. . . .Adjust to the students and how they learn and not to the negativity of other teachers. Accept help, be receptive to it; persevere through the first year. The second year is much easier! (*student-student mentoring*)

When asked if she will mentor others in the future, she said that she would like to: 'I know from my own experience that [students] do not really speak up. Now that I am on the other side, I would take the initiative to help others.'

Physics department Parent Academy exemplar

In this exemplar, we discuss experiences in mentoring and guiding participants in a Parent Academy established as part of a Science, Technology, Engineering and Mathematics (STEM) based scholarship programme to involve parents in the academic journey of their NSF scholarship-awarded children, some being preservice teachers. In the following sections, examples of how mentorship through the Parent Academy has empowered parents in supporting their students are discussed (see Figure 3).

Background of parent involvement in higher education

Involvement of parents/supporters in the educational process is critical for student success. Parent involvement in their student's education tends to lessen as students transition from high school to a college or university and their involvement is usually in the form of encouragement, guidance on their choice of major/career, and determining how the cost of their education will be covered (Ma et al., 2016).

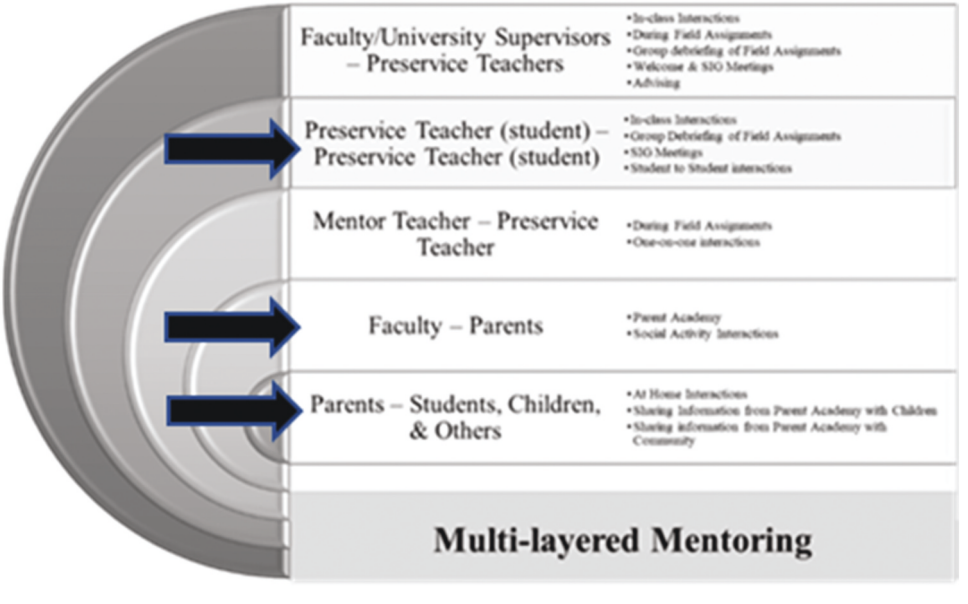

Figure 3. Multi-layered mentoring in physics department Parent Academy.

It is expected that the young adults, at this point, should start taking control of their own destinies and figure out their pathways to a future career. From the university perspective, professors/instructors 'rarely have the opportunity to meet or talk to the parents/supporters of the students [they] mentor and advise on their academic pathways' (Faculty interview).

Students majoring in STEM fields choose to do so for many reasons such as their love for science and mathematics, the inspiration of a teacher, and for some, the influence of parental guidance. Although many students pursue a STEM major, the IES National Centre for Education Statistics study (Chen, 2013) shows that from 2003–2009, only 48% of STEM bachelor's degree candidates earned a STEM degree. Students of underrepresented minority (URM) groups particularly are affected and therefore, may benefit from additional encouragement and support for their education.

One form of support that has been utilised at the K-12 level are parent academies which are developed by teachers, parents, and education leaders to inform parents of the learning expectations of their students (National PTA, 2019) and to provide resources so that parents are equipped to assist their students in meeting these expectations. Typical parent academies are designed to bridge the gap between the academic and family community by bringing both entities together through education-based events. These may be family-oriented science/maths events and, providing access to scientific resources which can help them make connections between science, real world situations and scientific careers. Research about K-12 parent academies has shown that student success is highly impacted by parental involvement, regardless of socioeconomic background and race/ethnicity or level of education of the parents or legal caregivers (Henderson & Mapp, 2002,; Pate & Andrews, 2006). Although not typical for 4-year college and university programmes, the Parent Academy for the STEM Scholarship programme is designed to provide parents with the knowledge and resources needed to support and promote their adult children to complete their degrees. Having this knowledge is critical since parents are great influencers and mentors of student career decisions.

STEM Scholarship program Parent Academy

Many parents/supporters of college students are not aware of the challenges their children face. They also have no means of obtaining the knowledge they need to serve as mentors/supporters of their students to help them be successful. This may be due to many factors, including the fact that many students are first-generation, and have not had parents who have had college experiences themselves (Palbusa & Gauvain, 2017). Since research for K-12 STEM parent academies has shown that parent involvement has led to positive student outcomes, and research on parent involvement in a student's college career has promoted student success regardless of the parent's education level (Palbusa & Gauvain, 2017), we believe that employing this model may lead to student persistence to complete their degrees.

A Parent Academy meeting was instituted as part of the STEM PARENT Scholarship grant in whose meetings, college professors mentor parents/supporters (in the presence of their children/students) by introducing them to promising practices to support their student scholar. This non-traditional, proactive approach focuses on building and

strengthening the families' knowledge base by informing parents about university resources available to them to support their young adult children, exposing them to their students' programme mentoring them to empower their student to persist in their degree completion. One-and-a-half-hour Parent Academy meetings occur twice during the Fall and Spring semesters. Participants include students who are scholarship recipients, their parents/supporters and faculty members. Parent/supporters range from mothers, fathers, siblings, spouses, children, grandparents, boyfriends/girlfriends, and family friends. As one scholar stated, 'I am the youngest of 10 children. I brought my mom, dad, and my son [to the Parent Academy meeting].' Another said, 'My family doesn't live here. . .so I have a friend who comes with me.' These parents/supporters may or may not (1) have attended college, (2) understand the demands and expectations placed on university students, (3) be aware of the student's day-to-day experiences, and (4) know what opportunities/resources the university offers families and students. The Parent Academy connects the family and academic learning communities by establishing a means of communication that builds positive relationships. One STEM student summed it up this way: 'I like that my mom gets to be familiar with the university where I spend so much time.' *(faculty-parent mentoring)*

Faculty mentoring parents

During the Parent Academy, STEM faculty inform, inspire, educate, and support the participating students and their parents/supporters through regular science and academic information sessions which include: (1) discussing how to get into college, stay in college, and graduate; (2) assisting students/parents in making informed decisions regarding educational choices; (3) providing information to expose families to science through presentations/laboratory tours/demonstrations; (4) presenting workshops on topics such as financial management, employment, and career advancement (life after academia); and (5) interacting during social activities. Through this mentoring, parents gain new insights into their student's college experience. As one student explained, 'My parents now have a better understanding of what is expected of me in regard to studying and class time.' *(faculty-parent mentoring)*

Parent/Supporter voices of concern

Many discussions occur during the Parent Academy meeting around parent concerns for their student's success. One common theme is their fear of how to contribute to/handle the financial responsibility associated with college. As one parent explained, 'My biggest fears were financial responsibilities and my student becoming overwhelmed.' In the US, 70% of undergraduate students receive financial aid, of some type, to cover the cost of their college education. Often, students and their parents/supporters are not aware of the resources available to help them navigate the process of applying for and securing financial support.

This theme was taken up by Dev, a father, who immigrated to the U.S. with dreams of a better life for his family. Dev shared with the Parent Academy group that as a college graduate, who was a first-generation student, his first choice of career was to be a teacher, but he realised he would need additional education to achieve that goal. With the financial responsibilities of his young family on his shoulders, Dev chose to get a well-paying job and put his dream of being a teacher on hold. With two children, he continued

to work hard to provide for his family. Dev has concerns about the financial support they will need to achieve their dreams. Through a Parent Academy financial aid workshop, Dev was introduced to the procedures and practices of financial aid and the *Free Application for Federal Student Aid* (FAFSA) process that opened his eyes to ways he could help finance his children's education. He stated, 'I'm in better shape . . . I will use all these experiences. . .And my younger daughter who is in 10th grade is also benefiting.' Dev's story shows the ways in which the mentorship parents receive in the Parent Academy expanded to their mentoring of other children at home or attending other universities. *(parent-student mentoring)*

Parent/Supporter voices on mentoring received through Parent Academy

Through reflective feedback and survey responses, parents evaluated whether the Parent Academy sessions met both student and parent/supporter need and interests through various activities including informative talks on university services, student demonstrations and presentations of their research, and interactive icebreakers that build relationships. Sample parent responses were: 'The information from the financial aid department [was] very helpful' and 'Great speakers—had a lot of knowledge and helpful tips/advice; Great group of professors, too!' Their words indicated how useful the conveyed information at meetings was. Similarly, after parents/supporters, scholars, and faculty completed personality quizzes and shared outcomes at a recent Parent Academy meeting, one parent requested copies to share with his co-workers, commenting that the quiz would aid his work team's understanding of how they could best work together. Once again, we see the ripple effect of the multi-layered mentoring approach. *(faculty-parent mentoring)*

In a recent gathering, the parents/supporters were asked to voice their opinions of the Parent Academy meetings. After several comments were uttered by parents/supporters, one father seemed to speak for the group. He explained that as a parent who did not attend college, he did not have personal experience to draw on when counselling his daughter. 'These meetings help me to understand my daughter's experience in college. . . You [faculty] show me ways that I can support her in achieving her dream.' Throughout the room, the affirmative shaking of other parents'/supporters' heads indicated that his story was emblematic of many others.

Advisement with culturally relevant pedagogy exemplar

Reflecting on our professional experiences working with students and the NSF funded programmes in which preservice teachers participate, we have witnessed the importance of institutional agents, faculty, and staff serving as frontline practitioners, advocating and championing for the needs of students. Although mentoring relationships take many forms (see Figure 4), a shared principle that sits at the core is the desire to empower students through providing them with information, opportunities, and the relationships needed to successfully navigate the college experience (Museus & Neville, 2012).

Frontline practitioners willing to serve in the role of mentor or agents of social capital facilitate student success through proactively providing information, opportunities for engagement and guidance to students (Stolle McAllister, 2011). Mentoring, as well as student advocacy, is a responsibility we share as colleagues. In fact, we often triage the wide scope of urban challenges and demands stemming from both students' academic

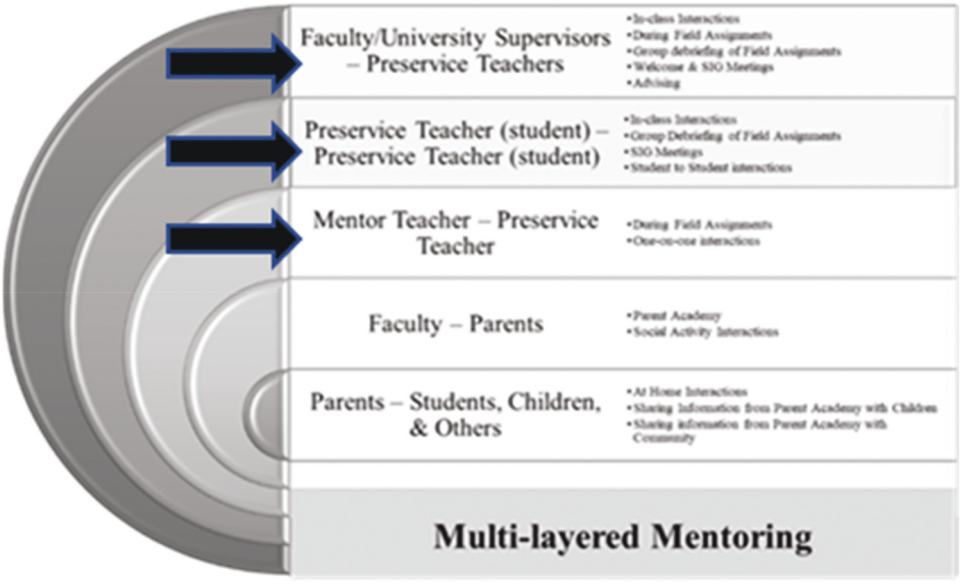

Figure 4. Multi-layered mentoring in the integration of culturally responsive pedagogy.

and non-academic life experiences. Moreover, as the literature suggests, we witness a substantial outflow of STEM majors from STEM fields early in their college careers, which affects their abilities to pursue secondary teacher certification as an undergraduate college student. Through developing and employing mentoring strategies, we endeavour to make the student experience more inclusive, responsive and less difficult to navigate amidst the strains of college life.

Mentoring context

The six instructors of the programme, all of whom were former teachers in K-12 educational settings, apply their pedagogical training and ability to advocate—a skill often found in teachers working in secondary settings—to support students in higher education learning environments. As advisors, we employ our communal knowledge and experience which lends many of the skills—empathy, service referrals, needs assessment, and crises management—necessary to develop student support services. We work collaboratively, with each overseeing aspects of the programme as well as coming together to prioritise, plan, and enact programming that meets students' needs. This collaborative leadership approach allows for flow and breadth of ideas and cultivates a shared vision regarding the mentoring of our students.

A key aspect of providing mentoring support is advising that is both relevant and contextualised to the students' individual experiences. Each day as frontline practitioners, we collectively work to connect with students, facilitate the transference of insight, provide guidance, advocate for ways to strengthen students' STEM knowledge and to convey a belief in the student's ability to succeed in their chosen career of teaching. Below are descriptions and accompanying personal accounts, of advising services and the

development of culturally responsive workshops that informed the integration of culturally responsive teaching praxis.

Advising services

As educators who mentor and interface with students both in-classroom and out-of-classroom places, we place heavy importance on the need to be a part of a strong academic and professional community of knowledge. Advising is used to reinforce this membership and sense of belonging as well as to improve students' self-confidence (Gardella et al., 2005), qualities that have been shown to increase STEM student retention (Trujillo et al., 2015). To ensure multiple points of access to information and in-person support, both primary and supplemental advising services are offered.

Course advising

The focus of advising efforts has been to establish advising services that support student success, address the wide-ranging needs of STEM majors, and advance the mission to produce highly qualified leaders in STEM Education. Supporting student success has happened in a variety of ways and was initially accomplished by Course Advising in which students from each course have a dedicated time frame to access advising services. This allows advisors to connect formally with all students enrolled in the programme twice a year. The programme faculty make having an advising appointment a requirement for class and often advertise and send reminders about the need to secure an advising appointment.

Jimena's show of strength

Jimena's story illustrates how the faculty-student mentoring relationship moves beyond prescriptive needs of students and targets the building of student self-confidence and the development of group membership that moves her from the margins to the centre where relationship is concerned.

Jimena was a senior and mathematics major enrolled in the first of two required high school field-based courses. As a student nearing the end of her teacher education programme, Jimena was required to participate in advising and to discuss preparation for student teaching. Like many others, Jimena was reluctant to come in for her appointment. Throughout the visit, her advisor/mentor could sense her unease, and when asked about how she was progressing in her classes, Jimena shared that as a new mother who decided to leave her full-time position in order to complete her degree, concern for managing her class load and her temporary decision to forego income were worries for her. Although Jimena had the support of her spouse, her circumstances were causing her to contemplate leaving school and to abandon her goal of becoming a mathematics teacher.

Jimena and her advisor/mentor talked through her many anxieties, among them being an older, non-traditional student with years of work experience who encountered difficulties relating to younger peers in the programme. Although Jimena was thriving academically with an above average GPA, her non-academic experiences were sources of stress. She and her advisor/mentor discussed the importance of her unique experiences and the value of her capabilities. Jimena's journey was distinct, encompassing full-time work experience in schools and experiences of being a wife and mother, all of which

would provide her peers with an opportunity to see the world differently. Reflecting on the meeting, the advisor/mentor realised that Jimena only saw the limitations of her situation rather than the strengths she possessed. This restricted her ability to see the value she added. While walking on campus a week later, Jimena and her advisor/mentor ran into one another and engaged in a brief discussion. Jimena shared her appreciation for the advising appointment as well as the positive response she received after sharing her concerns with her instructor. She stated, 'I could not believe how nice [my advisor/mentor] was when I told her about my baby. She did not even know I had a baby. Everyone has given me a lot of support and I am glad I came to talk to [her].' *(faculty-student mentoring)*

A student's sense of belonging is impacted by many factors (Nuñez, 2009). Jimena's advising appointment provided an opportunity for her to have her concerns addressed and her feelings acknowledged. The advisor/mentor-student interaction created an opportunity to provide multi-faceted support to a promising future mathematics educator.

Program orientation and peer advising

With the help of student ambassadors, a teacher education orientation guidebook and interactive presentation for incoming students was created. Orientation sessions provide information regarding helpful campus programmes/resources, study tips, policies, and a review of courses offered. Also, faculty members set aside time each semester and student ambassadors visit *teach*HOUSTON introductory courses to review the orientation guide and provide new students with helpful insider knowledge needed to successfully navigate the *teach*HOUSTON programme. This presentation is offered to nearly 200 students annually. Additionally, a peer advising component was added to supplement traditional advising services, extending the knowledge shared at the orientation. *teach*HOUSTON Ambassadors who provide the introductory orientation, also serve as peer advisors/mentors. These students are trained annually, providing students with the ability to seek one-on-one guidance from a knowledgeable and seasoned peer. Jorge's narrative below illuminates this dimension of his teacher education programme.

Jorge's story of resilience

Jorge's story illuminates the scaffolded support provided by the faculty-student mentoring relationship, and the importance of meeting students where they are to develop and stretch their talents. Jorge was a *teach*HOUSTON student and mathematics major who always sought opportunities to stretch his talents and to cultivate his leadership abilities. Jorge expressed that, as the oldest of three children, his parents depended on him to help with the caregiving of his siblings. He also shared that as a first-generation, Spanish-speaking American, he carried his parents' hopes and dreams for a better future on his shoulders. Due to his motivation to capitalise on every opportunity, Jorge participated in the many opportunities provided by the programme. He served as a teaching intern, a summer camp counsellor, and volunteered as a *teach*HOUSTON Ambassador. *(student-student mentoring)*

As a teaching intern, Jorge was tasked to help with both programme orientation and peer advising. He remembered the helpful information he received from the orientation experience and jumped at the opportunity to help provide this service to his peers. When

the day came along, he was very excited and looked forward to delivering the orientation which he had helped to revamp. After class ended, he seemed a little out of sorts and shared that he was not happy with the presentation as it did not go as he planned. He then asked to no longer be assigned the task. His advisor/mentor seized the moment and reviewed every detail of his presentation. They came up with a plan to do a same-day dry run days in advance of future presentations to help strengthen Jorge's confidence and preparation. After a couple of weeks of practicing and his advisor/mentor sitting in on the beginning of his presentations his confidence improved. Jorge went on to serve as orientation and peer advisor lead. Just prior to graduation, he expressed that had he been allowed to quit as a peer advisor he might not have continued in *teach*HOUSTON for fear of embarrassment. He was glad that his request was not accommodated and appreciated his advisor/mentor's willingness to help him move beyond his fear of presenting to peers. Jorge went on to complete his teacher education programme. Post-graduation, he has continued to reach out to other students to help them in the way he had been helped. He frequently shares his story of overcoming his anxiety about presenting to peers and incoming students at the Summer Leadership Institute. *(faculty-student, student-student mentoring)*

Integration of culturally responsive pedagogy

Culturally responsive curriculum integration

Culturally responsive pedagogy (CRP) was added to the teacher education programme after we attended a conference on the topic. We realised it was important for our students to understand not only the tenets of CRP, but also to examine their own cultural experiences, and to identify blind spots through engaging in reflective practice. After a year of CRP integration, we pursued an NSF grant opportunity that would allow us to enact CRP across the entire programme. The practices of CRP were a central focus of our proposal, which involved preparing pre-service and in-service STEM teachers to engage in the use of responsive practices. After receiving the new NSF grant award, we augmented the programme curriculum, providing workshops which included employing the use of culturally responsive activities and assignments and using of lesson planning rubrics as a guide to integrate the use of CRP. Additionally, we used the information employed in the CRP workshops to inform the development of a STEM Leadership master's course design to guide in-service teachers in their living of CRP practices.

Elizabeth's revelation

Elizabeth's story underscores the centrality of the faculty-student mentoring relationship on recognising and reinforcing the importance of students' lived experiences as a source of progressive consciousness and action that leads to anticipated positive transformation.

Elizabeth had experienced the culturally responsive workshop in both of her high school field-based teacher education courses. Each time Elizabeth was a willing learner who asked questions, shared thoughts and ideas about the topic, and desired to learn more about how she could integrate culturally responsive approaches in her teaching practice. Now in apprentice teaching, Elizabeth was putting her new knowledge into action and developing lessons that integrated the cultures of her students.

When an opportunity arose for Elizabeth to attend a Conference offering sessions on the use of CRP, she readily volunteered to attend. While there, Elizabeth attended many sessions focused on a range of topics, but squarely focused on learning how to improve her integration of CRP. During an afternoon keynote address, the speaker commented that if teachers are not encompassing *all tenets* of CRP, then they should exit the profession.

After the session, Elizabeth approached her advisor/mentor about the remark and honestly expressed concern as to whether she would be able fully incorporate CRP as a part of her teaching. Due to the plethora of information and the wide range of considerations a teacher must give to the development of lessons and teaching practices that are culturally responsive, we in *teach*HOUSTON purposefully argue for scaffolding the use of CRP. Since the speakers' statement was juxtaposed to the student's preparation, Elizabeth and her advisor/mentor debriefed after the session. Elizabeth shared that, although she was initially overwhelmed by the presenter's comments, it caused her to reflect on her thoughts and feelings which resulted in her being 'more committed to the use of CRP.' Elizabeth even reached out to her mother about what she had experienced, and instead of condemning the presenter, Elizabeth tried to understand the individual's passion and dedication to the use of CRP. In this situation, Elizabeth demonstrated her maturity, graciousness and reflective capacity. She was empathic to the position of the speaker and willing to reflect on her own practice as well. Developing these qualities will aid Elizabeth in becoming an exceptional teacher and advocate for CRP. *(faculty-student mentoring)*

Shared story threads

Although numerous themes have emerged, three shared story threads traverse the exemplars and stand out among the rest: 1) knowledge communities, 2) future selves and 3) inquiry. In the following sections we elucidate the ways in which these story threads are interwoven across the local educational landscape.

Knowledge communities

The theme of knowledge communities emerged in Maria's, Jemina's, Jorge's and Elizabeth's narratives of experience as well as in other unnamed students' sense of knowing. 'Safe' interactions with their faculty mentors, other students and, in one case (Elizabeth), a parent provided opportunities for storytelling that assisted student growth and contributed to a sense of belonging in a community of knowing (Craig, 1995). Moreover, knowledge communities helped the students (and their parents!) with making sense of their experiences and situating their perspectives in relation to their (or their child's) career choice, leadership opportunities and dedication to instructional practices. Faculty-student dyad relationships served as the teacher education programme's central nervous system. It formed the foundation on which countless other relationships around knowing and doing developed. These knowledge communities, which also were multi-layered and dynamic, engaged the prospective teachers, generated new outlooks and teacher knowledge through discursive practices.

The use of knowledge communities was exemplified in the case of Elizabeth, who through her participation in CRP workshops inspired her to enact instructional practices that embodied the lived experiences of students in her classroom. Elizabeth's continued dedication to personal and pedagogical growth prompted her to engage in conferences, which arguably exposed her to larger knowledge communities and new plotlines. Even when her own identity as a budding teacher was challenged, she gained new awareness about empathy as an important facet of experience and relational knowing and the critical importance of her narrating her advocacy for culturally responsive practices. In the case of Jorge, his layered experience in knowledge communities as a camp counsellor, ambassador, peer advisor, and intern tested his resolve to become a teacher as well as supplied him with the diverse experiences with the challenging plotlines he needed for his leadership abilities to emerge.

Future selves

Mentoring plays a key role in who we become. Our future selves are shaped and moulded by life experiences and the people we encounter. Faculty/University supervisor mentors helped to guide students and parents in their journey for STEM degree attainment and in their pursuit of a promising career and their best loved selves (Craig, 2013, 2017; Schwab, 1954/1978). As students envision their futures, they make choices which will set them on pathways which they believe are achievable. On their journeys, they encounter many mentors (i.e. professors, peers, parents, advisors) who will help them to story and restory their goals for the future.

Professors mentor students to help them develop knowledge as a sense of ongoing knowing that is open to revision through discursive practice. Through this process, they learn to position themselves in the field in which they are considered 'expert.' Their professors see their students as a reflection of former selves-in-the-making and want to ease their transitions from students to teaching professionals. In the Physics Education Exemplar, the mentorship Maria was named a teaching assistant in the Physics Inquiry course, helped her to enact inquiry-based teaching in her own physics classroom through 'borrowing and trying on' the teaching style of the professor who taught and mentored her. This is directly supported by the work of McDermott et al. (2000) who stated that *'Teachers tend to teach as they were taught . . . .'* (p.72). Therefore, professors who mentor prospective teachers and use promising practices in their own classrooms, in turn, shape the present teaching styles of their students and the future learning of secondary students.

Parents/supporters want to help their students make wise choices in life so that they will attain their envisioned selves. Often, this future that they may have imagined is influenced by the professions of the parents themselves or a family member (or their teacher educators). In the Physics Department Parent Academy exemplar, Dev is now better prepared to mentor his daughter and son, both of whom have both chosen to pursue health professions careers as this is the profession of many in their family. Nev additionally learned about how to finance their post-secondary educations based on resources made available to him by faculty mentorship through the Parent Academy. When parents choose to mentor their children, that mentoring is a continued process which unfurls throughout life. Through the continued mentorship, Dev received during the Parent Academy,

he became more able to effectively guide and mentor his children on their academic journeys to become their best-loved future selves from an occupational point of view.

Also, advisor-mentors use multi-layered mentoring to support students on their university journeys by not only guiding them on degree requirements and providing them with access to resources, but also by engaging them in the storying and restorying of their experiences in various contexts where matters of cultural belief, self-worth, behaviour and attitude, and professionalism all become matters of serious discussion.

Through the mentorship of an advisor, students receive positive feedback (i.e. You are smart) and advice which can motivate them, build their confidence, define their purpose and sense of belonging and encourage them to persist on their pathway to a STEM career. This advising/mentorship helps the student gain the academic and personal knowledge, skills and dispositions to move forward on their journeys to becoming their preferred future selves. As was shown in the multi-layered mentoring exemplar, Jimena was provided support consistent with her situation as a more experienced student with more family responsibilities than her peers. This fostered Jimena's staying power, which will greatly assist her as a future Math teacher and mentor to her students.

At some point in a student's journey, they realise they hold knowledge, have skills and have developed the disposition to take on the double-sided role of mentee and mentor. Learning from their past relationships with mentors, they pull from their experiences in context and mentor the people they encounter on their academic and/or professional paths as well as mentor themselves as they imagine their future lives as STEM professionals.

Inquiry

Inquiry is a pervasive theme that emerged throughout the exemplars, one which highlights the layered forms of mentoring occurring in this case. Dewey (1933) maintained that learning is deep-rooted in the experiences one enters, and the knowledge that arises through a process of inquiry. This process of inquiry stems from a perplexing experience or a discrepant event that leads one to think reflectively and engage in some type of action to resolve the problem. Furthermore, these actions involving discursive practices and the narrating of one's own experiences occur in social contexts within communities of knowers who construct their knowledge together (Dewey, 1938). One must rely on past experiences to solve discrepant problems. Reflective thinking involves both the past and the future in that students build upon their previous experiences and knowledge to construct new knowledge.

In the case of Maria, she learned through her experiences as a teaching assistant in the physics inquiry class and is currently transforming her own practice as a physics teacher to include more inquiry. She learned physics concepts deeply and realised that inquiry-based instruction is effective after experiencing inquiry first-hand. In the case of the physics department exemplar, professors designed the Parent Academy based on prior experiences with their own children and parents and were able to inquire as a community into promising practices to promote success in their children. In the case of the multi-layered mentoring exemplar, Jorge fine-tuned his orientation presentation through

practice and later became a leader in the Summer Leadership Institute. Additionally, faculty recognised the importance of incorporating culturally responsive pedagogy in the teacher education programme and worked collaboratively alongside their students to advance this goal. Through ongoing mentoring in a variety of situations on and off campus, the journey of inquiry into inquiry continues to evolve for faculty, parents, preservice teachers and in-service teachers and becomes increasingly generative and invitational as both time and situation unfold infinitely into the future. The latter is also true of the narrative inquiry research process we chose to conduct this research study featuring a multi-layered mentoring case.

Conclusion

We began this article with an exchange between the evaluator and a preservice student that featured his mentor professor responding to the youth's unshared—but perceived—doubts about himself. To reiterate, the mentor's assertion—'You are smart … '—shifted his self-talk and contributed to his more positive image of himself as a person and a prospective STEM teaching professional. To borrow Greene's (2001) words, 'the dialogical (i.e. discursive) situation' showed the mentor and the mentee 'caring for one another, able to look through another's eyes, [able to] talk about what they [were] discovering … about what is and what might be' (p. 108).The truncated excerpt animated how the mentee, like his mentor, was not 'a being' per se, but engaged in the developmental process of 'becoming' (Van der Wal & Van der Bie, 2015, p. 3) as was additionally the case in the representative narrative exemplars we carefully presented and analysed. As illustrated, this study contributes to the literature on how multiple iterations of formal and informal mentoring in higher education occur (Jacobs et al., 2021; Lunsford et al., 2017). In particular, the study provides insights into mentoring by showing the unfolding of diverse relationships (i.e. faculty-student, student-student, faculty-parent, parent-parent) within varied contexts (i.e. physics courses, student advising, parent seminars) (Dawson, 2014).

In addition to showing how our multi-layered mentoring experiences unfolded, we want to report that 88% of graduates have been retained over five years, which exceeds the retention rates of their urban school districts. This suggests that multi-layered mentoring, where *[teachHOUSTON]* is concerned, is helping to abate the teacher shortage.

As we end this research study, it makes sense for us to return to where we started. We want to revisit evaluation (French root word, évaluer, meaning 'to find the value of,' 'to find the worth of') and consider not whether our *teach*HOUSTON case's desired approach to mentoring was instrumentally accomplished according to the government's input-output grant stipulations, but whether what faculty and preservice students lived-in-praxis at the intersection between research and practice (and policy!) (Orland-Barak, 2010) was desirable and 'good' from an experiential point of view. For example, did 'connective tissues … hold … [the programme] together within and across different [mentors/mentees]' (Feiman-Nemser, 2001, p. 1049). Did the mentoring framework make the 'connective tissues' visible (Ambrosetti & Dekkers, 2010; Rockinson-Szapkiw & Wendt, 2020)? Did peer mentors form a part

of the mix and in different ways (formally/informally) (Budge, 2006)? Did the mentors encourage and use STEM research as part of the mentoring process (Cain, 2009)? What about boundary violations (Barnett, 2008; Gelles et al., 2019) and judgementoring (Hobson, 2021; Hobson & Malderez, 2013)? Did these behaviours occur in the storied exemplars we showcased and were they addressed in specific mentoring situations? And how was culture approached? Was it additively or subtractively present in the mentors' and mentees' stories of experience (Grapin & Pereiras, 2019; He, 2009)? Did multi-layered mentoring consistently improve teacher attrition/retention and address the teacher shortage, particularly after the COVID-19 pandemic? And, finally, did readers find our research exemplars trustworthy and potentially actionable in their mentoring-praxes?

Despite having ready responses to these queries, we know that the answers to these important questions relating to multi-layered mentoring are not ours to give. We leave this narrative inquiry knowing that judgements about the value/worth of our multi-layered approach to mentoring and its contribution to the literature and discourse in the field lie in the hands of our readers. In this case, we see narrative inquirers using narrative as both method and form, but we also see faculty and students storying their experiences in their reciprocal mentoring relationships. Furthermore, we also see story itself being a mentor as storied past experiences and knowledge inform, inspire, and guide present and future actions.

Postscript

Mentor Teacher: What happened in your first school-based teaching experience last week?

Student 1: Pacing was a problem.

Student 2: There were so many interruptions . . .

Student 3: Knocks on the door . . .

Student 4: Signatures needed on forms . . .

Student 5: Bathroom breaks . . .

Student 6: Fire bells . . .

Student 7: Too much content to cover . . .

Students: (almost in unison) We did not get to the 5th E (5E Inquiry lesson planning process) (5th E=Evaluation).

Mentor Teacher: Do not beat yourselves up . . . Your students do not know there is a 5th E . . . Only you as a teacher do . . . Next time, plan more tightly and everything will work out.

(Evaluator's Participant Observation Notes)

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