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COMMENTARY

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Beyond content and curriculum in elementary classrooms: conceptualizing the cultivation of integrated STEM teacher identity

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Abstract

As K-12 STEM education moves toward the integrated application of mathematics and science concepts in collaborative and complex real-world problem solving, there is a commensurate need to redefine what it means to be a STEM teacher in the early grades. Elementary teachers need more than professional development with innovative content and curriculum to be ready to integrate STEM; they need the agency that comes with a strong sense of who they are and who they want to become as STEM teachers. In this commentary, we propose a model for integrated STEM teacher identity with the goal of building a robust definition that is applicable to multiple educational contexts. The model captures the tensions between elementary teachers' multiple identities as STEM learners, professional teachers, and STEM education innovators. Our proposed model structures the complexity of these roles as an intertwining of components from extant professional teacher identity and STEM learner identity models. The careful cultivation of integrated STEM identities has the power to increase teachers' readiness to not only try but to sustain innovative curriculum. Teacher educators and professional development facilitators can use this model to provide more personalized support to teachers. Recommendations for future refinement of this model are offered along with implications for more equitable access to integrated STEM experiences for all students.

Keywords: Integrated STEM teacher identity, STEM integration, Teacher identity, Professional development, Elementary education, STEM identity, STEM learner identity, STEM teacher, STEM education

Introduction

National reports on STEM education in the United States (Honey et al., 2014; Tanenbaum, 2016) advocate for integrated experiences that promote equitable access to discovery and innovation. As the emphasis in K-12 STEM education shifts from a set of overlapping disciplines to the integrated application of mathematics and science concepts (Committee on STEM Education, 2018), there is a commensurate need to explore and redefine what it means to be a STEM teacher in the early grades. Elementary school is a critical time to influence students' interest in STEM (McClure et al., 2017), yet there remains a persistent problem of ineffective STEM instruction at the elementary level (Epstein & Miller, 2011).

An elementary teacher's readiness to integrate STEM goes beyond disciplinary content and pedagogical knowledge. Significant resources have been committed to building this specialized knowledge in STEM professional development, yet many elementary teachers do not feel prepared to integrate STEM (Corp et al., 2020; Shernoff et al., 2017) and do not see themselves as STEM teachers (Karaolis & Philippou, 2019). According to Wilson (2011), STEM professional development is

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often "short, fragmented, ineffective and not designed to meet the specific needs of individual teachers" (as cited in National Research Council, 2011, p. 21). This statement has been interpreted as a need to address contextual barriers to STEM integration, which may include pedagogical challenges, structural challenges, curriculum constraints, student readiness, and administrator support (Ejiwale, 2013; García-Carrillo et al., 2021; Margot & Keller, 2019; So et al., 2021). Although important, addressing contextual barriers alone will not change the landscape of STEM integration at the elementary level. It is not enough to focus on what teachers know and are able to do in designing impactful STEM education and professional development. The field must also acknowledge and attend to elementary teacher identity as it relates to integrated STEM and STEM teaching.

Changes in STEM teaching practice can only be sustained when teachers see themselves and are seen by others as integrated STEM teachers (El Nagdi et al., 2018). Advancing the field's understanding of elementary teachers' readiness to integrate STEM depends on the ability to explore and model the complexity of their identity construction as both teachers and STEM learners. Previous research has conceptualized and operationalized STEM identities within siloed disciplines (mathematics, science, and engineering) and focused on undergraduate students' perception of themselves as STEM people (e.g., Carlone & Johnson, 2007; Cribbs et al., 2015; Hazari et al., 2010). Existing S-T-E-M identity measures are insufficient for research on elementary STEM teacher identity because they are often focused on emerging STEM professionals. At the same time, recent research on professional teacher identity (e.g., Hanna et al., 2019; Hong et al., 2017) focuses on pre-service or early career teacher development with no attention to STEM interest, competence, or recognition. Understanding the intertwining of STEM and professional teacher identities is necessary to design educational experiences that build elementary teachers' readiness to integrate STEM.

In this commentary, we propose a model of integrated STEM teacher identity to begin to explain differences in how teachers learn and enact STEM in their classrooms. Integrated STEM teacher identity can be conceptualized by combining Hazari et al.'s (2010) four-factor STEM learner identity model and Hanna et al.'s (2020) professional teacher identity framework. Our proposed model structures the complexity of the intersection of STEM learner and teacher identities at the elementary level. We begin by articulating a research-informed vision of integrated STEM and building a theoretical foundation for the intertwining of professional teacher identity and STEM learner identity. After presenting our conceptual model, we offer implications for identity research and teacher professional development.

A vision of integrated STEM in elementary classrooms

There is a persistent lack of consensus on the conceptualization of integrated elementary STEM education in research (English, 2016; Honey et al., 2014; Moore et al., 2020) and in practice (Holmlund et al., 2018). These varied definitions are often driven by differing goals and contexts (Delahunty et al., 2021; Ortiz-Revilla et al., 2020). We seek to communicate a vision of integrated STEM as it can be experienced and enacted by elementary teachers across a variety of settings.

Traditional siloed approaches to teaching science and mathematics do not "reflect the natural interconnectedness of the four STEM components in the real world of research and technology development" (National Research Council, 2009, p. 150). Integrated STEM instruction in the elementary classroom provides opportunities for all students to engage with mathematics and science problem solving in real-world contexts (Kelley & Knowles, 2016). Nadelson and Seifert (2017) described integrated STEM as involving "conditions that require the application of knowledge and practices from multiple STEM disciplines to learn about or solve transdisciplinary problems" (p. 221). We elaborate on these conditions as student-centered, collaborative class structures that promote design and innovation and leverage technology (Kelley & Knowles, 2016). Our vision of integrated STEM in elementary classrooms retains the uniqueness of each STEM discipline but extends integrated STEM learning opportunities through modeling, simulation, and computational thinking (Hjalmarson et al., 2020; Waterman et al., 2020).

An integrated approach to STEM elicits multiple models of productive thinking (Li et al., 2019a) as students apply the engineering design process, mathematical reasoning, scientific inquiry, and computational thinking in collaborative problem solving. This conceptualization calls on teachers to be more than deliverers of science and mathematics content. Effective integrated STEM teachers engage students in collaborative and complex real-world problem solving (e.g., Li et al., 2019b; Moore et al., 2020) across all STEM content areas. Teachers who take a transdisciplinary approach to STEM learning (Vasquez et al., 2013) build bridges between STEM disciplines and real-world challenges as they shape how students make sense of the world. With this vision of a dynamic student-centered elementary classroom, STEM becomes more than its component content disciplines or even the intersections of content disciplines. STEM can be the way that teachers and students understand the changing world and its complexity.

The integrated elementary STEM classroom is thus more than the sum of its component disciplines. It builds knowledge of science and mathematics through inquiry and rigorous and relevant problem solving. Grounding integrated STEM learning in scientific inquiry and the engineering design process (Margot & Kettler, 2019) creates a productive environment for problem solving by iteratively testing and refining possible solutions (English, 2016). Integrated STEM in elementary classrooms is not manifested in worksheets and memorization of facts and procedures without context. Procedural fluency in mathematics (National Research Council, 2001) and process-driven inquiry in science are visible in STEM activities. Integrating STEM does not lessen the difficulty of mathematics and science; it creates opportunities to learn more deeply by normalizing struggle and uncertainty. Most importantly, the quality of the classroom experience transcends utilitarian conceptions of STEM education (Holincheck & Galanti, 2022); children are truly learning how to think and invent because these STEM skills and experiences are valued for their own sake.

This integrated STEM classroom vision is especially difficult to attain because elementary teachers are too often positioned from a deficit perspective in traditional social discourses about their STEM knowledge (Simpson & Bouhafa, 2018). These perspectives create a very narrow picture about who is and who can be an effective STEM educator. Elementary teachers may have minimal postsecondary depth in science and mathematics knowledge (Epstein & Miller, 2011), but content knowledge may not be the most significant barrier to effective integrated STEM instruction.

Research on barriers to effective STEM integration has often focused on teacher content knowledge and external contextual factors (Ejiwale, 2013; Margot & Kettler, 2019). Many STEM teacher education initiatives address these challenges by offering content experiences and curriculum resources, and yet there is a need to better understand how these initiatives transfer to the elementary classroom (Luft et al., 2020). Students' early experiences in mathematics, science, and engineering begin to frame their beliefs about who they are and who they could be (Archer et al., 2010; Maltese & Tai, 2010; Paul et al., 2020). Elementary teachers play a significant role in building their own students' STEM identities; they must see themselves as integrated STEM teachers if elementary students are to have opportunities to engage meaningfully with innovative K-6 STEM curriculum. The role of teacher identity in the realization of this vision for effectively integrating STEM in the elementary classroom requires further exploration.

Theoretical background

To conceptualize how elementary teachers see themselves as integrated STEM teachers, we turn to Gee's (2000) definition of identity as recognizing oneself and being recognized by others as a certain kind of person. Gee (1999) argues that there is an aspirational perspective to identity as "the kind of person one is seeking to be and enact in the here and now" (p. 13). Furthermore, identity is a learning trajectory which is "not an object, but a constant becoming….our identities incorporate the past and the future in the very process of negotiating the present" (Wenger, 2010, p. 133–4).

These widely cited identity framings are especially relevant in the longitudinal identity formation of elementary STEM teachers. Darragh (2015) elaborates on the notion of being recognized as a certain kind of person by describing STEM identities as performative; thus elementary teachers' STEM identities are derived from their accumulation of roles as STEM learners and as STEM teachers in a variety of contexts. Elementary educators bring multiple role identities as STEM learners to the education profession (Carrier et al., 2017) and may be asked to assume unfamiliar roles as they integrate STEM across disciplines. The ways in which elementary educators position themselves or are positioned by others (Cobb & Hodge, 2011) in professional development settings and classroom contexts shape their STEM teacher identities.

The emergent field of identity research in STEM education often focuses on STEM learner identity or professional teacher identity, but we argue that these identities are not separate and distinct. A model of integrated STEM teacher identity is needed to understand how these two identities interact and sometimes conflict in the elementary classroom. In the following sections, we synthesize the literature on professional teacher identity and STEM learner identity to support our conceptualization of integrated STEM teacher identity as an interweaving of these two identities.

Professional teacher identity

Much of the research on teacher identity has been narrated in longitudinal stories of cultural and educational contexts of teachers as individuals (Beauchamp & Thomas, 2009; Clandinin & Connelly, 1999; Lutovac & Kaasila, 2019). While narrative research can reveal the situational complexity of teacher identity, it falls short of providing results that can be used to make generalizable claims about the development of teacher identity over time (Avraamidou, 2014). A second category of research on teacher identity has focused on influences on teacher identity formation (e.g., Hong et al., 2017; Izadinia, 2013; Pennington & Richards, 2016; Volkmann & Anderson, 1998). Izadinia (2013) reviewed empirical studies about pre-service teacher identity and identified four influences on the development of teacher identity (reflective activities, participation in learning communities, context, and prior experiences). Pennington and Richards (2016) described identity broadly to include contextual, physical, and social characteristics of effective teachers, thus framing identity as a construction of foundational competencies.

Beijaard et al. (2004) described a third category of teacher identity research as studies focused on the characteristics of professional identity and how these characteristics explain teacher learning or decision-making. Consistent with this categorization, Hong (2010) examined the factors of teacher identity related to teachers' decisions to leave the profession (value, efficacy, commitment, emotions, knowledge and beliefs, and micropolitics). Studies that fall within Beijaard et al.'s (2004) third category can be helpful for understanding teacher decision-making within distinct contexts. However, these studies may contain factors that cannot be assigned to the domains of a generalizable model of how individuals see themselves as teachers (Hanna et al., 2019).

Teacher identity conceptualizations that conflate personal characteristics, internal factors, and external influences make it impossible to build a common and shared understanding of professional teacher identity. To work toward our broader objective of capturing the interplay of roles in describing integrated STEM teacher identity, we distinguish between what influences professional teacher identity and what constitutes this identity. This delineation is an essential step in explaining what makes an individual within the teaching profession identify as an integrated STEM teacher. It is the foundation upon which researchers can examine the external influences on the formation of integrated STEM teacher identity and track how teacher education programs support teacher identity development over time.

Recent efforts by Hanna et al. (2020) move the field of education toward a generalizable understanding of what constitutes professional teacher identity across contexts. They describe teacher identity as "a socially shared and coherent set of meanings" (p. 2) that define the particular professional role of teachers independent of external influences. Building upon their 2019 literature review of teacher identity instruments, Hanna et al. (2020) refined subscales from an array of previous studies to develop a Teacher Identity Measurement Scale with four domains of teacher identity. These domains are defined below and illustrated in Fig. 1:

- Motivation: Why am I teaching?
- Self-image: How do I see myself as a teacher?

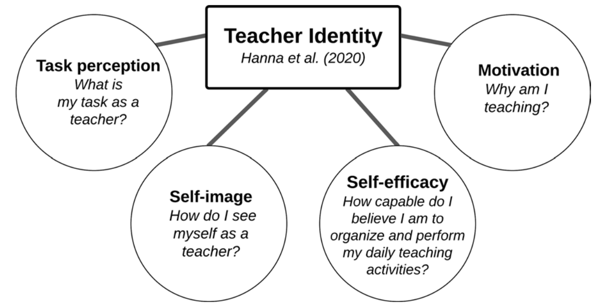

Fig. 1 Components of professional teacher identity (Hanna et al., 2020)

- Self-efficacy: How capable do I believe I am to organize and perform my daily teaching activities?
- Task perception: What is my task as a teacher?

These four components are deeply embedded in how teachers see themselves and distinct from personal characteristics and external influences. This professional teacher identity framework is a starting point for conceptualizing the complexity of teacher identity, but it does not capture the unique tensions that teachers may experience as they enact an integrated STEM vision in elementary classrooms.

Accounting for tensions in constructing an integrated STEM teacher identity

Elementary teachers' identities are defined by the many roles they take up in the classroom; the tensions between these roles can lead to challenges as they called to disrupt more siloed structures of STEM learning (Cross Francis et al., 2018). Their own experiences as learners in siloed STEM classrooms and teacher education courses create additional challenges as they negotiate learning experiences and teaching expectations (Avraamidou, 2018). Teachers' ability to meet these challenges is dependent upon both the malleability of their identity roles and their agency to construct these roles in innovative ways.

Teacher identity is not fixed; it is developed over time as a result of teachers' context and experiences (Beijaard et al., 2004). It has been characterized in the literature as evolving (Jiang et al., 2021; Skott, 2019; Wenger, 2010) and as an ongoing process (Avraamidou, 2018; Beijaard et al., 2004). The malleability of teacher identity underlies the potential for teacher education and professional development to influence STEM integration in elementary classrooms. The ongoing process of a STEM teacher's identity construction is driven by experiencing professional learning and by creating integrated STEM experiences for their own students (El Nagdi et al., 2018).

Teacher agency also drives the process of teacher identity development (Avraamidou, 2018; Beijaard et al., 2004). As Brickhouse (2001) noted, "Learning is not merely a matter of acquiring knowledge, it is a matter of deciding what kind of person you are and want to be and engaging in those activities that make one part of the relevant communities" (p. 286). Agency is deeply connected to a teacher's abilities to not only seek professional development opportunities (Beauchamp & Thomas, 2009), but also to shape their own teacher identities.

The multiplicity of the roles that teachers are expected to play (Vermunt et al., 2017) can lead to tensions and dilemmas (Hong et al., 2017), and this is particularly true for teachers who are seeking to integrate STEM. Traditional approaches to education position the teacher as a single-subject expert with an obligation to transfer knowledge to students (Vermunt et al., 2017). In more contemporary approaches to teaching, the teacher is positioned as a learning process expert. The teacher is expected to facilitate active, self-regulated, and collaborative learning opportunities in the classroom (Vermunt et al., 2017). This positioning creates identity tensions for elementary teachers who are expected to fill generalist roles while teaching multiple subject areas with deep STEM content knowledge expectations (Chen & Mensah, 2018; Willis et al., 2021). Competing teaching identities result from differences between teachers' understanding of their roles and others' expectations of them (Pillen et al., 2013).

Integrating STEM can lead to an "internal negotiation to incorporate the new role into an existing sense of self" (Ni et al., 2021, p. 282). The identity tensions that teachers experience can be either an opportunity for growth or a justification for maintaining the status quo, especially in the contexts where STEM learning outcomes are used as accountability measures (Cross Francis et al., 2018). For elementary teachers who are asked to innovate STEM in their classroom, their role identities (Brenner et al., 2018; Shanahan & Nieswandt, 2011) are related to their positions and actions (Keiler, 2018). Their classrooms become environmental and professional contexts to which they also bring their own identities as STEM learners. These STEM learner identities are constructed over a lifetime of formal and informal educational experiences, and they interact with their expected roles as elementary teachers.

STEM learner identity

Research on STEM learner identity has predominantly focused on science students, building upon the foundational work of Carlone and Johnson (2007). They examined student identity in science disciplines, drawing upon Gee's (2000) definition of identity as a certain kind of person. Their model of science identity has three interrelated dimensions: *performance* of scientific practices, *competence* as knowledge and understanding of content, and *recognition of oneself and by others* as a science person. Carlone and Johnson (2007) have profoundly influenced how the field conceptualizes STEM learner identity. Researchers on STEM learner identity have operationalized these three dimensions in the pursuit of a generalizable model of STEM learner identity (Cribbs et al., 2015; Dou & Cian, 2022; Espinosa, 2011; Godwin, 2016; Hazari et al., 2010; McDonald et al., 2019; Paul et al., 2020).

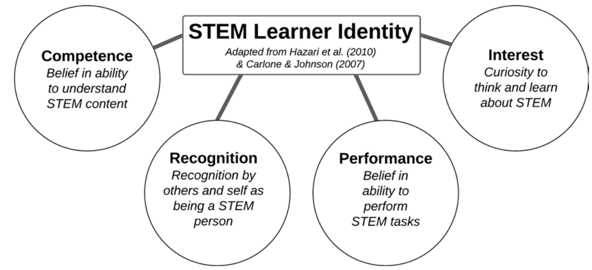

Fig. 2 Components of STEM learner identity (Carlone & Johnson, 2007; Hazari et al., 2010)

Hazari et al. (2010), using data from the Persistence Research in Science and Engineering project, extended the Carlone and Johnson (2007) framework. They justified an additional dimension of interest by contrasting their participants (college English students) with the successful scientists in the Carlone and Johnson (2007) study. Interest influences students' decisions of who and what they want to be (Hazari et al., 2010). The research team reported significant correlations between performance, competence, recognition, and interest and a "seeing oneself as a physics person" identity variable with the strongest correlation being recognition. The components of Hazari et al.'s (2010, p. 990) model are defined below and illustrated in Fig. 2:

- Competence: Belief in ability to understand STEM content
- Recognition: Recognition by others and self as being a STEM person
- Performance: Belief in ability to perform STEM tasks
- Interest: Curiosity to think and learn about STEM

Originally used to describe physics learner identity, the Hazari et al. (2010) framework has been broadly applied in STEM learner identity research, including quantitative studies of undergraduate mathematics students (Cribbs et al., 2015), undergraduate engineering students (Godwin, 2016), and elementary STEM students (Paul et al., 2020). Hazari et al. (2013) later merged the dimensions of performance and competence because these factors were indistinguishable in factor analysis (Cass et al., 2011). Cribbs et al. (2015) used this three-component framework and found that mathematics identity is most strongly related to competence/performance in undergraduate mathematics. This relationship is mediated by interest and external recognition in mathematics, with recognition having a stronger direct effect. Dou and Cian (2022) recently confirmed the robustness of the Hazari et al. (2010) framework in their structural equation model of the construct of STEM identity.

The Carlone and Johnson (2007) and Hazari et al. (2010) models were developed to predict student retention and persistence in STEM coursework (Carlone et al., 2014), but the components of these models are especially relevant as we describe the STEM learner identities that teachers bring to their professional work (Avraamidou, 2018). Carlone and Johnson's (2007) conceptualization of performance and competence as distinct components provides a more flexible framework for teachers' STEM learner identities than the models that combine these components (e.g., Cribbs et al., 2015). Competence is related to the demonstration of meaningful knowledge and understanding of STEM content, while performance relates to making competence visible to others. Although quantitative research has failed to distinguish between competence and performance, qualitative researchers have found that performance as evidence of STEM competence is not necessarily indicative of beliefs about STEM competence (Hudson et al., 2018). As integrated STEM challenges teachers to think about STEM competence and performance in novel ways, there is value in retaining these as separate dimensions in our initial conceptualization of STEM learner identity.

Elementary educators bring their identities as K-16 STEM learners to their teaching practice. STEM professional development often focuses on innovative curriculum and positions teachers as learners (e.g., Baker & Galanti, 2017; Baker et al., 2022; Nadelson et al., 2013). These new educational experiences add another layer to the construction of their evolving STEM learner identities. STEM teacher education has the potential to either exacerbate or alleviate the tensions that teachers may feel in designing and facilitating their own integrated STEM experiences (Chen & Mensah, 2018).

As teachers continue to develop their identities as both STEM learners and teachers, they are negotiating their integrated STEM teacher identities. A juxtaposition of separate identities is insufficient; teachers rely on their STEM learner identities as they build and express their professional teaching identities (Cross Francis et al., 2018; Owens, 2008). There is a need to capture the negotiation of multiple identities in relation to STEM by reframing professional teacher identity in terms of integrated STEM knowledge. The contextualization of STEM teaching and learning identities within a single model disrupts societal discourses about who has STEM knowledge and who can be an effective integrated STEM teacher.

A model of integrated STEM teacher identity

Although the existing models of professional teacher identity and STEM learner identity are useful for understanding aspects of integrated STEM teacher identity, independent models are insufficient for conceptualizing how elementary teachers see themselves as integrated STEM teachers. The field needs to capture the complexities of a multi-faceted identity that draws upon their experiences as STEM learners and their teacher identities. The generalized treatment of pedagogy in teacher identity models does not attend to the unique curricular expectations of integrated STEM classrooms. Seeing oneself as an elementary teacher and seeing oneself as a STEM person are not mutually exclusive. We seek to conceptualize the complex intersection of the role identities of non-STEM undergraduate, elementary teacher, and STEM education innovator. The components of each of the independent models are necessary but not sufficient to describe the unique expectations and tensions within innovative STEM teaching at the elementary level. An integrated STEM teacher identity model helps us to both understand and to impact elementary classroom practice.

Our model of integrated STEM teacher identity (see Fig. 3) combines elementary professional teacher identity (Hanna et al., 2020) together with STEM learner identity (Hazari et al., 2010). The components of professional teacher identity intersect with past and present STEM learning experiences, while the components of STEM learner identity intersect with expectations for teaching elementary content.

In constructing this model, we modified the language within select components of the prior models (see Figs. 1, 2) for consistency and to reflect the complexity of integrated STEM teacher identity. Integrated STEM was incorporated into the components of Hanna et al.'s (2020) model for professional teacher identity. A second component of interest was added to distinguish between curiosity about STEM content as a learner within the Hazari et al. (2010) framework and the desire to understand STEM pedagogy. An elementary teacher's sense of self encapsulates interest in both learning STEM and teaching STEM. The components of our model of integrated STEM teacher identity are defined below and illustrated in Fig. 3.

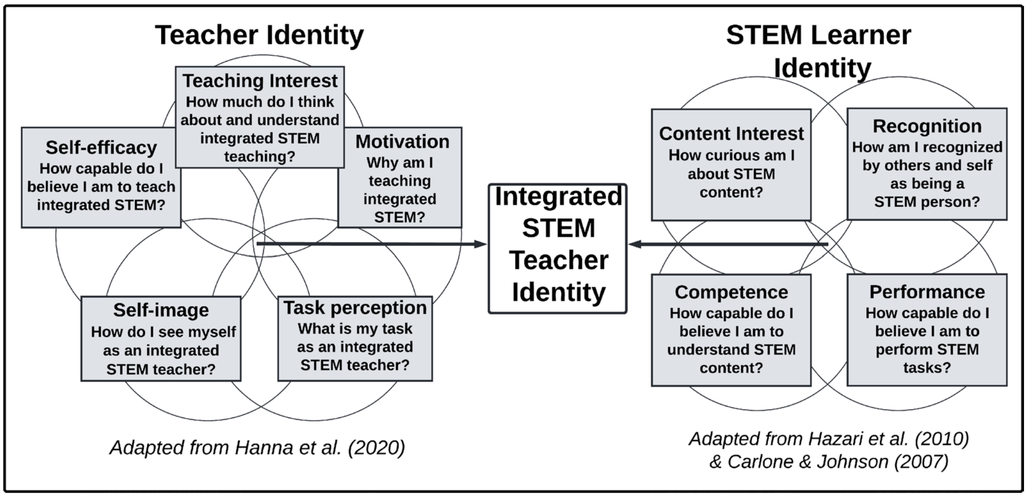

Fig. 3 Theoretical model of integrated STEM teacher identity

STEM learner identity dimensions

- Performance: How capable do I believe I am to perform STEM tasks?
- Competence: How capable do I believe I am to understand STEM content?
- Recognition: How am I recognized by others and self as being a STEM person?
- Content interest**:** How curious am I about STEM content?

Teacher identity dimensions

- Motivation: Why am I teaching integrated STEM?
- Self-image: How do I see myself as a STEM teacher?
- Self-efficacy: How capable do I believe I am to teach integrated STEM?
- Task perception: What is my task as an integrated STEM teacher?
- Teaching interest: How much do I think about and understand STEM teaching?

While these adaptations of the original models begin to capture the intersections of professional teacher identity and STEM learner identity, we recognize that our conceptualizations are not yet supported by empirical data. The combined model conceptualizes the likely overlap between components *within* professional teacher identity and STEM learner identity. We further theorize that there is an overlap *across* the original models. We call on teacher educators and educational researchers to explore these intersections *within* and *across* these original models.

Conclusion and implications

The STEM education research community continues to innovate content and curriculum for informal and formal STEM experiences in elementary schools. Our model of integrated STEM teacher identity extends these innovations by focusing on the teachers who need to bring and sustain these practices in elementary classrooms. Teachers' identities are continually evolving and can influence how they position themselves or are positioned by others in classroom contexts and professional development settings. By understanding the intertwining of teacher and STEM learner identities as conceptualized within our model, teacher educators and professional development facilitators will be better equipped to cultivate integrated STEM teacher identities.

Identities are malleable in that they are constructed in the ways that the teachers see themselves and are seen by others over time. Future research should build upon this initial conceptualization to work toward a robust generalizable model of integrated STEM teacher identity. The further intersections of gender, race, and class should inform the refinement of the model. Additionally, integrated STEM identities are not independent of context. Potential barriers to STEM integration (e.g., structural challenges, curriculum constraints, student readiness, and administrator support) might be mitigated by developing strong integrated STEM teacher identities.

To support the continued refinement of this combined model, the STEM education community should build evidence of what each of these dimensions looks like for practicing elementary teachers. Empirical studies grounded in data from classroom observations, teacher interviews, professional development artifacts, and new survey instruments can provide this evidence. The field should study integrated STEM teacher identity longitudinally to describe how integrated STEM teacher identities evolve over time. Understanding the malleability of identity and the tensions between role identities is necessary to tackle the challenges of designing effective integrated STEM teacher education for elementary contexts.

STEM educators can use the knowledge from a generalizable model of integrated STEM teacher identity to guide the design and facilitation of both pre-service education and professional development. Teacher adoption of innovative STEM resources has been linked to the identities teachers bring to professional development (Ntow & Adler, 2019). Hanna et al. (2020) argued that a shared understanding of what constitutes teacher identity can pave the way for more personalized support in both elementary teacher preparation and continuing professional development. Attention to integrated STEM teacher identities increases the likelihood that teachers who experience integrated STEM content and curriculum as learners feel empowered to enact these innovations in their elementary classrooms. Successful STEM professional development must reconcile the identity tensions which may otherwise interfere with the very ambitious, student-centered practices that teacher educators are seeking to model and facilitate (Darragh & Radovic, 2019). As they prepare elementary teachers to innovate STEM in their classrooms, teacher educators who understand their participants' identities can be more adept at developing and strengthening these identities.

Strong integrated STEM teacher identities are also essential to developing strong student STEM identities. The careful cultivation of integrated STEM teacher identities has the power to increase educators' readiness to not only try, but also to sustain innovative curriculum. When today's elementary teachers see themselves as competent doers and facilitators of innovative STEM experiences for their students, they will advance efforts toward broader STEM access and participation. We encourage the readers of this journal to join us in building upon this initial conceptualization of integrated STEM elementary teacher identity as we strive to improve access to high-quality STEM education for all students.

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