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An Autoethnographic Self-Study Navigating the Transition to Becoming a STEM Teacher Educator

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Abstract

This paper reports on a self-study where I take an autoethnographic stance in narrating my cultural origins, trajectory and identities as a teacher turned teacher educator working in the field of education in Ireland. Using self-study, I explore how my habitus has influenced my experiences of being a biology teacher at second level to teaching STEM education on initial teacher education programmes. Autoethnographic self-study is the hybrid approach used to describe and systematically analyse my experiences and learning as I struggle with a transitioning identity. The integrated use of both self-study and autoethnographic approaches enabled a deepened understanding of my professional practice and my embedded professional identity. Emergent findings from inductive analysis of multiple data sources from students, colleagues and my own reflections on my practice provide opportunities for rich description on three key domains. I present how reflection on the *cultural* self can lead to personal/ professional growth and how seeing and hearing beyond my "self" facilitates significant and holistic professional learning. Finally, I discuss how my professional growth or stagnation as a STEM practitioner is predicated and mediated by meaningful collaboration with others.

Keywords

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This paper reports on a self-study where I take an autoethnographic stance in narrating my cultural origins, trajectory and identities as a teacher turned teacher educator working in the field of education in Ireland. Using self-study, I explore how my habitus has influenced my experiences of being a biology teacher at second level to teaching STEM education on initial teacher education programmes. Autoethnographic self-study is the hybrid approach used to describe and systematically analyse my experiences and learning as I struggle with a transitioning identity. The integrated use of both self-study and autoethnographic approaches enabled a deepened understanding of my professional practice and my embedded professional identity. Emergent findings from inductive analysis of multiple data sources from students, colleagues and my own reflections on my practice provide opportunities for rich description on three key domains. I present how reflection on the *cultural* self can lead to personal/professional growth and how seeing and hearing beyond my "self" facilitates significant and holistic professional learning. Finally, I discuss how my professional growth or stagnation as a STEM practitioner is predicated and mediated by meaningful collaboration with others.

Keywords: autoethnography, self-study, professional identity, STEM education, professional growth

In this self-study, I take an autoethnographic stance in narrating my cultural origins, trajectory and identities as a teacher turned teacher educator working in the field of education in Ireland. Using elements of self-study inquiry, I explore how my cultural habitus has influenced my experiences of *being* a science and biology teacher in a school before transitioning to teaching Science, Technology, Engineering and Mathematics (STEM) education on initial teacher education programmes. Opportunities for professional growth emerge through reflection and analysis of the self as agent, socially and culturally positioned to interact and learn with others (Hadar & Brody, 2016; Hamilton, 2018). Autoethnography was a useful approach to use in this research because it enabled me to describe and systematically analyse my experiences in order to understand the influence of socio-cultural domains on such experiences (Ellis, 2007). Autoethnography challenges orthodox ways of doing research and considers research as a political, socially conscious endeavour (Ellis et al., 2011). The telling of personal and professional stories enabled me to have better understanding of complex and meaningful phenomena I experienced in my professional practice as a teacher and teacher educator. Stories can introduce unique ways of thinking that help people make sense of themselves and others (Adams, 2008; Bochner & Ellis, 2016). Given the relational nature of teaching and teaching how to teach, reflexively understanding our inherent identities is integral to analyzing our professional growth as educators. In this autoethnographic study, I report on how my teacher identity is challenged by my resistance to *becoming* a STEM

educator. I share my acquisition of a deepened understanding of my professional practice, during and following the process of inquiry into my professional identity.

Korthagen's (2001) distinction between knowledge and knowing and *episteme* and *phronesis* derived from Aristotelian concepts are useful constructs to appreciate the connections between personal knowing and professional growth. These distinctions provide tension by challenging some paradigmatic conceptions of knowledge, knowing and objective truth, particularly in the science and mathematics fields. I want to share my cultural experiences as a second level teacher who transitioned to becoming a teacher educator in the last 4 years, because reflecting on my practice within two different culture-sharing groups has yielded much personal and cultural awareness, learning and growth. Perhaps some of my experiences may resonate with others navigating the varied cultural spaces of school and university, teaching and teacher education. The "auto" positionality I take to examine my cultural existence with others enables me to reflect on my current professional struggle with membership of a culture-sharing group in a STEM Education department. Because my initial professional role was as a biology teacher in a second level school, the shift to teacher education *and* STEM education means my professional identity is very much in flux. I am reluctantly but increasingly being positioned by staff and students in my field and place of work as a "STEM Education Practitioner." I feel as though my identity as a biologist and science teacher is being forcibly removed and presented as something else called STEM. This is something I am resisting and this resistance is impeding my professional growth as I grapple with balancing conformity to my metamorphosing role expectations, with resistance to the neo-liberal economically driven cultural vacuum into which I am being subsumed. I position myself in the centre of this autoethnographic self-study (Ellis, 2007).

This approach enables me to create meanings from my own lived experience. This paper provides the space to acknowledge my discomfort with STEM and convey that in a legitimate way to readers. Nonetheless, I feel that making theoretical connections with existing ideas helps with an analysis of my own storytelling and makes meaning making easier for those who resonate with this work. Hamilton, Smith, and Worthington (2008) discuss how methodological choice affects the inquiry of researchers. With this in mind, I present a model where I identify the intersection between autoethnography and self-study for the purposes of this research. Stryker and Burke's (2000) theoretical concepts within identity and social identity theory are important in highlighting how social and cultural structures mediate identities, which then influence the process of self-verification. This, in turn, affects a person's level of commitment to sustaining these social structures or resistance towards such structures. This theory helps explain my struggle from having a professional identity as a biology teacher for many years to now being identified within my institution and externally as a teacher educator/STEM practitioner. In the discussion of the findings from this study, I use concepts from identity theory to inform my multiple identities played out through my varied professional roles. I explore how my prior identity does not act as a scaffold to developing a new or adapted identity as a STEM practitioner. I also use Bourdieu's (1977, 1998) seminal concepts of habitus and capital to position myself along the continuum of cultural insider/outsiderness, both as a teacher and teacher educator.

Given that this paper examines my struggle with a challenge to my extant professional identity, I present literature suggesting that confusion about what STEM is in practice, may ameliorate the challenge for individuals like me, finding themselves in the midst of the arguably ambiguous disciplinary boundaries that encompass STEM. The merged use of autoethnography and self-study enabled me to consider my personal and teacher identities from a cultural vantage point. Importantly, I consider my professional growth in light of others I work with, who mediate the varied expectations and roles particular to STEM teacher education.

What is STEM?

This review presents literature, which details the significant ambiguity that surrounds the meaning of STEM, nature of STEM, pedagogies of STEM, impetus for development of STEM and support for practitioners working in STEM education. It is based on this literature that I articulate key research questions that frame this study. There is a clear need for research that explores the practitioner experience of *becoming* a STEM education practitioner, based on existing research on STEM education.

While it is well known that STEM is the acronym for Science, Technology, Engineering and Mathematics, there has been considerable debate internationally about what STEM education means in practice (Akerson et al., 2018; Lawrenz et al., 2017). Traditionally, science and maths have dominated STEM related teaching in primary school, with little focus on engineering or technology (Bell, 2016; Bybee, 2010; Rosicka, 2016). This complexity around STEM education is a barrier for those finding themselves identifying or working as STEM education practitioners (Bell, 2016; Bybee, 2013; Rosicka, 2016). Significant research is emerging on the development of identities among students of STEM (Archer et al., 2010; Carlone & Johnson, 2007; Kim & Sinatra, 2018). Recent research studies argue strongly for the mentoring for STEM students to engender a sense of belonging in STEM fields (Kim & Sinatra, 2018). However, very little research exists on the professional development of STEM practitioners in teacher education (Akerson et al., 2018), despite increasing expectations of integration, knowledge and skills being required by those teaching across the STEM disciplines (Bybee, 2010, 2013). Additionally, there is little support for STEM teachers or teacher educators who have come from discrete disciplines with embedded identities associated with their undergraduate disciplinary area (Akerson et al., 2018; Hobbs, 2013). This lack of professional development to *become* a STEM education practitioner is relevant to this study, as an identity cannot be easily developed without support in the transdisciplinary area of STEM education.

Much of the reviewed literature is not sufficiently defining STEM (Bybee, 2013) and this is adding to confusion with how STEM education is positioned in different contexts and jurisdictions. Having a science, maths, engineering or technology practitioner identity and having an integrated STEM identity are different entities (Akerson et al., 2018; Vale et al., 2019). Identifying as a biologist or biology teacher and/or a science teacher also have nuanced differences. It is evident that identifying as a STEM teacher educator may be challenging for many, given the breadth of the discrete disciplines it attempts to assimilate and encompass (Akerson et al., 2018; Hobbs, 2013). Therefore, I share concerns about the positioning of the individual disciplines within STEM when used interchangeably, within the integrated STEM construct. This is because of the potential of alienating practitioners who identify as biologists, physicists, scientists, mathematicians, engineers or technologists, as discrete from the other STEM disciplines. The literature suggests that belonging to the cultural and social STEM education space is complex and worthy of greater analysis. This is because of issues of identity are connected to professional growth (Akerson et al., 2018; Wu et al., 2018). It is encouraging that attention is being given to the interactionist aspects of having a STEM identity; with literature beginning to discuss the importance of understanding more about developing STEM identities (see Kim & Sinatra, 2018). The lack of clarity on the nature of STEM as a construct affects the transition to a STEM practitioner identity, of significant relevance to this study.

The research on STEM education to date has not sufficiently addressed the pedagogy of integrated praxis within STEM education. It is argued that STEM itself is a socially constructed label (Akerson et al., 2018) devised in response to economic and global pressure for a greater number of STEM graduates for the global labour force (Ball, 2008; Bybee, 2013). There is no agreement on the "nature of STEM," with some claiming there is no real "nature

of STEM" (Peters-Burton, 2014). Despite the apparent and increasing popularity of STEM education, it is not an entirely innocuous entity. Hobbs (2013) call for specific and particular conditions to be put in place to facilitate effective STEM teaching. This is particularly important when teachers are required to teach a related discipline that is out of field, as is increasingly the case in integrated STEM education. Integrated STEM education can have negative effects on the teaching and learning of discrete STEM disciplines. For example, it has been found that the learning of specific skills and knowledge in science has been affected by the increased emphasis on an integrated STEM approach (Lederman & Lederman, 2014). In addition, significant challenges have been cited for teachers expected to teach out of field in a discipline they are unqualified to teach (Hobbs, 2013). The powerful role of beliefs and identities across the boundaries of STEM disciplines needs to be investigated further due to inherent challenges with traversing such boundaries (Vale et al., 2019). The lack of a distinct STEM pedagogy mitigates against the transition to, or development of, a STEM educator identity.

Akerson et al. (2018) assert that STEM exists merely as an intention, which is to create interdependence between the inherent disciplines. This is because there are no agreed universal STEM methods and conflicting views are omnipresent about what constitutes a foundation STEM discipline or what a hierarchy of the disciplines within STEM education might be (Akerson et al., 2018, Bybee, 2013). For example, a recent national STEM education report in Ireland (see DES, 2016) positions mathematics as the underpinning foundation discipline for all STEM learning. Alternatively, Margot and Kettler (2019) propose that all STEM subjects could be integrated by teaching through the engineer design process, as this approach offers children the best opportunities to problem solve. Yet, Capobianco's (2016) study found significant issues with including engineering within a science methods course for teachers. Other studies position science and maths as having a dual but very distinct foundational role to STEM education (Bell, 2016). Some studies claim science and mathematics are positioned as equally pivotal to STEM education due to them having high status in comparison to technology and engineering, which occupy a lowlier position in education (McGarr & Lynch, 2017). This dichotomy of thinking in the literature is evidence of an emerging STEM field replete with the sort of debate and tensions one would expect when a new movement or educational direction is being considered. What is worrying, however, is the speed with which the STEM movement is progressing, certainly in Ireland. Many recent studies in Ireland identify pedagogical challenges among a significant number of primary teachers of science and mathematics, currently teaching these subjects as discrete curricular areas (Clerkin et al., 2016; Murphy et al., 2012). These issues include low teacher content knowledge, low teacher confidence and negative pupils' experience of science and maths in schools. There are cited self-efficacy dilemmas among teachers within the discrete and the integrated teaching of science and maths (Wu et al., 2018) and numerous challenges with beliefs, conceptions and identities around STEM Education (Levy et al., 2013). This questions the speed and timing of the STEM movement and raises questions about the motivation and value of positioning STEM education as a discrete integrated disciplinary domain. It especially points to the professional competencies required to *do* STEM teaching effectively. Akerson et al. (2018) state the following, in relation to STEM:

> No single individual (well, maybe an omniscient being) can deeply conceptualize the nature of all of the individual disciplines, plus the content of those disciplines, as well as their interdependence and methods for making meaningful explicit connections among those disciplines. (p. 10)

It is interesting to contemplate why current policy makers are so exercised with the teaching/delivery of STEM and the more recent focus on provision of professional development in STEM education (Bell, 2016; DES, 2016, 2017; Marginson et al., 2013). This is adding to an already complex process of learning to teach for pre-service teachers who are still required in many educational systems to teach the discrete disciplines in primary and secondary schools. It also adds to an already complex endeavour for teacher educators tasked with teaching their students how to teach (Hamilton, 2018). If this is motivated by the global economy, it surely poses wider questions about the purpose of education (Ball, 2008). The literature on the STEM landscape provided here evidences significant confusion, ambiguity and complexity with regard to STEM education and its purpose. This supports the need for research, where the experiences of practitioners navigating this undulating STEM terrain can be better understood.

Context: The Irish Educational Landscape

The educational landscape is important to this study as it provides insights into the cultural, systematic and contextual setting for this study. I teach in the Irish education system, which is characterised by its general academic rather than vocational focus and is relatively undifferentiated in the sense that the majority of students follow a similar pathway, terminating with the Leaving Certificate (LC) Examination (see Canny & Hamilton, 2018; Smyth & Banks, 2012). The second-level system comprises of a three-year junior cycle programme, at the end of which students are awarded a Junior Cycle Profile of Achievement (DES, 2015). The senior cycle programme terminates with the nationally standardised Leaving Certificate (LC) state examination (see Iannelli et al., 2016; Smyth & Banks, 2012) when learners are approximately 18 years old. Most students study general science to junior cycle and science sub divides into discrete disciplines such as, physics, chemistry, and biology for examination at LC, if chosen by students. The high-stakes LC terminal examination awards students a grade based on their content knowledge across a range of subject areas. The LC grades are converted to points, in a system where students compete for places on third-level programmes (CAO, 2019). Therefore, most students are eligible for entry to higher education, making the system of attaining points in the LC very competitive (see Banks & Smyth, 2012). This drives students to choose subjects based on interest but also based on potential success in terms of perceived attainment of a high LC grade.

Currently in Ireland, numerous national reports (see DES, 2016, 2017), and research studies (Childs, 2001, 2002) cite concern with regard to low levels of student uptake of the physical sciences in upper secondary school, partially fuelling the STEM education impetus. High numbers of males and females take science in lower secondary and biology in upper secondary, but it is suggested this is because biology is easier to get a high grade. The higher uptake in biology and more elite status afforded to the physical sciences in Ireland (Childs 2002) inadvertently positions biology lower on the hierarchy of *valuable* science and indeed STEM. It is also evidenced that biology is overrepresented by females, because the majority of biology teachers in Ireland are women (DES, 2016, 2017) and that the majority of generalist science teachers up to junior cycle level are biologists and that this is not helpful in engaging more students' interest in the physical sciences. This hierarchic and gendered approach to the science sub-disciplines may be partially driven by the developing STEM agenda and the STEM education movement. This is because STEM incorporates the mathematical, engineering and technology fields with science, where it could be argued there are greater links between these disciplines and the physical sciences, than the life or health sciences. While an understanding of this contextual insight is useful it does nothing to explore the dilemma for many practitioners from the discrete disciplines being rapidly subsumed into STEM education.

In light of my professional identity as a science/biology teacher/teacher educator, this gender debate and hierarchical positioning of the sciences and STEM disciplines intensifies my struggle to identify with STEM education, despite being positioned there. Much of this debate feeds into my deep cynicism around STEM, as it appears contradictory and obtuse. Therefore, identifying with what STEM is and what it means to be a STEM educator is challenging and leaves significant questions about how teacher educators can grow professionally in what could be perceived as an ambiguous but extremely prominent education field.

There is a clear gap in the autoethnographic self-study and STEM education literature for exploration of externally induced change to teacher identities based on the evolution of global curricular constructs like STEM. Therefore, this study is timely and informs the development of a number of research questions to frame the exploration of STEM practitioner identity formation.

My Research Questions Include:

- How can autoethnographic self-study help me to understand my resistance to being identified as a STEM practitioner?
- How can theoretical concepts related to identity, operate as a platform for analysis of my habitus, culture and insider/outsider positionality in my department?
- How has collaboration mediated resistance and feelings of alienation at developmental nodes throughout my career as an educator?

This autoethnographic study is of importance because the STEM construct is powerful, and my experience of transitioning identities brings a timely focus on the increasing international importance placed on STEM education. This work contributes to existing work on teacher identities by providing a unique focus on the evolution of a STEM practitioner identity.

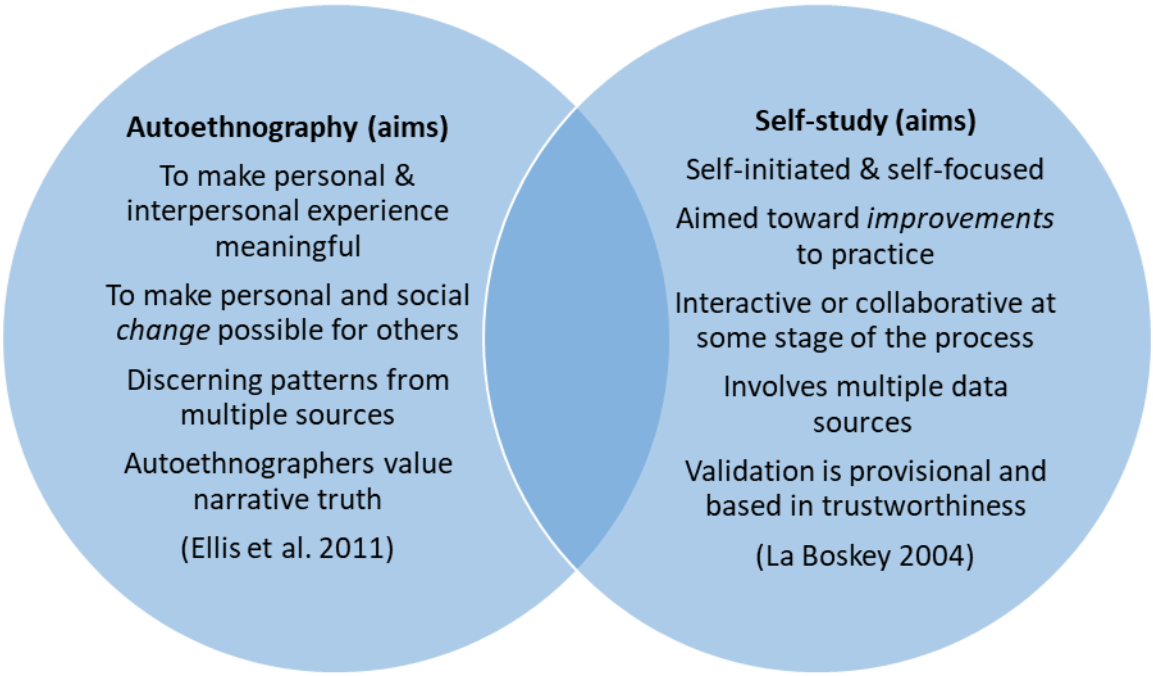
Methodology

This study is an autoethnographic self-study because it is grounded in my telling of my personal and cultural experiences, albeit influenced by others sharing the cultural space. Autoethnography opens a wider lens on the world, challenging rigid definitions of what represents meaningful and useful research. This approach helps us understand how the kinds of people we claim to be, or are perceived to be, influence interpretations of what we research and how we conduct such research (Adams, 2008). I considered using narrative inquiry, but this approach focuses more on the gathering of narratives from others while drawing on our own narratives. Given my specific focus on the cultural "self in practice," autoethnographic self-study was the most suitable research approach. Elements of self-study inquiry are particularly valuable to this research, as self-study is self-initiated, interactive and focuses on the self in practice, which enables an increased understanding of my *self* and a deeper understanding of my teaching and learning practice in a shared cultural space (Loughran et al., 2004). Teacher educators can conceptualise and enact their professional development through reflection and reflexivity in accordance with the educators evolving identity (Loughran, 2014). Thus, my transitional trajectory throughout the paper demonstrates an evolution of my interconnected personal/professional and transient identities. I present my experience of becoming a teacher educator by teasing out key moments of professional growth first as a biology/science teacher and now as a STEM practitioner. This journey is paused at junctions where developmental nodes of this *becoming* are shared. I use Brookfield's (1995) lenses to

offer cultural colour to the ongoing trajectory towards improved practice and management of my changing professional identity. These lenses provide moments to include other voices within the cultural spaces I occupy, as I believe our stories are played out within social domains mediated by others (Bochner & Ellis, 2016; Ellis, 2007; Ellis et al., 2011).

I have already outlined briefly above why these two approaches suit the cultural and self-foci of my research questions. In addition, Figure 1 illustrates my interpretation of the interconnectedness of Autoethnography and Self-study, given the dual integrated approach to this research. There are many overlapping features of autoethnography and self-study in this study, as identified by Figure 1. This figure highlights overlaps between the two approaches used in this study (Casey et al., 2017). One interesting similarity is the connection between trustworthiness as a validity tool in self-study the aim of autoethnography that a work seeks *verisimilitude*. This requires it to evoke a feeling among readers that the experience is believable and that what has been represented could be true (Ellis, 2007). In self-study, trustworthiness is about establishing that findings are credible, transferable, confirmable, and dependable (Berry, 2008).

Figure 1
Integrating Autoethnography and Self-study



Autoethnography can be positioned among three genres of research. The first is "native anthropology" where former subjects of ethnographic study research their own group. The second is termed "ethnic autobiography" where members of ethnic groups write personal narratives. The third is "autobiographical ethnography" where the researcher includes personal experience into the ethnography. Autoethnographers can be seen to occupy dual or multiple identities which can shift according to the social situation they find themselves in (Reed-Danahay, 1997). As I am researching myself as a participant in the study there is a strong autoethnographic aspect to this work. Reed-Danahay (1997) suggests that autoethnography is more authentic than traditional ethnography due to there being more truth to the insider's perspective. When examining a social context where there is a dominant value system, others play roles in our stories and we in theirs (Muncey, 2010). The meaningful relationships I share

with others in this cultural setting inform my stories. Relationships and interactions are inevitably influenced by the researcher's position within the culture. Therefore, I have been ubiquitously reflexive, using journaling and field notes, throughout the research process from methodology to data collection, to analysis and write up. Hertz (1997) argues that reflexivity enables researchers to become more conscious of the ideology, culture and politics of those we study and our own position. The feminist dimension is important, as I am a woman and an insider to the institutional habitus where I teach, albeit with my own personal habitus. Reinharz (1997) asserts that reflexive feminist ethnography combines the way in which a researcher's attributes become meaningful, as the researcher gains knowledge in the field. Nonetheless, autoethnography and self-study can appear somewhat self-indulgent to others. Sparkes (2000) claims the charge of self-indulgence stems from an individual's deep mistrust of their own self-worth and wanting to look outside of the self because that may be an easier option. I believe there are developmental nodes along an educational trajectory where we should look simultaneously at self and other. This facilitates an opportunity for me to explore my-*self* in practice, and to enable professional growth to progress, unhindered by a lack of understanding of how culture influences my resistance to adopting a STEM identity.

When researchers engage in autoethnography, they retrospectively and selectively write about experiences that are connected to them (Bochner & Ellis, 2016). However, in addition to sharing experiences, autoethnographers analyse these experiences. Data collection for this autoethnographic self-study spanned one year and comprised of me collating weekly written journal reflections focusing on my thoughts, experiences and observations at meetings during the transition to becoming a member of the STEM education department. Participant data from students' evaluations of teaching and some testimonial unsolicited data was also used, providing data from varied sources. These data sources are relevant for autoethnographic self-study as they emerge from my own reflexive excerpts, with some data *about me* from others, an important feature of self-study. This also provided a balance between data generated by my personal reflections and some third-party data from those who experienced my practice as a teacher/teacher educator.

This research project has been influenced by Denzin's (1997) interpretive practices, where data fragments are connected temporally, spatially and relationally to narrative texts and structural formations. The data was inductively analysed and indexed using open content coding to first generate sub-categories from the index of codes (Flick, 2009). Open coding is commonly used in grounded theory where the analytic process of the researcher during reading and re-reading the data identifies concepts (codes) into the observed data and these codes are achieved by segmenting data into expressions or short sequences of words (Flick, 2009). Following coding, broader themes for discussion emerged from patterns, which became evident once the data were re-examined and organised thematically. The analysis of multiple sources of data enabled me to identify patterns of cultural experience evidenced by field notes and journaling, data from students, and/or artefacts from others. Quotive data which best evidenced the thematic discussion was selected from the excerpts of written journal entries or student feedback. The representation of the data uses large quotive fragments to support analytical and thematic assertions (Caine et al., 2013). Ethical approval was requested prior to commencing the research, and approval was granted, as per my institutions ethical guidelines for studies involving human participants.

Three key themes emerged from the analysis of data. I discuss how autoethnographic self-study as a hybrid research approach enables professional growth, an area cited in the literature as lacking within the field of STEM education. I highlight how seeking feedback on past and current practice from others mediates this self-reflection and provides another lens for learning and professional growth in transition to becoming a STEM practitioner. Finally, I discuss the experiences, which contributed to or reduced my resistance to transitioning to

becoming a STEM educator. The discussion that follows has relevance for others who may be in a similar transition. The findings supporting the key themes are discussed under the following thematic headings:

> Reflection on the cultural self *as* personal/professional growth.
> Seeing and hearing beyond my "self" as professional growth.
> Professional growth or stagnation as a STEM practitioner.

I share the findings in this paper, through thick descriptions of personal and interpersonal experiences supported by the data collected and analysed. The discussion describes and interprets these patterns using facets of storytelling, informed by theory and literature (Ellis et al., 2011). Telling chronological stories evocatively is relatively uncommon in research on science and maths teacher education. Therefore, this paper fills a methodological gap and provides new ways to envisage STEM educators' professional growth, by focusing on identity and culture as worthy investigative domains. I share my stories around three thematic areas/domains of key importance to the research questions. The findings in this study are represented in the story I tell and in response to the research questions, I pose and answer. The first section is a cultural narrative presenting data which I argue informs my struggle with professional growth as a STEM educator.

Reflection on the Cultural Self *as* Personal/Professional Growth

I begin this discussion by firstly presenting a section of narrative data that illustrates my cultural past and present in order to contextualise my "self" in this study. I include this section in the findings because it provides the reader an insight into my autoethnographic positionality at the point of discussion of the themes. In that sense, this section is connected thematically to all that this paper discusses. This narrative section is important because it evidences (using a narrative account), my embedded teaching philosophy and my particular professional identity. This portrait of my personal/professional and cultural habitus makes my assimilation and identification with being a STEM educator difficult. Not alone this, but the reflection bound as story here has enabled me to unravel some of the complexities inherent in my transitioning identity, which may be similarly useful for others.

Rubin et al. (2014) stress the subjective and intersectional nature of social class. They distinguish between one's current socio-economic status, which is mutable and social class, which is more static. Both have powerful influences on an individual's experiences and perspectives. Where socio-economic status is measurable, it is argued that social class is perceived subjectively by a person, although they are co-occurring constructs. It is important that individuals are able to reflect on their own internalised standards based on contextual experiences and varying reference groups. It is important in autoethnographic work to represent my positionality at the outset as a researcher. It is based on this proposed subjectivity that I discuss my positionality in this research, as connected to my cultural self. My social class has informed my experience of education, aspirations and career trajectory. My story has influenced my teaching philosophy. My cultural past mediates my resistance to becoming a STEM educator because my personal/professional self are integrated and because I am teaching for in excess of 30 years, where embedded, immutable and deeply held values and beliefs have developed over time. The narrative that follows evidences this:

> I am a woman born into a working-class familial habitus with limited valuable cultural or social capital. This is similar to many Irish girls' experiences and origins growing up in Ireland during the 70's and 80's. My primary and

> secondary education was in schools with a mix of working-class and middle-class students. It was in secondary school I began to feel out of place. I was put in the top stream based on my entrance examination results and most of my peers in this class were middle class. I was more comfortable with the banter and culture of the students in the lower streams, many of whom were working class like me. I struggled considerably with the confines of school and home life. I was like a "fish out of water," and I realise this was due to my alienation from the middle-class culture of the school and my peers, and a disconnect between my familial and institutional habitus. I quickly became disillusioned with school and truanted at every opportunity with my working-class friends in other classes, as a form of resistance to the dominant hegemonic middle-class culture I enjoyed this freedom until I was caught, and after several bouts of running away from home and the unpleasant repercussions that entailed, I weighed everything up and began to conform. This was an act of conscious agency to avoid the stress of fighting the system and school as described by Bourdieu (1977). In my final school years, having fully conformed to my school's institutional norms, I succeeded academically and did well in my Leaving Certificate examinations. I learned that conformity had its benefits and I consciously left resistance behind for a time.
>
> I trained as a science/biology secondary school teacher in London where I was comfortable in the diverse mix of teaching practice schools the city provided, and I got my first teaching position in a diverse multicultural school in Wales. Later, I returned to Ireland and got a teaching position in a large middle-class girls' school. From the outset, I felt (as I had in my own school) that I did not fit in at this school, despite my socio-economic status now being akin to a member of the middle classes. I did a Master of Education degree and it was at this stage that I began to read more widely, and I developed a particular interest in social justice issues. This interest evolved further over the years as I embarked on a PhD. After completing the PhD and spending a few years as a seconded in-career teacher advisor, I commenced my current role as a science teacher educator, where I am now a member of the Department of STEM Education. I have realised that my cultural habitus/identity as a working-class woman has affected my experiences as a teacher and teacher educator.
>
> My teaching now spans thirty years across second and third level and my teaching philosophy has been influenced by many of my previous life and teaching experiences. While as a younger secondary school teacher, I identified more with teaching science and biology, more recently, I think about myself as an educator in the broader sense. My teaching philosophy stems from an ethic of care for learners. I care for them and I care about their academic and pedagogical progress, as pre-service teachers. I generate relational trust through care, as I believe this is supportive of educational and emotional growth among learners. I believe that trust facilitates the development of a connected identity between a person's self and their learning. (Researcher Reflection 2019)

Banks (2004) calls for practitioners to provide a space for more egalitarian, less elitist relational opportunities for teachers and students, where teachers encompass a moral philosophy based on an ethic of care that enables learner and teacher to flourish. My philosophy of teaching has been informed by deeply embedded cultural conceptions of being a working-class girl and

experiences of being a learner in school and as a teacher and teacher educator. I have limited shared lived experience beyond my own school days of being with people like me. Teaching and especially teacher education is predominantly occupied by middle-class staff, who are relatively homogeneous in terms of class, ethnicity and possession of valuable social and cultural capital (Bourdieu, 1998). There is evidence in the literature about the importance of understanding one's identity, given the complexity of teaching and learning (see Loughran, 2014) and existing beliefs are powerful in shaping who we are and how we act as teachers. Evidently, beliefs play a critical role in defining behaviour and our beliefs strongly influence our perceptions. It is my cultural past and firmly held beliefs as findings elicited through the reflective process outlined and used in this study that mediate my transition to becoming a STEM educator. This is not only connected to the lack of clarity about STEM as a construct discussed earlier (Akerson et al., 2018), but also connected to issues of social justice and unequal access connected to STEM education (Banks & Smyth, 2015; DES, 2016, 2017)

Seeing and Hearing Beyond my 'Self' as Personal/Professional Growth

Although I use my practical knowledge as data in this paper, this knowledge is grounded in reflection and reflective practice and feedback from others. Data collected over time has reinforced my sense of identity as a science/biology teacher and this data makes it difficult to move away from a space where I am comfortable. Using Brookfield's (1995) lenses of theory, personal experience, colleagues' eyes and students' eyes, I share autobiographical data as a teacher and then a teacher educator, some student data from both school and ITE and peer data from colleagues in teaching and now in teacher education. The power of this data is such that I find it hard to identify as someone other than who I have been, personally and professionally for nearly 30 years. The data highlights how I identify as a science/biology teacher of people and not a STEM practitioner.

I have regularly and consistently used reflection and reflexivity to deepen my understanding of my own practice, with a view to improving the "me" in what I do. How I teach and how I evaluate my practice, is through inquiry of the self in practice. Dewey (1986) highlights the value of instructional approaches based on reflection, thinking and experiential learning, rather than didactic teaching. Inquiry based learning in cooperative groups is the approach I use to teach science concepts and skills, because it promotes a caring interdependent learning environment, based on social and cognitive constructivist principles, which are conducive to effective learning. The cooperative learning idiom, "we sink or swim together" (Johnson & Johnson, 1999) relies on relational trust and care for collective success. I see the teacher as a facilitator of this collective unity, in keeping with my philosophy of care for the learner. I am particularly interested in Dewey's (1986) idea that human experience becomes meaningful when our stability is disrupted and when faced with a problem to solve and reflect upon. This resonates with where I am now in the transitional identity space brought about by becoming a STEM educator. This problem-solving approach is very useful for science teaching and indeed learning in life, weaving the professional and personal, the "self" and the practitioner. Constructivist theory also informs "inquiry into pedagogical practice" for my own teaching. This is evidenced in a recent peer observation report from a colleague in the faculty, who observed me teaching first year ITE students how to teach science:

> It is worth noting from that start that Miriam moved about the class interacting with each group and she created an atmosphere in which the students felt comfortable expressing their opinions and answering questions. Although these were a 1st year group, their level of interaction resembled that of 3rd/4th year groups. At each stage of the tutorial Miriam interacted with the students,

> listening to their individual group discussions – asking for input from the students when really good suggestions, questions or explanations came up. She drew the students out and so it was really a two-way interaction all the way through the tutorial. (Peer observation report, 2018)

My teaching philosophy stems from personal past experiences of my teachers and their support for me as a person and a learner. One personal reflection written in my teaching portfolio where I reminisce on my teenage years captures this:

> During adolescence, I was lost. I began to skip school to indulge in the less conformist elements of life. As a promising athlete and "good" student, I began to find myself in conflict at home and at school due to resistance behaviours. Two people came to my aid. These were not family or friends, but two teachers who collectively influenced me. One teacher, Ms Crosse, knew I could run, and she began to meet me at the door of my classroom with a spare pair of runners saying that she needed me on the running team. She was my first influential mentor and she encouraged me to run in a different direction, away from the potential perils I was unerringly chasing. The second teacher, Mr Broderick, called me after class one day and told me I was wasting my academic potential and encouraged me to think about and reassess what I was doing. I began to focus more on my learning and decided then that I wanted to teach. Ms Crosse and Mr Broderick believed in my personal and academic potential in a holistic way. I discovered the value of a good teacher, beyond the delivery of a curriculum or a subject discipline. (Researcher reflection, 2019)

Many years later, I can relate these experiences to Palmer's (2007) work, which calls for the presence of the authentic teacher, connected to their students. Therefore, relational care and trust underpin the learning goals I set for the students I teach. What I am trying to achieve with my students in science education, is that they become confident and knowledgeable in both the science content and pedagogical content within (and beyond) the primary science curriculum. I believe that teaching from a care perspective provides a safe space for the students to learn and presents the duality of learning as a relational and cognitive endeavour. My philosophy motivates me to facilitate student teachers' learning in a way that enables them to transition from college as competent and caring practitioners, who can further learn through research- informed pedagogical innovation. I believe that constructivist pedagogies such as cooperative inquiry-based learning, demonstrate for students how effective science knowledge and skill development is made possible, within an ethic of care. I am emphatic that care for the students I teach positively catalyses the learning process, to facilitate the *becoming* of competent, confident and effective learners of science. This is reflected in a message from a past biology student whom I taught:

> I don't know if you'll remember me, but I hope you do. I was in your biology class in 2010... Although you only taught me for one year, you made a huge impact on my life, more than you will ever know. You are a fantastic teacher & I loved going to your classes, loved biology. I still have your notes and regularly go back to them. If you have left school, you will be a huge loss…your classes were so warm, an open environment… (Unsolicited student testimonial 2018)

I do what I do because it made a difference to my learning when teachers cared for me, so I understand the power of care. I see relational interdependence as "encompassing and

enabling" of effective teaching and learning in science education and thus, central to my teaching philosophy. Within *respect-ful* spaces, the learning of science content and pedagogy becomes more enjoyable, accessible and achievable for the students I teach. This is evidenced by a card from a colleague upon leaving teaching for teacher education: "Thank you so much for being a stalwart teacher to me, a colleague to work with and a passionate person who cares for your subject and your students" (Unsolicited colleague testimonial 2018).

Similarly, a Master's student I supervised appreciated the ethic of care he experienced:

> It was nice to spend a little time in 'the land of academia' for a while. It wouldn't really be my thing and I did find it challenging and I am not sure if I would have enjoyed (if that's the right word) the year if I didn't have you supervising my thesis. It is probably up there with making my stairs in terms of personal achievements. So, when I say it's a small token it is, because you cannot put into words or gifts what real gratitude is, so thank you… (Student feedback 2019)

I love biology and this is because from a young age I was fascinated with life and living things. As I studied biology discretely at upper secondary school, the words, classification, and subcategories of biology with diverse areas such as botany, zoology, microbiology and their interaction with our environments and ecology were fascinating to me as a learner and then as a teacher. Therefore, as a generalist science teacher with a biology specialism, I have good confidence in the basics of physics, chemistry, with a particular flair and knowledge in biology. This is evident in a comment from a different peer observer to a third year ITE tutorial:

> The session ended with students completing their learning log for the session (exit ticket). My overall impression was of a teacher who is so knowledgeable, who uses every opportunity as a learning experience for her students and who creates a climate of warmth and security that allowed these students to engage fully with the lesson. (Peer observation report 2018)

It is important to note that I faced significant challenge in my early years of teaching and again while transitioning from teaching to teacher education (see Hamilton, 2018) and feedback on my practice was not always positive. However, I am presenting positive affirmation here because it illustrates the embeddedness of my particular identity as a committed and invested science/biology educator. This reinforces my struggle to be positioned outside this embedded professional identity as a biology teacher, which stemmed from my experiences as a biology student many years before. For example, it took me considerable time to challenge my own experiences as a learner of biology and to move away from a didactic content led approach to teaching science. It is widely acknowledged that teachers can take a knowledge rather than skills-based approach to biology teaching due to prior experience of having a content delivered didactically rather than through inquiry approaches (Breslyn & McGinnis, 2012; Ozel & Luft, 2013). I find my new role teaching science pedagogical content particularly interesting and am now becoming more confident in teaching about the range of valuable methodologies in science education pedagogy. This is evidenced in the peer learning made possible by sharing my practice with a colleague who was new to teacher education:

> The use of modelling is very powerful and something I will try to incorporate more into my own teaching. The use of modelling in dispelling the misconceptions about light as a way to engage the students in finding the correct

> answer worked well. This is something I need to think about in my practice. Miriam's energy and passion for her subject left me invigorated and so glad I had taken part in this process of dual learning. (Peer observation report, 2018)

I love teaching science and biology as is evident in the data shared. I have taken numerous opportunities to use reflection, feedback and professional learning opportunities to become a better teacher and teacher educator. Self-study has helped me transition to teacher education with a level of challenge that was manageable and invigorating. I needed to learn to teach how to teach as a science education lecturer, I had an inherent confidence in aspects of my practice from prior positive and constructive feedback as a schoolteacher. With my recent assimilation as a member of a newly formed STEM department and transition to *becoming* a teacher of STEM on a Masters of STEM Education programme, I am uncomfortable. I am reluctant to adopt this new positionality, which is alien to me and due to cited personal and professional concerns about the purpose of STEM education, I am not confident about what STEM is and even less confident about my abilities or indeed interest in teaching STEM. This is a significant barrier to my professional growth as a teacher educator, worthy of reflection.

Professional Growth or Stagnation as a STEM Practitioner

I love science, particularly biology, as detailed above. I did not enjoy maths from early on in primary school and into secondary school. I found it very boring, abstract, and it did not seem to connect with me or my life or interests in any way. Technology is such a broad area; I am unsure what it really encompasses within the STEM domain. Engineering is unfamiliar to me, and I have no meaningful relationship to this discipline. While I can certainly see integration opportunities and common problem-solving skills of value between these four disciplines, I see similar integration between science and geography, art, history, language, music and physical education. Of course, as a science teacher, I understand that a biologist would struggle to effectively teach food science without connecting this learning the chemical compositions of biomolecules and role of enzymes. Equally, a chemist would teach the abstract concepts associated with atomic theory and sub-atomic electrons more effectively, by grounding it in a concrete biological example, such as the photosynthesis of green plants. Teaching heat without considering changes of state and solubility, given the strong conceptual connections between energy and its applications to the water we drink and the air we breathe does not make sense. However, these valuable links between science disciplines are not always made by teachers who like me, often identify as having a specific expertise and self-efficacy in one science in particular (Bandura, 1997; Breslyn & McGinnis, 2012; Ozel & Luft, 2013). Perhaps professional growth would be best served by developing better linkage between science concepts *within* the science disciplines before shifting entirely towards STEM integration. Indeed, as STEM becomes the hybrid STEAM, (with many more iterations potentially lining up to gain traction on the fast-moving bandwagon that is STEM), could we, as science educators, be in a polychotomous position, struggling to hold on to the remnants of an identity as a biologist, chemist, physicist, let alone scientist:

> I do not feel we have stopped to interrogate what it is and what it means to be part of STEM education. I do not feel I fit into this integrated STEM discipline and argue that this integration is challenging to operationalise in an education system like Irelands that structures curriculum entirely as discipline specific. From infants in primary school to second level and on into third level all four STEM disciplines exist on the curriculum (if there at all) as distinct and discrete disciplines or subjects. I find myself asking repeatedly if STEM is a discipline

> in itself, an integrated cohesive paradigm, a visionary curriculum or a collection of disciplines, with conceptual commonalities. STEM education is messy and when I speak to other science teachers about what they perceive STEM education to be, they provide a personal (albeit situated) perspective, which often belies their positionality and comfort/discomfort with the acronym. (Reflection 2019)

I know I am not alone with this challenge to both an embedded identity and cynicism about STEM because of the speed and lack of clarity, with which it has emerged in the Irish context. Therefore, it is important to discuss and challenge thinking around STEM. My resistance to STEM and to being positioned as a STEM education is clear and while I present a partially practical rationale for this resistance, I feel it is the challenge to my personal and professional identity and my habitus that is behind my scepticism about the value of STEM. I position STEM lower on my salient hierarchies, a concept explored by Stryker and Burke (2000) and this influences my role choice to be a dissenting voice. My self-identification as a STEM education practitioner is low relative to my salient identity as a biology teacher. When a salient identity is low, commitment to role relationships requiring that identity is low and counter roles or resistance behaviours can result (Stryker & Burke, 2000).

Despite my reluctance to engage with a shifting identity there are positives emerging in the ways the department are coming together as discrete specialists within STEM. We have developed a collaboration with a local primary school to provide STEM education opportunities for children predominantly from disadvantaged backgrounds. This has been interesting to reflect on for a number of reasons:

> The habitus of these children relates to my own and in this way, our similar habituses transcends the STEM lens, within which we work together. I am beginning to see a benefit to STEM in that these children are getting an opportunity to access new knowledge and skills in a domain, which is dominated by the middle classes. This will generate valuable cultural capital for these children going on to secondary school and may influence their interest and enjoyment of science, or the other disciplines. In this way, the STEM label and being positioned as a STEM practitioner is not limiting and I can see scope. (Reflection 2019)

In terms of identity theory, this commitment to generating some shared meanings about the positives of STEM education among the department creates new links between existing identity and behaviour (Stryker & Burke, 2000). Secondly, there has been a diversity brought to the new department, by nature of the variety of mathematicians, engineers, technologists and science practitioners now having conversations about what we can create as a vision for STEM education together as evidenced in my reflections:

> I am learning more about the other disciplines and while I am unlikely to develop a love of maths, I am developing a better appreciation of the commonalities inherent in the STEM disciplines. Interestingly, although I feel like the counter voice in many of our meetings, colleagues are open to discussions analysing STEM, which is cathartic. (Reflection 2019)

In addition, my reluctance to teaching on a STEM Education postgraduate programme has been allayed by the support of colleagues (Gallagher et al., 2011; Hamilton, 2018) many of whom are feeling equally overwhelmed by the speed of the development and focus on STEM

education, in Ireland. The need for extensive and mutual planning necessary due to the diverse range of disciplines and colleagues contributing to the programme has led me to new collaborations, insights and perspectives. Finally, being given the freedom to create a module that gives me permission to interrogate critical perspectives within STEM education with the postgraduate students, has been useful in terms of my own resistance and negative attitude to STEM. We have a STEM café group set up with the aim of developing a STEM research culture to enhance our understanding of STEM, led by the head of the department. This group operates as a voluntary space where discussion takes place on potential ideas for STEM education research and work with teachers and schools. This space is effective in generating trust between new department members as well as collaboration (Hadar & Brody, 2010). The group are generating valuable social capital as colleagues, which is a positive in terms of potential professional growth among newly formed groups (King, 2014).

I have shared my experiences and struggle of being in transition to becoming a STEM education practitioner. This is an autoethnographic study of myself in practice. It explores how culture, professional history and personal philosophy mediated my professional transition to becoming a STEM educator. As such, it is not about comparing or generalising to other autoethnographic studies. It is sharing a lived experience for others to relate to or to partially relate to. I have illustrated how the embeddedness of my particular identity as a passionate science/biology educator reinforces my struggle to be perceived or positioned outside the existing professional identity I possess. This identity has been forged by my own reflection, reflexivity and practical knowledge as well as by feedback from those whom I have taught, teach or work with. I believe more attention needs to be paid to the role of culture and identity in such transitions both at a micro and macro level. I suggest that perceived pressure on practitioners towards subjugation to becoming a STEM practitioner may push the identity and belief boundaries of those who identify as science or maths too far. This could consequently impede the future professional growth of teachers and teacher educators, leading to resistance actions or complete disengagement with STEM. There is also a need to have a clear educational purpose for STEM education, a nature of STEM and some methodology of praxis across the STEM disciplines in order for practitioners to identify with the positive possibilities STEM education may hold.

This paper illustrates some departmental actions that are presently mediating my beliefs about STEM and assisting with the generation of a culture-sharing group. The beginnings of a partial STEM identity may be a possibility for me in the future. Nonetheless, it is clear from the arguments presented that we need to critically evaluate educational movements for educational value and purpose prior to making shifts predominantly based on economic trajectories or economic imperatives. The need for professional support for those assigned the task of implementing STEM education or teaching how to implement STEM education requires adequate time for dialogue, reflection, argument, inquiry, professional support and resources, in exploring such change. Autoethnographical self-study facilitates an exploration of how a personal habitus, culture and identity act as powerful mediators of our agency as educators to shift between a continuum of conformity and resistance that both protects the integrity of what we do and indeed safeguards who we are as teachers.

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