Mid-Career Professionals in STEM Transiting to School Teaching: Barriers at the Border

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Abstract: *In many countries there is a shortage of quality teachers in areas of science, technology, engineering and mathematics (STEM). Additional to the low levels of recruitment is an extraordinary high attrition rate with some 50% of beginning teachers leaving the profession within five years. One solution implemented in several countries has been to encourage mid-career professionals in the area of STEM to become school teachers. These professionals are said to bring to teaching enthusiasm, knowledge and a passion for their subject which will impact engagement and learning by students. However, these career-changers have constructed professional identities and are accustomed to working within a culture of collaboration and inquiry. In contrast, school cultures are quite different and often teaching is a lonely solitary affair with little opportunity for collegial relationships aimed at knowledge building in the context of teaching. Crossing from a culture of STEM to a culture of schools and teaching can be challenging. This study was conducted with 13 teachers who were followed for three years. However, this paper reports on the experiences of one teacher with an engineering background crossing the boundaries from practising STEM to Teaching STEM.*
Keywords: Beginning teachers, Engineers, School culture, professional identity, career-change teachers

1.Introduction

The transition of mid-career professionals to science, mathematics or technology teaching in schools is a common phenomenon. There are policy initiatives in many countries that draw on the assumption that mid-career professionals whose subject matter knowledge is substantial, provide value to the teaching of STEM in secondary school classrooms. The assumption exists that their experiences and enthusiasm for their subject matter will inspire more students to achieve greater outcomes in school and to pursue careers in the sciences. Although the experiences of beginning teachers have been extensively studied for over half a century (e.g., Veenman, 1984), there has been little research on teachers whose background has been in the practice of STEM but who have for various reasons decided to pursue a career in teaching. We describe these as career-change teachers in this paper.

2.Theoretical Background

The transition to teaching is difficult for many beginning teachers whose main priority is survival (Ginns, Heirdsfield, Atweh, & Watters, 2001). The first year of teaching seems to involve not just an extension or modification of beliefs and practices from their own school experiences but also a need to reconcile the experiences of teacher education courses that espouse new theories of education to develop entirely new perspective on schools and schooling (Zeichner & Tabachnik, 1981). Although, there is an attempt to refine their knowledge of teaching (Rockoff, 2004), many beginners adapt their teaching behaviours and beliefs to accommodate the culture of the existing school environment (Zeichner & Tabachnick, 1981). Mid-career professionals face challenges that many younger beginning teachers do not. The process of career change or transitioning from one work culture to another involves restructuring of personal and professional identities (Wilson & Deaney, 2010). This transition can be an abrupt and unsettling experience. Many factors influence the reasons for change such as redundancy in a previous career or dissatisfaction with the values and demands of their prior workplace (Watters, 2011). For them teaching offers a promise of more meaningful work (Wilson & Deaney, 2010).

The terms “boundary crossing” (Akkerman & Bakker, 2011) or “border crossing” (Aikenhead, 1996) imply a migration from one geographical position to another; from one culture to another. In this context, culture means the distinctive way of life, the nature of the social interactions and relationships within a group (Schoen & Teddlie, 2008). Akkerman and Bakker (2011) conceptualise a boundary as a “sociocultural difference leading to discontinuity in action or interaction” (p. 133). The boundary represents the cultural difference and the potential difficulty of interaction across these systems. Giroux (1992) introduced the concept of ``border crossing'' as a way to formulate the role cultural workers might play in the development of a critical pedagogical practice that works across disciplines.

If we turn our attention to STEM, practitioners in the various disciplines that constitute STEM build knowledge (Nonaka, 1994). However, scientists, technologists and engineers also work in the cultural space of their discipline. The discourses, practices and norms of behaviour in the disciplines of science are well documented (Pickering, 1992). The norms and practices of STEM are characterised by collaboration, networking, discourse and partnerships.

Schools have complex rituals of work, personal relationships, mores, shared values, rules, and moral codes of practices that define a unique culture (Maslowski, 2006). Schoen and Teddlie (2008) have attempted to categorise the dimensions of school culture in terms of professional orientation, organisational structure, quality of the learning environment and the extent of student-centred focus. Adapting to a new culture requires close observation and engagement with members of that culture. However, acculturation into teaching can be difficult for new teachers (Sparks, 1991). Teachers often fail or succeed on their own rarely interacting professionally with colleagues. That does not imply that at a departmental level in a secondary school, some collaboration occurs at least in formal planning. Departments and their subcultures have the potential to contribute effectively to teacher learning and development (Smethen & Adey, 2005). With effective leadership, schools can establish cultures that value collegial relationships, focus on common interests in subject knowledge and promote the development of staff (e.g., Busher & Blease, 2000). Such cultures provide a highly supportive for beginning teachers (Williams, Prestage, & Bedward, 2001). For career-changers, particularly those whose background professional experiences might have been in research laboratories, engineering workplaces, industrial enterprises where they had strong professional identities as scientists, engineers, mathematicians or technologists, transiting to the isolation of teaching presents significant challenges. The purpose of this paper is to explore the ways in which boundary crossings were facilitated or obstructed.

3.Aims

In this paper we seek to understand the challenges to professional identity that career-change STEM professionals confront in becoming teachers.

4.Methods

A qualitative case study approach was adopted (Yin, 2003). Fifteen participants (7 males, 8 females) (ages ~22-45) were selected for the study based on their academic profile which included at least three years work experience in a science related career and convenience of geographical location. These participants had undertaken a one-year Graduate Diploma of Education qualification to meet teacher registration requirements. The cohort of participants included three PhD qualified research scientists, an agricultural scientist, two engineers, a former flying instructor, a medical scientist, an ICT technician, a business manager, a nutritionist, an ecologist, a farmer with agricultural science qualifications, and a forest scientist. This report focuses primarily on Natalie, one of the engineers.

4.1.Data sources and evidence

There were three data collection cycles over three years. In year 1, (A) an initial 10-15 minute telephone interview was undertaken two months after commencement of the teaching year to obtain demographic and personal data; (B) after six months of teaching each participant was interviewed by phone or in person using a semi-structured interview protocol; (C) approximately 5 hours of teaching a single topic in a grade 8 or 9 class were videotaped; and (D) a follow-up day-long

interview was conducted approximately two weeks after completion of the topic. All participants were visited at their schools on at least two occasions and field notes recorded of the school environment and resources. In years 2 and 3, additional data were gathered from a further 5 hours of videorecording of teaching each year and annual daylong debriefing sessions in which the same semi-structured interview protocols as used in year 1.

5.Findings

Natalie was employed on contract to teach mathematics in years 8-12. She was in her late thirties and had children of her own. Her previous employment had been as an engineer and the main reason she gave for changing careers related was the need to have a stable family life for her children. She described her experience and work life as an engineer:

[As an Environmental Engineer] I worked really long hours and they [engineers] are very project based. Environmental Engineering is to do with specialising hydrology and hydraulics so I worked with water, like water supply and sewerage and also...in sewerage it was a network…like network modelling of sewers which relies on um like flood, understanding of flood mitigation so um so hydrology is the term of that branch [of engineering].

Her orientation to engineering was driven by a passion for mathematics and problem solving. When asked to reflect on her career as an engineer, she described the nature of engineering in terms of the open-endedness and inquiry based nature of the work and how solutions to problems were never unambiguous.

In engineering, there's so many open-ended questions and often there's no right or wrong answer so what I have gained from my experience is really the open-ended nature of questions and don't always think that you're right or wrong, it might just be the best solution available or the best for the time.

As an engineer she espoused beliefs about the role she undertook. She was a project manager and responsible for major problem solving tasks. She worked in teams and had defined goals to achieve. Engineering culture is characterised by team work and interaction with other engineers in pursuing common problems (e.g., Leonardi, 2001). This culture is created and maintained through daily patterns of interaction among community members.

In the early conversations with her about teacher she reflected on how her engineering work experiences contrasted with the expectations of what was the norm in schools:

Like here it's all exam, pretty much exam based, they've got one requirement from assignment so that's sort of an additional requirement but our focus and our teaching really is still very much towards the exam

Despite these expectations she had attempted to introduce problem solving tasks that were open ended but this then generated stress brought on by departmental requirements and the expectation for 'closed' tasks to be implemented.

So that's worked really well with them but we're coming up to a test and now I'm a bit scared … I just hope they can now do the test because it's written in the format that the text book is in, see if you follow the text book format, that's what format the test is written in whereas I've brought in these big open-ended questions.

Natalie's early strategy to fit into the school involved identifying four colleagues and to think up questions each weekend to help her understand what to do during the following week. Her mentors provided support in response to her request but were not proactive in setting up relationships that focussed on teaching and classroom practices. Thus while she received some support, this did not alleviate her anxieties. Natalie also put pressure on herself because of her beliefs about what mathematics was important in life based on her engineering background and what her school was implementing in their curriculum. These apprehensions worsened in the second year when management structures, teachers were replaced and she lost the support of most of her original mentors.

She was torn between two cultures – the culture of engineering and the use of mathematics and the culture of school mathematics. The critical features that characterised an engineering culture – genuine complex problem solving, teamwork and communication were absent from her school. Although she persisted in teaching and remains in the profession, albeit not at this school, she has struggled to cross the border into a teaching profession. Her persistence would seem to be driven by family circumstances rather than the development of a professional teacher identity.

Natalie was not unique among the 15 beginning teachers who were career changes. For example, Jackie, an experience professional scientist having spent a decade in a commercial laboratory found the experience daunting and quite different from her experiences in school some twenty years previously. For Jackie, it was the lack of collaboration and what she saw as lack of leadership that was constraining her capacity to fully engage professionally in teaching. She was accustomed to working in supportive teams with clear structures and procedures. Natalie and Jackie were among those who survived three difficult years. The experiences of Katie and Kelly were a contrast. Both found the transition relatively easy even though their two professional cultures were quite distinct from that of teaching. These teachers received considerable social support and were drawn into a harmonious relationship with peers in schools where there appeared to be a more collaborative culture. Finally, some career-changers retreated from the border and left teaching. In all, of the fifteen teachers who began in the study only seven survived the first three years of teaching.

6.Discussion and Conclusions

The concept of border or boundary crossing provides an insight into the issues around transiting from one culture to another. In this study, the culture is that shared by members of a profession such as engineering transiting to teaching. Thus, individuals who are engineers have one identity as an engineer. Engineering is characterised by norms, practices and assumptions in which applied problem solving, collaboration, teamwork and communication dominate. Engineers are skilled in working in teams of mixed professionals. At the individual or departmental level, whilst much has been written about cooperative communities, the reality is that teachers tend to work in isolation. It is likely that those schools where professional communities exist at least at the departmental level are more successful because they have developed a culture definable as a school culture (Schoen & Teddlie, 2008).

In the case of Natalie, she exhibited a strong sense of professional identity as an engineer and as such struggled with the lack of opportunities to have meaningful conversations with others in the school staff room. Her confidence was low and remained low without support or positive reassurance. Although she exhibited some proactive intentions to remedy her lack of knowledge about the curriculum by consulting colleagues these instances did not represent the sorts of interactions she was familiar with in engineering. Her role as a project manager could not be equated to that of being a classroom teacher where she felt disempowered and constrained by irrelevant curricula.

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