



How a trainee mathematics teacher develops teacher self-efficacy

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How a trainee mathematics teacher develops teacher self-efficacy

Abstract

This research contributes new understanding of how teacher self-efficacy is acquired and developed by a preservice teacher during a one-year programme of initial teacher education (ITE). Our findings are consistent with previous studies in confirming that self-efficacy is acquired through vicarious experience, verbal persuasion and mastery experience while being undermined by negative physiological and affective states. In this study, however, we consider three separate subdomains of teacher self-efficacy: efficacy in classroom management, efficacy in student engagement and efficacy in instructional strategies. Based on a qualitative analysis of a trainee's weekly reflections, this research shows that efficacy development is phased, initially dominated by developing efficacy in classroom management and efficacy in student engagement and, only at a significantly later stage, in instructional strategies. This is an important contribution to understanding how trainee teachers develop professional efficacy. Based on these findings, we tentatively offer a new self-efficacy development trajectory framework which can be used to inform the development of ITE programmes or continuing professional development programmes.

Keywords: Initial teacher education; teacher self-efficacy; social cognitive theory; mathematics education; professional learning trajectories

Introduction

Teacher self-efficacy has been identified as an important factor in teachers' work and professional learning (Klassen & Tze, 2014; Klassen, Tze, Betts, & Gordon, 2011; Zee & Koomen, 2016), primarily because it is linked to student achievement and motivation (Bruce, Esmonde, Ross, Dookie, & Beatty, 2010; Midgley, Feldlaufer, & Eccles, 1989; Ross, 1992; Thoonen, Slegers, Peetsma, & Oort, 2011). Teacher self-efficacy is the belief a teacher has in their ability positively effect students' progress and confidence (see, for example, Tschannen-Moran & Woolfolk Hoy, 2007). Furthermore, self-efficacious teachers have higher levels of job satisfaction, show lower levels of stress, are less likely to burn out (Aloe, Amo, & Shanahan, 2014; Collie, Shapka, & Perry, 2012; Klassen & Chiu, 2010) and are generally more effective in behaviour management (Chacón, 2005; Woolfolk, Rosoff, & Hoy, 1990). Self-efficacious teachers are also more likely to experiment with and be more ambitious in their teaching (Abrami, Poulsen, & Chambers, 2004; Berman, McLaughlin, Bass-Golod, Pauly, & Zellman, 1977; Guskey, 1988; Stein & Wang, 1988) and implement student-centred or constructivist teaching strategies (Nie, Tan, Liau, Lau, & Chua, 2012) or use innovative approaches in the classroom (Thurlings, Evers, & Vermeulen, 2015). In this paper, we consider an under-researched area of teacher self-efficacy – the qualitative investigation of how efficacy beliefs are developed (Tschannen-Moran & Woolfolk Hoy, 2007; Klassen et al., 2011).

Once established, self-efficacy is relatively stable (Bandura, 1997) but when developing, it can be affected by a variety of factors such as, professional feedback and encouragement, enactment experiences or physiological and affective states (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). It is, therefore, important to understand how self-efficacy is developed at

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3 these very early stages of development (Tschannen-Moran & Woolfolk Hoy, 2007), such as
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5 during initial teacher education (ITE) programmes.
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9 There has been considerable growth in teacher self-efficacy research since the 1970s (Klassen
10 et al., 2011; Zee & Koomen, 2016) but this research has been mostly quantitative (76.7%
11 between 1998-2009; Klassen et al., 2011) with few qualitative accounts. Yet, leading
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13 researchers in this quantitative field have called for qualitative methods to help identify how
14
15 self-efficacy is developed (Tschannen-Moran & Woolfolk Hoy, 2007; Klassen et al., 2011).
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17 This research addresses this gap, offering a detailed account of how a trainee secondary
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19 mathematics teacher's self-efficacy developed through a programme of university-led ITE,
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21 based on their year-long diary. This longitudinal single case study provides a unique
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23 opportunity to investigate the development of self-efficacy qualitatively, by attending to fine
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25 details of data provided by the teacher herself. The rich accounts allow an analysis which can
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27 offer not only exploratory but also explanatory findings, addressing the issue of our limited
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29 knowledge on how different efficacy sources support the development of teacher self-efficacy
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31 described previously in quantitative studies (Tschannen-Moran & Woolfolk Hoy, 2007). In
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33 England, there is a very high attrition rate, with up to a third of teachers leaving the profession
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35 in the first five years (Weale, 2016). Since teacher self-efficacy is closely related to burnout
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37 and stress, this study could contribute to understanding this issue.
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46 We now develop our conceptual framework for this research, beginning with the concept of
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48 teacher self-efficacy and its domains, we then conceptualise a developmental trajectory in
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50 terms of the domains and finally the sources of self-efficacy as part of ITE.
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54 **Teacher self-efficacy**

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57 Self-efficacy is a belief an individual has in their capability to be successful in an activity
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59 domain (Bandura, 1997). While knowledge and beliefs are important in becoming proficient
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3 in a complex activity such as teaching, self-efficacy theory sheds light on the dynamic and
4 reflexive relationship between thought and action (Bandura, 1997). Most human action is
5 directed by thought; an individual's self-efficacy influences the construction and rehearsal of
6 "anticipatory scenarios" (Bandura, 1993, p. 118). Higher levels of self-efficacy result in more
7 ambitious goals, while lower levels of self-efficacy make it more likely for a person to imagine
8 failure or lack of success (Bandura, 1993). Novices in any activity necessarily consider their
9 actions in advance; according to self-efficacy theory, they construct a mental model of future
10 action based on a self-assessment of their knowledge, capabilities and the context (Bandura,
11 1997). As a person becomes more self-efficacious in an activity, their actions become almost
12 automatic and routinised and, once developed, self-efficacy is relatively stable (Bandura,
13 1997).

14 ***Domains of teacher self-efficacy***

15 Self-efficacy is not a general characteristic of the individual; being efficacious in playing the
16 piano, for example, does not necessarily mean being efficacious in learning another language
17 (Bandura, 1997). In other words, self-efficacy is specified in relation to an activity domain.
18 Careful definition of the domain is essential in producing valid conceptualisations of self-
19 efficacy. (Bandura, 2006). If the domain is defined too broadly or too narrowly, self-efficacy
20 lacks specificity or can become meaningless. Moreover, the specification of a domain requires
21 high-level regulatory functions, so efficacy in simple, routine tasks, like tying shoelaces, is
22 meaningless (Bandura, 1997).

23 In defining teacher self-efficacy domains, we draw on the teacher self-efficacy
24 conceptualisation developed by Tschannen-Moran and Woolfolk Hoy (2001), who, using
25 factor analysis, identified three connected domains: *efficacy for classroom management*
26 (EfCM), *efficacy for student engagement* (EfSE) and *efficacy for instructional strategies*
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3 (EfIS). EfCM relates to a teacher's belief in their ability to manage student behaviour and
4 establish themselves in the classroom. EfSE represents a teacher's belief in their ability to
5 motivate students. EfIS reflects teachers' beliefs in their capability to use alternative teaching
6 strategies, assess and pitch the right level of challenge and respond to unexpected situations.
7
8 Table 1 provides a detailed characterisation of the three domains, based on the 24-item OSTES
9 (Ohio State Teaching Efficacy Scale) instrument developed by Tschannen-Moran and
10 Woolfolk Hoy (2001).
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20 *****TABLE 1 somewhere here*****
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23 ***Development trajectories of teacher self-efficacy***

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27 Having considered domains of teacher self-efficacy, we now consider the general processes by
28 which self-efficacy is developed. Previous studies by Tschannen-Moran & Woolfolk Hoy
29 (2007) and Meister & Melnick (2003) suggest that teacher's self-efficacy tends to develop
30 within the domains of classroom management and instructional strategies first, and only then
31 transitioning towards student engagement. However, Schoenfeld's (2011) development model,
32 which we consider in parallel, suggests a different trajectory. The model consists of three
33 'planes' of professional activity (see Figure 1). The first plane is concerned with *classroom*
34 *management* (and is similar to EfCM), the second plane involves *implementing engaging*
35 *activities* (similar to EfSE), the third plane involves *engaging in diagnostic* teaching.
36 Schoenfeld characterises diagnostic teaching as, "...attending to the thought patterns of
37 individuals or groups of students and providing them with feedback and activities tailored to
38 their particular understandings" (Schoenfeld, 2011, p. 191). This has some similarity with EfIS
39 as adaptive or responsive teaching and employing alternative approaches. It is also similar to
40 *contingency* in the Knowledge Quartet (Thwaites, Jared, & Rowland, 2011) which
41 characterises how a teacher adapts and responds to different classroom situations and student
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3 needs. We also see this domain as linked to *ambitious teaching* (Stylianides & Stylianides,
4 2014), as reflecting the use of more challenging student-centred problem solving, dialogic and
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needs. We also see this domain as linked to *ambitious teaching* (Stylianides & Stylianides, 2014), as reflecting the use of more challenging student-centred problem solving, dialogic and investigative activities. Schoenfeld (2011) suggests that, initially, beginning teachers are concerned with classroom management, then with student engagement, while diagnostic teaching is the preserve of experienced and accomplished teachers (see Figure 1, which represents a learning trajectory from plane 1 to plane 2 and then to plane 3). This contrasts with the findings of Tschannen-Moran & Woolfolk Hoy (2007) and Meister & Melnick (2003) who found that teacher self-efficacy for student engagement develops last. Our conflation of EfIS with diagnostic teaching, contingency and ambitious teaching preserves the features of EfIS but adapts it to a reflect a teacher's developmental progress in different aspects of teaching. This could explain Schoenfeld's (2011) and Tschannen-Moran's and Woolfolk Hoy's (2007) apparently contradictory conclusion about the order in which different aspects of teaching capability are developed. Our research sheds further light on this.

*****Figure 1 somewhere here*****

The four sources of self-efficacy

Self-efficacy develops as a learner (in this case a trainee teacher) receives information about their capability. According to Bandura, there are four sources of information: the direct experience of doing an activity; observing others who demonstrate competent actions; verbal and social encouragement and support; and physiological and affective states (Bandura, 1997).

These can be characterised as follows:

- ***Enactive Mastery Experiences (ME)*** – which provides information about personal capability through feedback from direct personal experiences;

- *Vicarious Experiences (VE)* – from the observation of others and through transmission of competency by comparison with others;
- *Verbal Persuasion (VP)* – social influences that support the existence of capabilities, through feedback and encouragement from others;
- *Physiological and Affective States (PAS)* – which can undermine the individual's sense of capability as a result of, for example, illness, anxiety, stress or tiredness.

All four sources are often involved in the development of teachers' self-efficacy (Bruce & Ross, 2008) but not always simultaneously. While ME is generally identified as the strongest source of self-efficacy, followed by VE then VP (Bandura, 1997; Tschannen-Moran & Woolfolk Hoy, 2007), the practicalities of teacher training and the working environment influence the access trainee teachers have to the different sources of efficacy. Due to limited opportunities for ME, trainee teachers rely mostly on VE and VP early in their development (Tschannen-Moran & Woolfolk Hoy, 2007). This is consistent with Milner (2002), who found that VP was as a critical source of self-efficacy until there were opportunities for ME.

Research Questions

The focus of this study is on how and when each of the three domains of self-efficacy (as formulated earlier) develop and how the four different sources of self-efficacy contribute to this development. Within this we aim to address the following research question:

How does a trainee mathematics teacher's self-efficacy develop during a programme of initial teacher education?

Methodology

This research uses a longitudinal explanatory case study approach (Yin, 2014), drawing on empirical data from a single participant's weekly written reflections collected through a one-

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3 year ITE programme. The analysis involved preliminary coding of the data to identify Alison's
4 (pseudonym) reflections relating to self-efficacy. Firstly, we sought examples of where she
5 reflected on her confidence, emotional responses and thinking in response to the professional
6 learning process on the school-based part of the course. From this, we attempted to identify
7 each of the three domains of self-efficacy (EfCM, EfSE, EfIS) and the sources of their
8 development (ME, VE, VP or PAS). The coding was undertaken by both authors separately
9 and verified on completion. A final draft of this paper was given to Alison, who confirmed that
10 the analysis reflected her experience as a trainee.
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22 Our aim was to maintain a narrative or biographical coherence that reflected the participant's
23 overall experience and avoid a fragmented treatment of themes. This allowed us to develop a
24 learning trajectory for this participant. This research provides an explanatory account of one
25 trainee teacher's professional learning, based on the development of their self-efficacy. While
26 we are confident that the framework is applicable to this case study, based on our knowledge
27 and experience of working with other trainees, we recognise its potential to be generalisable.
28 Our claim to generalisability is based on Yin's (2014) analytic rather than statistical
29 generalisation (i.e. generalising to theory or expanding an existing theory), but further research
30 is needed to confirm its validity and applicability to other disciplines and phases of schooling.
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44 This research complies with the British Educational Research Association guidance on ethics
45 (British Educational Research Association (BERA), 2018), the participant gave informed
46 consent and was given the opportunity to withdraw at any point and an approach was agreed
47 to preserve the participant's anonymity.
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54 ***The case: Alison***

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57 Our case selection is based on an "intensity sample" approach (Cohen, Manion, & Morrison,
58 2011, pp. 156–157), where the data associated with the case allows us to explore the
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3 phenomena we are interested in. Initially, we approached all trainees, from a particular
4 academic year, for permission to use their weekly reflections which are held on the university's
5 virtual learning environment (VLE). Five trainee teachers consented to participating in the
6 research. Having read their reflections, we selected Alison as our case, since her diary gave a
7 particularly detailed account of her experiences (both in practical and emotional terms),
8 providing unique insights into her thinking about her progress and development through the
9 programme.

10
11 Alison attended a state school in England, where she performed well in public examinations
12 and went on to study mathematics at university where she gained a first-class degree. She had
13 excellent subject knowledge in preparation for a teaching career. Her interest in becoming a
14 teacher had been prompted by a teacher at her school and she had been further encouraged by
15 her university tutor. During her interview for the ITE programme, Alison came across as
16 confident, enthusiastic and thoughtful and was considered to have excellent potential to
17 successfully complete the programme.

18
19 It is not possible to say that Alison is typical or representative of trainee teachers but, based on
20 our observation of other trainees on the course, we suggest that her experiences are common
21 to many trainees. The uniquely detailed account of Alison's learning journey provides a
22 powerful insight into how trainees develop their capability on the ITE programme. By
23 theorising Alison's experiences using the sources and domains of teacher self-efficacy we
24 propose a tentative model based on a single case.

25 26 ***The initial teacher education programme***

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28 Alison's training takes place on a university-based ITE programme in England, where both
29 authors are lecturers. Although the programme is described as university-led, trainees spend
30 over 80 per cent of the 36-week course in schools. Upon successful completion of the course,

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3 trainees are awarded a Postgraduate Certificate in Education (PGCE) and Qualified Teacher
4 Status (QTS) subject to a successful completion of a one-year induction in a school.
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9 The ITE programme begins in September and concludes in June of the following year. In the
10 first weeks of the course, after an induction week, trainee teachers attend their first placement
11 school for three days a week and return to faculty for lectures and independent study for the
12 other days. Trainees complete this first professional placement (PP1) in week 14 of the course,
13 immediately before the December break. In January, they start their second professional
14 placement (PP2), where they spend most of their time, until the final fortnight of the
15 programme in June. Teaching is undertaken by faculty-based subject lecturers and a school-
16 based mentor.
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28 **Results**

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31 In this section, we provide an account of how Alison's teacher self-efficacy develops in each
32 of the domains (EfCM, EfSE and EfIS) and the role of the sources of self-efficacy (ME, VE,
33 VP, PAS) within this development. We divide this account into two subsections, based on the
34 two school placements.
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41 ***Professional Placement 1 (PP1)***

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45 Throughout PP1, Alison's focus is on the development of EfCM with some attention given to
46 developing EfSE, although this is at a slightly later stage. Alison's initial reflections relate
47 directly to EfCM, she considers how she might establish herself with a class, deal with
48 disruption and establish clear rules and routines. These reflections reveal Alison's sense of
49 anticipation, anxiety and uncertainty: she is anxious about entering the classroom and standing
50 in front of students, she imagines it will not go well and worries that her mentor, Rebecca, will
51 have to intervene and take over the lesson:
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3 We [Alison and the school-based mentor] decided I'd have a go at teaching
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5 Y7 [year 7] a starter on Wednesday this week (eek! I'm hoping the idea of
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7 standing up in front of a class gets less terrifying after this, right now I'm
8
9 having visions of it going so badly out of control Rebecca will have to step
10
11 in halfway through and say "that's enough" and then I'll get kicked off the
12
13 course, maybe a tad dramatic (week 4).
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18 Self-efficacy involves constructing a mental model of competent action, but Alison finds it
19
20 difficult to do this at this stage. Anxiety (PAS) appears to undermine Alison's self-efficacy, but
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22 VP from her school-based mentor and university lecturer counter this. They reassure Alison
23
24 that such feelings are normal at this early stage and suggest ways of managing them. The
25
26 university lecturer provides a written response to her reflection as follows:
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30 Please don't be anxious about how your first starter goes. This is the
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32 beginning of a journey and you are not expected to get things perfectly
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34 correct right from the start (or indeed ever!). Do practise your starter and
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36 get comfortable with the things you will say, though – that might help with
37
38 the nerves.
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43 The lecturer provides Alison with some encouragement (VP) and suggests practising things in
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45 advance to develop self-efficacy through ME. During the following week, Alison articulates
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47 how here EfCM is developing, attributing this to ME.
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51 ...my starter with year sevens, ... actually went quite well! (... it was
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53 really important to just try standing in front of the class and realise that
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55 no matter what happened they weren't all going to start booing me or
56
57 anything) (week 5).
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3 In the above reflection, Alison indicates the significance of ME in the development of EfCM
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5 and this continues in subsequent weeks:
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9 Next week I'm teaching another half a lesson to Y7 [year 7] ... and I'm
10
11 already starting to feel much less nervous about the prospect of standing
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13 up in front of the class - it's sort of like, I've already done it and shown
14
15 Rebecca where I'm at, and she doesn't seem to think I deserve kicking off
16
17 the course yet, so as long as I keep trying hard she won't change her mind
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19 (hopefully!) (week 7).
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24 Efficacy appears to be strengthened through increasing opportunities for ME and from VP from
25
26 her mentor, who reassure Alison that she does not "deserve kicking off the course". VE,
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28 however, is an important source of efficacy in the early stages of training, Alison spends a lot
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30 of time observing practice and reflecting on her observations.
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34 Rebecca asked me to take her [a struggling student] outside at which
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36 point I realised I had absolutely no idea how to comfort a sobbing child
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38 who I'm not allowed to hug, I have no authority to say anything like
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40 "maybe you'd be happier moving to a different class" too, and who would
41
42 instantly see through any attempts I made to say things like "you're not
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44 the worst in the class, cheer up!". So Rebecca came out and was
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46 motivational in a tough love kind of way: "No, you can't do these
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48 multiplications right now, but I don't mind, because the important thing is
49
50 that you're going to be able to do them by the end of the lesson. Now I'm
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52 going to get you a chair so you can sit out here for five minutes to calm
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54 down." (it seemed to work! I'll have to remember that) (week 4).
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3 In this example, the mentor is initially looking for ways to give Alison a chance to develop
4 EfCM through ME. Alison feels she does not know how to handle the situation effectively, in
5 response the mentor models the behaviour for Alison (VE). In the final sentence of the
6 reflection, there is an indication that VE positively influences Alison's EfCM, who plans to use
7 the observed technique in the future.
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15 Initially, opportunities to observe practice (VE) and discussions with mentors (VE & VP) act
16 as main sources of information about her capabilities. Increasingly, however, ME becomes
17 more important, at first through rehearsing approaches in an empty classroom, then by teaching
18 parts of lessons and then increasingly through teaching whole lessons. In week 6, Alison begins
19 to reflect on incorporating investigative tasks in her teaching and how these made her aware of
20 students' motivation and engagement during the lesson. She indicates that this is something she
21 previously did not think about and that, initially, she was anxious about it. This is the first
22 indication of attention to EfSE.
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35 The pupils had been doing some investigation/group stuff at the beginning
36 of the lesson, so they were all mixed up ... and a little bit more excitable
37 than usual ... The main thing that I didn't anticipate in the plan was how
38 amazingly keen they'd be ... I got as far as the one example before
39 everyone was going OH MY GOSH MISS IT'S ALWAYS THE SAME
40 WOW CAN WE TRY IT AGAIN I WANT TO KNOW WHY IT WORKS
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49 - which was obviously fantastic but I was a bit taken aback!
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51 Alison is encouraged to consider student engagement further in week 7, having observed a
52 lesson.
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57 ...the thing that most struck me was that if you go into a lesson all mentally
58 prepared to be a stroppy year 8 it's really easy to not get engaged and have
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3 no idea exactly what's going on! It was a very useful (if slightly
4 demoralising) insight.
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9 Alison's mentor also highlights the importance of student engagement in her feedback to her
10 about teaching:
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14 One of the main things that came out of it was that I need to start planning
15 more time for the students to actually be doing things, and no matter how
16 good you are at explaining things, standing at the front and expounding
17 can never be a complete substitute for doing it and making mistakes
18 yourself! (week 10)
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27 In the above extract, Alison develops EfSE through VE as she observes and reflects on
28 practice, then through VP when her mentor gives her encouragement.
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32 While Alison's EfCM continues to develop, tiredness, stress and anxiety undermine this
33 development at times (PAS). In week 11 she indicates how tiredness and workload negatively
34 affect her self-belief and progress:
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40 Had a bit of a wobble this week. I think it was partly to do with being
41 cumulatively exhausted ... partly because the workload is getting bigger
42 and partly because I feel like I'm stagnating a bit. For the past couple of
43 weeks my targets have been to do with behaviour and pace, and at my last
44 mentor meeting Rebecca and I agreed to keep them going, but I feel like I
45 wish I could just wave a magic wand and get good at those things so I
46 could move on to thinking about something else... I feel like I've let Rachel
47 [class teacher] down because I took in her Y9's books on Monday and have
48 been so busy stressing about lesson plans/markings ... that I didn't get them
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3 marked by Friday ... I think this all came to a head on Thursday when I
4 just got into my car to go home and started crying ... Sunday was a day
5 that I'd planned to do a lot of work, and I ended up feeling too ill to do any,
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7 that I started the week behind and stressed and it all spiralled from there.
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13 Increased workload, stress and tiredness have a negative effect on Alison's efficacy. She is
14 frustrated that she is still focussing almost exclusively on classroom management and feels that
15 she should be extending her practice and thinking more about different aspects of teaching. She
16 begins to make a conscious effort to develop EfSE and describes the development through ME:
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23 I've been trying to make lesson plans that involve much more doing on the
24 part of the students to keep the pace up, but I don't think I've got the balance
25 right because I feel like I'm being really procedural and just giving them a
26 load of questions to do without much thinking ... and even then I keep on
27 not making it to the end of the lesson plan ...
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34 There were some good things that happened this week! I had a really good
35 lesson with Y8, I was teaching them about defining sequences as shifted
36 times tables and they were all really engaged and trying super hard (week
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42 11)
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46 This developing awareness of student engagement is further visible in the following reflection,
47 where Alison's predominant focus is on student engagement:
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51 The second lesson today was so much better – it was about using rectangles
52 and trapezia to estimate the areas under curves, and I think it was the first
53 ever thing I've taught where the students were more (rather than less)
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3 happy with it than I thought they'd be ... and it really boosted my
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5 confidence (week 12).
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9 Alison concludes PP1 by reflecting on her progress, which illustrates the extent to which EfCM
10 has developed.
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14 ... even though there were times when I felt like I wasn't really
15
16 progressing, to go from being terrified to do a 10-minute starter to actually
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18 enjoying teaching them for 2 hours is quite a big improvement!
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22 Alison's PP1 reflections illustrate how VE was initially a primary source of self-efficacy
23 supported by VP. As Alison is given more classroom experience ME becomes increasingly
24 important. There are negative effects of PAS owing to tiredness, anxiety and stress, however,
25 this is countered by VP and Alison's growing sense of efficacy, particularly in EfCM and EfSE.
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27 Development of EfIS is limited but begins to become significant in PP2, as we describe in the
28 following section.
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37 ***Professional Placement 2 (PP2)***

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40 In the first few weeks of PP2 Alison focuses on becoming more assertive in the classroom.
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42 Even though during PP1 her EfCM had developed, Alison is in a new school with new classes
43 and must establish herself in an unfamiliar environment. Through PP1 she developed gradually,
44
45 with a steady increase in teaching which kept the level of demand manageable, in PP2 Alison
46
47 is expected to begin teaching more classes and experience teaching more challenging students.
48
49 Consequently, EfCM becomes a significant focus for her development again. Alison's account
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51 reflects the new context and demands.
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57 I taught Y8 [year 8] on Wednesday and I was really excited about it [...]

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59 The only problem is that they were being very exuberant, and behaviour
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3 was getting a bit out of hand, and while my target was to be able to use
4 sanctions confidently, I got to the stage of warning where the next step
5 would be to send a pupil out of the room, but I bottled it and let him carry
6 on misbehaving because I wasn't confident about how I would deal with
7 that. ... when Nigel [mentor] pointed out 'well this is what we were meant
8 to be focussing on this lesson and it wasn't so great in that respect' I felt
9 really dejected even though I knew that was really illogical (and I got over
10 it as quickly as I could, it was just an involuntary emotional response – but
11 Nigel and I have discussed sanctions since then and I feel much more
12 confident about what to do in that kind of situation – so hopefully I'll be
13 able to put what I learned in to practice then!) (week 19).

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30 This negative experience challenges Alison's EfCM. Her mentor's criticism highlights an
31 aspect of her classroom management that he believes needs attention. This illustrates how self-
32 efficacy is not just developed through positive experiences, Alison's mentor helps her to see
33 how her approach is working and helps to evaluate its effectiveness. This criticism can
34 undermine self-efficacy as a result of negative responses to the criticism (PAS), however, VP
35 can counter this leading to a positive effect on self-efficacy through ME.

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Apart from the initial focus on classroom management during PP2, there are fewer references
in Alison's reflections than during PP1 and are almost absent until week 30 when Alison
expresses a high level of EfCM and acknowledges the important role of VP:

I'm generally feeling a lot more confident about behaviour management
stuff and being able to cope alone with a class next year, especially after
your helpful comments [from university lecturer]!

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3 Throughout PP2 Alison's attention is mainly on student engagement (EfSE), with some
4 attention to instructional strategies (EfIS). We observe this shift of attention in the following
5 reflection:
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11 I taught year seven once this week and it was a bit of a 'meh' lesson, but I
12 think that was due to the content rather than anything else (... I focussed
13 really hard on presenting it [a task] in one way because I thought they'd be
14 okay doing the maths for it, when it turned out that they weren't I hadn't
15 really shown them an alternative route to fall back on (mainly because I
16 hadn't considered it!)) (week 24).
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26 This reflection is among the first which suggests a shift from EfCM toward the further
27 development of EfSE and an awareness of instructional strategies (EfIS). Alison expresses
28 some confidence in classroom management and becomes interested in how her lesson plan and
29 her explanations in the lesson impact on the students. At this stage, she articulates limited levels
30 of EfIS but recognises the role of instructional strategies. She explains the challenge of being
31 responsive in-the-moment – explaining things in different ways during the lesson – and how
32 this affected the quality of the lesson.
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43 In week 28, Alison makes further reference to student engagement (EfSE), she indicates that
44 her experience of learning to teach is characterised by initially developing EfCM followed by
45 EfSE. The domains are related but are treated as distinct aspects of teaching during teacher
46 training.
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53 The lesson itself was just talking through some examples of solving
54 algebraic equations on the board and then setting them off on a load of
55 textbook questions – I know that their usual class teacher doesn't only
56 teach textbook-style lessons, but he suggested it as a good format for while
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3 I was getting to know that class and it felt quite boring – hopefully I can
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5 feel comfortable doing some more stuff with them soon.
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9 Alison's EfSE and EfIS continue to develop through ME. We can observe a focus on
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11 instructional strategies in week 31 but also related to student engagement.
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14 I taught another lesson to my Y9s [year s] on Friday, which went quite
15
16 well. There was more of me at the front and it felt much more like active
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18 than passive teaching, but I still got some good thinking and ideas out of
19
20 people.
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24 In this reflection, Alison indicates developing EfSE, she articulates awareness of and
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26 consequently a focus on student engagement and participation. As she encourages students to
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28 articulate their thinking, this illustrates a willingness to engage in adaptive and responsive
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30 teaching (EfIS). During the final weeks of the course, Alison's reflections suggest that ME is
31
32 the main source of self-efficacy, support from others remains important but VE is less
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34 important. While the workload, stress and anxiety continue (PAS), Alison is efficacious enough
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36 to manage the negative effects of these aspects.
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41 **Discussion**

42 ***Development of self-efficacy in the three domains***

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45 In this research, we have shown how a trainee mathematics teacher's self-efficacy develops
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47 through an ITE programme. We identify this development in terms of the three teacher self-
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49 efficacy domains suggested by Tschannen-Moran and Woolfok Hoy (2001): *efficacy for*
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51 *classroom management* (EfCM), *efficacy for student engagement* (EfSE) and *efficacy in*
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53 *instructional strategies* (EfIS). There is a sequential development of Alison's self-efficacy,
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55 which begins with EfCM from the start of the school placement and continuing through the
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3 programme. EfSE begins to develop slightly later, while EfIS begins to develop later in the
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5 second school placement. This observation is consistent with Schoenfeld's (2011) teacher
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7 development trajectory through three planes – from classroom management to implementing
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9 engaging activities and then engaging in diagnostic teaching (see Figure 1). It contrasts,
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11 however, with what Tschannen-Moran & Woolfolk Hoy (2007) and Meister & Melnick (2003)
12
13 propose, that teachers develop classroom management skills, then broaden the range of their
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15 practice and then develop their skills in motivating and engaging students. It is important to
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17 explain this disparity. In contrast with Tschannen-Moran and Woolfolk Hoy's (2007)
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19 quantitative study, our qualitative approach leads to a different operationalisation of EfIS. In
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21 the OSTES questionnaire, EfIS can be interpreted qualitatively, as a teacher's capability in a
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23 breadth of practices and alternative approaches (See Table 1). Indeed, we take the EfIS factor
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25 and integrate it with Schoenfeld's (2011) developmental framework and interpret it as adaptive,
26
27 contingent and ambitious teaching and we observe the trainee developing classroom
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29 management skills (EfCM), then attending to student engagement and motivation (EfSE) and
30
31 then developing the capability to deploy a breadth of approaches to respond and adapt to the
32
33 classroom environment and student thinking (EfIS) (see Figure 2). The advantage of our
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35 approach is that we consider *how* efficacy develops in each domain and how the domains are
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37 related to each other.
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45 *******FIGURE 2 somewhere here*******

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48 Finding that a trainee teacher initially focuses on classroom management is unsurprising and it
49
50 is consistent with a substantial body of research that links preservice teachers' stress and
51
52 student behaviour (see, for example, Chaplain, 2008). Based on the analysis of Tschannen
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54 Moran and Woolfolk Hoy (2001) we characterise the EfCM in terms the teacher establishing
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56 themselves with a class, how they get students to follow classroom rules and how they respond
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58 to difficult or disruptive students (see Table 1); the emphasis is on the teacher and their
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3 performance. Our data show how the trainee is preoccupied with their performance,
4 particularly during the early stages of the school placement and when they move to a new
5 school for their second placement. While a trainee continues to develop EfCM, there comes a
6 point at which they feel comfortable enough to start thinking about student engagement and
7 motivation.
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12 Bandura (1997), suggests that when an individual becomes self-efficacious in an activity, their
13 actions become almost automatic or 'routinised' – they do not have to think about all their
14 actions. As the trainee develops EfCM, their attention shifts to EfSE, as some aspects of their
15 developing practice become more routine. In this case study, we see that attention shift to EfSE
16 in the second week of the school placement (week 6) and continues through the programme.
17 Even though classroom management at this stage is not yet a set of almost automatic responses
18 (as might be observed in an experienced teacher), Alison has now sufficient self-efficacy not
19 to have to constantly think about what she is doing and can turn her attention to the students.
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25 In developing student engagement, the trainee starts to consider how students respond to the
26 teacher and their level of engagement. It appears that Alison's attention shifts from herself to
27 the students. It is noticeable in her reflections she treats these domains as distinct aspects even
28 though they contribute to her teaching overall. This could be because of where the trainee's
29 attention is as they develop, Alison's initial focus is on what she is doing (EfCM), then her
30 attention shifts to the students and their engagement and motivation (EfSM). Finally, she begins
31 to think about how she reacts and responds to students and adapts her teaching appropriately
32 in the lesson (EfIS). At each stage, she becomes sufficiently efficacious so that her thinking is
33 not dominated firstly by classroom management, then by student management. Once she has
34 achieved this she can develop adaptive, contingent (Rowlands, Thwaites, & Jared, 2011),
35 ambitious (Stylianides & Stylianides, 2014) and diagnostic teaching (Schoenfeld, 2011). The
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3 second aspect of this research considers how efficacy is developed, which we discuss in the
4 following section.
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8 ***The four sources of self-efficacy in the three domains***

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11 EfCM is developed through all four sources of self-efficacy (VE, VP, ME & PAS) which is
12 consistent with previous research (see, for example, Bruce & Ross, 2008). While ME is
13 generally agreed to be the strongest source of self-efficacy (Bandura, 1997), we found that VE
14 and VP – similar to Tschannen-Moran and Woolfolk Hoy (2007) – were the most important
15 sources of information for development of self-efficacy at an early stage of teachers' training.
16 Initially, Alison has limited opportunity for ME, since she is mostly observing other teachers
17 and reflecting on these with her mentor and lecturers. ME is limited to teaching small parts of
18 lessons or practising in empty classrooms. As the course progresses, as Alison takes on more
19 teaching, she develops self-efficacy through ME, supported by VP. This is consistent with
20 Milner (2002), who found that VP was as a critical source of self-efficacy until there were
21 opportunities for ME. VE remains important through the programme since trainees continue to
22 observe practice. The importance of PAS should not be underestimated. When Alison is faced
23 with anxiety, high workloads, stress and tiredness, these affective dimensions undermine
24 teacher self-efficacy through PAS. In response, VP serves to mitigate these effects. It is
25 important to recognise the role of mentors, colleagues, lecturers and peers in providing
26 emotional support through the programme and also the role of mentors in helping develop ME
27 by providing feedback on the trainee's developing practice.
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52 ***The two-dimensional teacher self-efficacy model***

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55 In this analysis, we bring together the self-efficacy development domains EfCM, EfSE and our
56 adapted interpretation of EfIS based on Schoenfeld's (2011) diagnostic and adaptive teaching
57 Table 2. The first row (VE) reflects that initial domination of the observation of practice. The
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3 first column is occupied by EfCM since it is the dominant domain in the initial stages of the
4 programme. Increasingly ME plays a role in EfCM. Once Alison feels efficacious in classroom
5 management she starts to think about student engagement, hence we locate EfSE in the second
6 column. In the final column, Alison starts to attend to instructional strategies. The arrows in
7 the first two rows indicate trajectories as we have outlined in the previous subsections.
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12 We locate VP across all columns because the verbal support and encouragement that Alison
13 receives can be specific to each domain but also considered as a more general support. Finally,
14 PAS generally provides negative effects across all domains and is mitigated by VP. The arrows
15 from the VP row indicate how support from mentor, lecturers, colleagues and peers help
16 overcome negative experiences and help sustain levels of efficacy at the beginning.
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28 *****TABLE 2 Somewhere here please*****
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30 31 ***The importance of trainee teachers' self-efficacy in the current policy context*** 32

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35 The policy direction in England since 2010, has been to emphasise teachers' acquisition of
36 knowledge and skills as they train, characterising teaching less as based on professional
37 judgement but as a 'craft'. The government white paper, *The Importance of Teaching*
38 (Department for Education (DfE), 2010), set out how teaching should be based on "proven"
39 best practice (DfE, 2010, p. 19) and learnt by observing "the very best teachers" (Gove, 2011).
40
41 It denigrates the importance of teacher judgement, agency and emotion suggesting that there
42 are methods and approaches that can be applied efficiently. Conceptualising professional
43 learning in terms of self-efficacy acknowledges the acquisition of knowledge, but that
44 reflection and collegial support are necessary for developing higher-level teaching skills
45 (contingent, responsive and diagnostic approaches) and are central to effective teaching (Soini,
46 Pietarinen, Toom, & Pyhältö, 2015). The two-dimensional model challenges the craft model
47 and illustrates how becoming an expert teacher is more than applying the best methods
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3 effectively. Learning to teach is a cognitive and emotional process. It involves becoming part
4 of a community of practice, using professional judgment and developing the confidence and
5 sense of agency to challenge and extend existing practice. The government model does not
6 acknowledge the challenge for a trainee and early-career teacher in developing efficacy in
7 instructional strategies – the high-level adaptive and diagnostic professional skills.
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15 **Conclusion**

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18 We investigated how a trainee mathematics teacher's self-efficacy developed through a
19 programme of ITE, using her weekly reflections. The analysis shows that the trainee's
20 development takes place within three domains and is sequential, beginning with classroom
21 management, followed by student engagement then instructional strategies. Self-efficacy is
22 developed within these domains through the four sources of self-efficacy: Enactive mastery
23 experience (ME), vicarious experience (VE), verbal persuasion (VP) and physiological and
24 affective states (PAS). From these observations, we propose a two-dimensional framework
25 with the sources of self-efficacy on one axis and the domains on the other, to create a
26 developmental field (see Table 2).
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40 Our findings build on the research of Tschannen-Moran & Woolfolk Hoy (2007) but bring new
41 insights into *how* a trainee teacher's self-efficacy develops through an initial teacher education
42 programme. The nature of this study provides a limited elaboration of the development
43 trajectory but does provide important insights into a trainee's development. By expanding this
44 research to include, for example, lesson observations, interviews with teachers and mentors,
45 more cases or different phases and subject areas would allow our proposed model to be tested
46 and developed further.
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58 This research offers a new understanding of mathematics teachers' professional learning in the
59 initial phases of their training. The model proposed integrates both cognitive and social factors
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3 within the learning trajectory. Although based on a single case of a trainee mathematics teacher
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6 participating in a particular programme of initial teacher education, we consider this framework
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8 to be of value in other subject areas and programmes, which may prove useful in thinking about
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10 the design and improvement of programmes of professional development and in better
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12 understanding high attrition rates in the first few years of teacher's careers.
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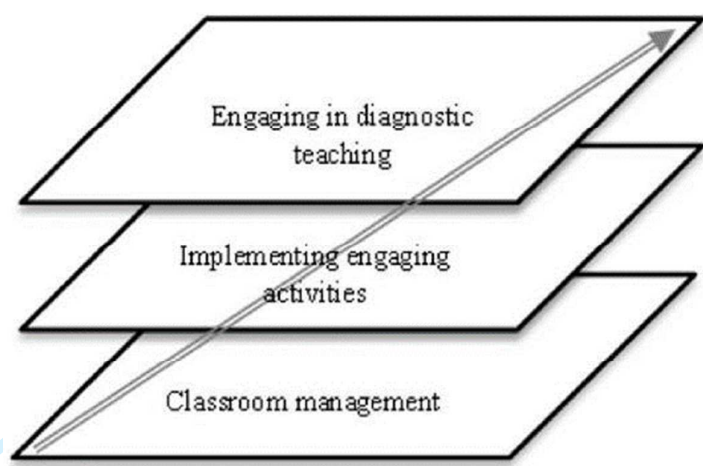


Figure 1: Schoenfeld’s (2011) teacher learning trajectory - three planes of professional activity

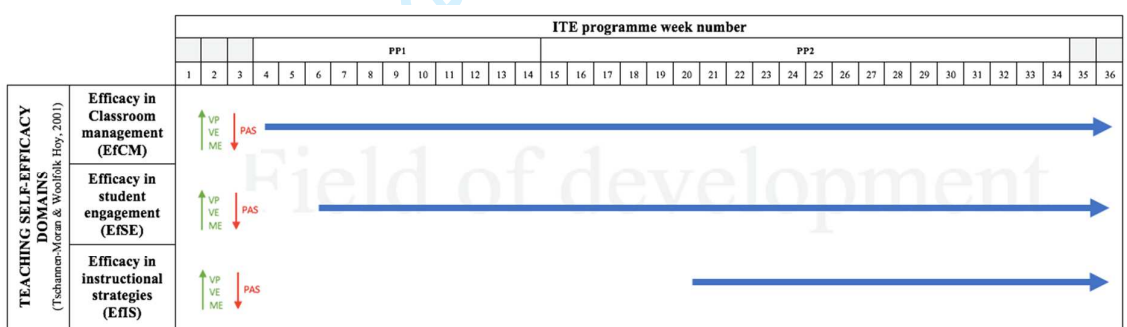


Figure 2: The sequential development of self-efficacy in the three domains in the case of Alison

Table 1: Descriptors of domains of teacher self-efficacy, based on the 24-item long-form OSTES (Ohio State Teaching Efficacy Scale) instrument developed by Tschannen-Moran and Woolfolk Hoy (2001)

	Teacher self-efficacy domains		
	Efficacy for classroom management (EfCM)	Efficacy for student engagement (EfSE)	Efficacy for instructional strategies (EfIS)
Summary of domain characteristics based on the Tshannen-Moran and Woolfolk Hoy, (2001) instrument items.	<ul style="list-style-type: none"> - control disruptive behaviour; - get the class to follow classroom rules; - calm a disruptive student; - establish a classroom management system; - stop a few disruptive students from ruining a lesson; - respond to defiant students; - to make expectations clear; - establish routines. 	<ul style="list-style-type: none"> - get students to believe they can do well; - help students value learning; - motivate students who have low interest; - improve the understanding of students who are failing; - assist families in helping children do well; - help students to think critically; - foster student creativity; - getting through to the most difficult students. 	<ul style="list-style-type: none"> - use a variety of assessment strategies; - use alternative explanations or examples; - craft good questions; - implement alternative strategies; - respond to difficult questions; - gauge student understanding; - adjust level for individual students; - provide appropriate challenge.

Table 2: Two-dimensional self-efficacy development framework for the case of Alison

	Efficacy in Classroom management (EfCM)	Efficacy in student engagement (EfSE)	Efficacy in instructional strategies (EfIS)
Vicarious Experience (VE)	This is important in the beginning of the first placement and to some degree at the beginning of the second. Alison learns techniques vicariously and sees them used effectively.	Alison observes approaches to engage & motivate students, but Alison does not reflect on this until after EfCM has developed.	There is little reference to observing instructional strategies as contingent, adaptive, diagnostic or ambitious approaches.
Enactive mastery experience (ME)	Alison gradually experiences more teaching through teaching parts of lessons then increasing her teaching load over the programme	Alison begins to try out different approaches and tasks and experiences how students respond to them. She is able to assess her capability in motivating and engaging students.	Alison begins to reflect on her adaptability and flexibility in the classroom. She experiments with ambitious tasks, but EfIS is not strongly developed at the end of the programme.
Verbal persuasion (VP)	Throughout the programme mentors, lecturers, peers and teachers and other staff in schools provide support and encouragement to help the trainee believe in their capabilities as they develop		
Physiological & affective states (PAS)	Alison experiences tiredness, anxiety and stress, self-doubt and, for example, lessons not going well. This undermines her developing belief in their capabilities. Although, through the programme, her self-efficacy is developing, and she is increasingly able to put setbacks into perspective and manage challenging environments and workloads		