

Reconceptualising teacher self-efficacy in relation to teacher identity

A longitudinal phenomenological study of pre-service secondary
mathematics teachers during initial teacher education

Gosia Marschall



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Academic dissertation for the Degree of Doctor of Philosophy in Mathematics Education at Stockholm University to be publicly defended on Friday 15 October 2021 at 13.00 in Vivi Täckholmsalen (Q-salen), NPQ-huset, Svante Arrhenius väg 20.

Abstract

This research involves a conceptual investigation of teacher self-efficacy and its appraisal by focusing on how five pre-service secondary mathematics teachers make meaning of their experiences in the process of their development. Recognising methodological limitations of previous studies in the area, this one-year longitudinal study uses abduction and interpretative phenomenological analysis of qualitative data collected from participants' written weekly reflections, planning documents, lesson observations and interviews. This research shows that teacher self-efficacy is a domain-specific, task-oriented aspect of a more general narrative self-schema—while driven by an agentic goal pursuit and based on cognitive processing of information from enactive, affective, vicarious and social experiences, the teacher self-efficacy appraisal process also attends to aspects of the individual's past, present and future selves, all of which are incorporated in an ongoing transformation of self as a competent teacher in a narrative continuity. This means that teacher self-efficacy appraisal is much more closely connected to the development of professional identity than has been previously acknowledged. The study contributes to the existing field of teacher self-efficacy by going beyond the well-established four self-efficacy sources framework and extends our understanding of the complexity of the teacher self-efficacy concept and its development. Consequently, it proposes an iterative, narrative model of teacher self-efficacy development—one which is centred in the meaning-making process and which extends other models prevalent in the literature. The new way of conceptualising teacher self-efficacy in this study helps address the previously narrow treatment of teacher self-efficacy, helps explain the contradictions related to changes in teacher self-efficacy and its stability, and has significant implications for conceptualising and understanding teacher professional learning.

Keywords: *abduction, initial teacher education, longitudinal phenomenological study, narrative identity, narrative self-schema, pre-service secondary mathematics teachers, teacher professional learning, teacher self-efficacy.*

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Stockholm
University

Department of Mathematics and Science Education

Stockholm University, 106 91 Stockholm

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To Theo, Jacob,
Filip and Kris

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Abstract

This research involves a conceptual investigation of teacher self-efficacy and its appraisal by focusing on how five pre-service secondary mathematics teachers make meaning of their experiences in the process of their development. Recognising methodological limitations of previous studies in the area, this one-year longitudinal study uses abduction and interpretative phenomenological analysis of qualitative data collected from participants' written weekly reflections, planning documents, lesson observations and interviews. This research shows that teacher self-efficacy is a domain-specific, task-oriented aspect of a more general narrative self-schema—while driven by an agentic goal pursuit and based on cognitive processing of information from enactive, affective, vicarious and social experiences, the teacher self-efficacy appraisal process also attends to aspects of the individual's past, present and future selves, all of which are incorporated in an ongoing transformation of self as a competent teacher in a narrative continuity. This means that teacher self-efficacy appraisal is much more closely connected to the development of professional identity than has been previously acknowledged. The study contributes to the existing field of teacher self-efficacy by going beyond the well-established four self-efficacy sources framework and extends our understanding of the complexity of the teacher self-efficacy concept and its development. Consequently, it proposes an iterative, narrative model of teacher self-efficacy development—one which is centred in the meaning-making process and which extends other models prevalent in the literature. The new way of conceptualising teacher self-efficacy in this study helps address the previously narrow treatment of teacher self-efficacy, helps explain the contradictions related to changes in teacher self-efficacy and its stability, and has significant implications for conceptualising and understanding teacher professional learning.

List of articles

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List of Abbreviations

EfCM – Efficacy for Classroom Management

EfIS – Efficacy for Instructional Strategies

EfSE – Efficacy for Student Engagement

ITE – Initial Teacher Education

ME – Enactive Mastery Experiences

MMRS – Mentor Meeting Record Sheet

OSTES – Ohio State Teaching Efficacy Scale

PAS – Physiological and Affective States

PGCE – Postgraduate Certificate in Education

QTS – Qualified Teacher Status

SCT – Social Cognitive Theory

TSE – Teacher Self-Efficacy

TPL – Teacher Professional Learning

VE – Vicarious Experiences

VP – Social and Verbal Persuasion

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1. Introduction

Teacher self-efficacy has been defined as teachers' task-oriented judgements about their capability to effectively organise and execute specific courses of action (Bandura, 2006) in a particular professional context (Tschannen-Moran, Woolfolk-Hoy, & Hoy, 1998). It has been shown to play an important role in the teaching profession in aspects of teacher behaviour and adaptive functioning (Woolfolk Hoy & Davis, 2006), consequently helping to bring about a variety of educational benefits both for students and teachers (Hattie, 2015). Previous research has reported that teachers with high levels of teacher self-efficacy positively influence students' mathematics self-efficacy (Chang, 2015), and students' motivation and achievement (Chang, 2015; Katz & Stupel, 2016; Thoonen, Slegers, Peetsma, & Oort, 2011; Zee, Koomen, de Jong, 2018), albeit indirectly (Bruce, Esmonde, Ross, Dookie, & Beatty, 2010). Self-efficacious teachers are regarded as more enthusiastic and committed to their profession (Chesnut & Cullen, 2014; Klassen et al., 2009; Klassen & Chiu, 2010). Considered to be more confident risk-takers (Varghese, Garwood, Bratsch-Hines, & Vernon-Feagans, 2016), teachers with high teacher self-efficacy are more likely to experiment with and be more ambitious in their teaching (Mohamadi & Asadzadeh, 2012). For example, implement new curricula (Fullan, 2003), reform-based instruction (Charalambous & Philippou, 2010; Nie, Tan, Liau, Lau, & Chua, 2013) and innovative teaching approaches (Thurlings, Evers, & Vermeulen, 2015; Tschannen-Moran & McMaster, 2009), and consequently deliver a higher quality of mathematics instruction (Holzberger, Philipp, & Kunter, 2013; Newton, Evans, Leonard, & Eastburn, 2012). Self-efficacious teachers have higher expectations of their students (Ashton & Webb, 1986), are more likely to engage in formative assessment (Xiang, Yum, & Lian, 2020) and to focus on students' learning as opposed to performance goals (Wolters & Daugherty, 2007). They are generally more effective in behaviour management (Chacón, 2005), refraining from controlling students' behaviour through punishment, and focusing on collaborative resolution of classroom issues (Hoy, 2001). They are more likely to encourage students' autonomy and boost students' confidence (Ross, 1998), and to place importance on building warm relationships with students (Nurlu, 2015). They are less likely to criticise students and label them on the basis of their behaviour, are less likely to

disregards students' varying needs (Soodak & Podell, 1993), and more persistently support students who struggle (Nurlu, 2015).

Importantly, while teachers with weaker teacher self-efficacy are more likely to experience depersonalization and disengagement (Aloe, Amo, & Shanahan, 2014) and consequently leave the profession (Zee & Koomen, 2016), self-efficacious teachers tend to have higher levels of job satisfaction, experience lower levels of stress, and are less likely to experience emotional exhaustion (Dicke et al., 2014; Klassen et al., 2009; Tsouloupas, Carson, Matthews, Grawitch, & Barber, 2010) and burn-out (Aloe et al., 2014; Collie, Shapka, & Perry, 2012; Klassen & Chiu, 2010; Skaalvik & Skaalvik, 2010, 2017; Wang, Hall, & Rhimi, 2015). This has been ascribed to the key role that teacher self-efficacy plays in developing teacher functioning skills (Woolfolk Hoy & Davis, 2006) which help teachers regulate their stress, anxiety and fears (Finlayson, 2014; Shen, 2009) by affecting their goals and aspirations (Mohamadi & Asadzadeh, 2012), their diligence and effort (Varghese et al., 2016), as well as persistence in the face of difficulties (Isbel & Szabo, 2015).

Results such as these are encouraging since they suggest that helping teachers develop strong teacher self-efficacy might contribute to addressing wider educational issues. Such results also led to an increase in research seeking to better understand how teacher self-efficacy develops and what the sources of its development are (Klassen, Tze, Betts, & Gordon, 2011; Tuchman & Isaacs, 2011). Yet, despite this substantial research interest in the last 30 years (Klassen & Usher, 2010), little is still understood about the process of teacher self-efficacy development. I suggest that the issue relates to the overreliance on quantitative methodologies (Morris, Usher, & Chen, 2017; Tschannen-Moran & Hoy, 2001) which over decades have focused predominantly on measuring levels of teacher self-efficacy at different times of teachers' careers and on correlating teacher self-efficacy with educational aspects (such as teacher satisfaction, burnout or academic achievement, or with sources of teacher self-efficacy and factors interacting with it), thus failing to deal with the complexity of the concept of teacher self-efficacy. Moreover, the results of this research, although important and informative in many ways, have led to conclusions which are difficult to comprehend (such as, for example, that teacher self-efficacy is both stable and malleable) as well as important theoretical implications, which have led the field to suffer from a reductive conceptualisation of teacher self-efficacy as a set of personal beliefs; the level of which (e.g., high or low) can be assessed using a variety of questionnaire scales. This conceptual reduction of teacher self-efficacy means that even the most recent qualitative efforts to study its development still struggle to capture the complexity of this process. This is, perhaps, not the least due to our ongoing struggles to define the fuzzy concept of belief itself (Batchelor, Torbeyns, & Verschaffel, 2019; Leder, 2019) and our limited understanding of how beliefs in general change (Erens & Eichler, 2019; Rolka & Roesken-Winter, 2015). It is, therefore, not unreasonable to expect that such

struggles would bear consequences for the teacher professional development field, whose “efforts to increase teacher self-efficacy through in-service and other similar interventions have [so far] met with mixed success” (Tuchman & Isaacs, 2011, p. 415).

It has often been claimed in the literature that unless we gain a better understanding of teacher self-efficacy and how it develops, then growth in the field will remain limited and the implications for educational purposes and the real value of teacher self-efficacy will not be fully appreciated (Klassen et al., 2011). This study responds directly to this concern, taking to heart Philippou and Pantziara’s (2015) plea “for a clearer meaning of the construct, deeper examination of its genesis and development, reconsideration of measures and methodologies, and more relevance to educational practice” (Philippou & Pantziara, 2015, p. 99).

The study was guided by two general, interconnected, aims: to develop an understanding of the process of teacher self-efficacy appraisal and to reconceptualise teacher self-efficacy. Aiming to address important conceptual, theoretical, and methodological gaps (Henson, 2002; Labone, 2004), the study investigated the concept of teacher self-efficacy and its development from a new longitudinal perspective—a rich qualitative phenomenological enquiry. It was founded on the premise that a thorough understanding of teacher self-efficacy development could not be merely abstracted from the empirical, but required an ongoing engagement with theory which pays attention to sociological, psychological and philosophical aspects of learning. Designed in this way, executed abductively (Tavory & Timmermans, 2014), and using Interpretative Phenomenology Analysis (IPA; Smith, Flower, & Larkin, 2009), the study revolved around a continuous interweaving of the empirical data and theory. As such, the study brings new theoretical insights to the field, not only in how it illustrates the process of teacher self-efficacy development but also in how it connects this to aspects such as affect, social context and professional identity. Consequently, the study contributes to the field by challenging the prevalent treatment of teacher self-efficacy as a belief and illustrating its development through the socio-psychological lens of narrative self-schema construction. In relation to that, the study illustrates the narrative process of teacher self-efficacy development and formulates an iterative narrative model of this development which incorporates posits of self-efficacy theory (prevalent in the current research) and a narrative theory of self. It also contributes to the wider field of Teacher Professional Learning (TPL).

It is important to emphasise that, although this study was conducted in the context of Initial Teacher Education (ITE), the findings can be extrapolated to teacher education and professional development in general. The particular focus on ITE in this study was based on the understanding that this period is characterised as representing the greatest challenges, learning opportunities, and, consequently, the greatest teacher change in the context of their overall

development (Usher & Pajares, 2006). As such, I regarded this period as providing the best research opportunities. In terms of the learning process, however, the characteristics of teacher development at this stage, as I argue in this thesis, bear no significant difference to those experienced by in-service teachers.

I start by presenting a theoretical background to the concept of teacher self-efficacy rooted in social cognitive theory and the theory of self-efficacy (Bandura, 1986, 1997, 2012). I then present a review of literature related to teacher self-efficacy development, which leads to an exposition of research gaps that needed addressing. These include a description of the field's current struggles with contradictory and unexplained findings. Based on these, I explain the rationale and present further theoretical perspectives I considered in the process of the study. Following this, having elaborated on the study's ontological and epistemological perspectives and methodology, I summarise the results presented across four articles and suggest a general narrative model of teacher self-efficacy development. Finally, I explain the significance of the study to the field of teacher self-efficacy and teacher professional learning in general.

2. Theoretical Background—Social Cognitive Theory

Paying particular attention to individuals and their dispositions, Social Cognitive Theory (SCT; Bandura, 1986, 1989, 2001) considers simultaneously cognitive, social and affective aspects of learning (as described in Article 1). It considers a transactional view of the individual and society, which is based on a reciprocally causal interaction of personal factors (cognitive, motivational, affective), environment, and behaviour (Bandura, 1997; see Figure 1); an interaction which “provides people with opportunities to exercise some control over their destinies” (Bandura, 1997, p. 8).

SCT’s founding principle is that people learn by observing behaviour modelled by others and that this learning takes place internally (Omrod, 2006) and is governed by four processes: selective, cognitive, motivational and affective (Bandura, 1986). Selective processes relate to an individual’s assessment of situations they wish to attend to and the importance of these. The selected information is then coded and formed into mental models. This codification is guided by self-regulation and anticipatory scenarios (Bandura, 1993) both of which help humans undertake activities they wish to pursue, based on a perceived likelihood of success (*self-efficacy*). This perceived likelihood of success is appraised on the basis of the difficulty of the task one wishes to undertake, cognitive capacity and knowledge, appraisal of one’s previous successes and the physical and affective states of the individual. In this context, learning represents a continuous process of error elimination and refinement, where enactment and experience (combined with modelled behaviour and external feedback) provide an individual with information about how gathered knowledge and developing skills could/should be adapted and improved to guide further development.

In the context of teacher education, in contrast to constructivist and sociocultural theories, SCT does not dichotomise teacher learning into acquisition and participation but rather sees it as taking place in the social context and as being “appropriated and internalised by persons individually” (Ernest, 2010, p. 40). It sees learning as both internally and socially constructed, where teachers must observe, cognise and then experience situations in which they see themselves as having an impact on student learning (Bates, Latham, & Kim, 2011). Moreover, unlike constructivist and social-cultural perspectives, SCT pays particular attention to individual goal

pursuit (Ernest, 2016), agency, and reflective aspects of the learning process (as described in Article 1). In other words, individuals are both “contributors to their life circumstances... [and] products of them” (Bandura, 2006, p. 164). This perspective emphasises that agentic learning “does not occur in a vacuum, but in response to motivation and within a certain context” (van der Next et al, Long, & Engelbrecht, 2018, p. 9). Importantly, it rejects the dualistic view of self by seeing individuals as simultaneously agents and objects. The former is reflected in how individuals act on the world, the latter on how they reflect and act on themselves (Bandura, 1997).

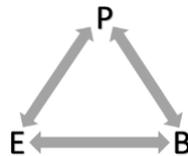


Figure 1. Triadic Reciprocal Causation model of interactions between P—personal factors, E—environment, B—behaviour (adapted from Bandura, 1986)

SCT treats agency as an evolving state, which is “achieved by individuals through the interplay of personal capacities and the resources, affordances and constraints of the environment by means of which individuals act” (Priestley, Biesta, & Robinson, 2015, p. 19). In other words, it emphasises an inseparable, dynamic relationship between an individual and the collective, highlighting that individuals do not live their lives entirely autonomously or independently of society (Bandura, 1997). Teachers’ professional lives, their performance and job satisfaction are inevitably shaped and affected by the environment in which they work (e.g., Klassen, Usher, & Bong, 2010; Skaalvik & Skaalvik, 2007). For example, the directives and expectations of schools, government, and society as a whole can all exert pressure on teachers, who have to negotiate the dynamic between their agency and the pressure in everything they do (Bandura, 1997). Ashton and Webb's (1986) documentation of many such pressures, although dated, remains relevant today; such include, but are not limited to: heavy workloads and low professional status, insufficient resources, a sizable share of problematic students, lack of advancement opportunities, troubling bureaucratic practices, and questionable leadership (in Bandura, 1997).

Not all environmental pressures are considered negative, however. It has been shown, for example, that schools’ high standards and ambitious goals have potential to encourage teachers to persevere in their efforts and work through difficulties they might encounter along the way (Goddard, Hoy, Woolfolk Hoy, 2004). Similarly, schools’ past academic success and ‘good’ reputation (Goddard et al., 2004) as well as trust in their headteachers’ ability to exert influence over authorities (Hoy & Woolfolk, 1993) can contribute to an increase in teachers’ beliefs in institutional capability and, subsequently,

their own capability within it. The same can be true for teachers who feel included in school decision-making processes and who have greater freedom to make decisions about their own classrooms (Moore & Esselman, 1992). Other influential contextual factors include: the school structure and students' economic status and grade (Adams & Forsyth, 2006); school setting (urban versus rural; Knoblauch & Woolfolk Hoy, 2008), external respect for the teaching profession (Cheung, 2008), and culture (Klassen et al., 2009; Yada et al., 2019; Yada & Savolainen, 2017).

Importantly, the agentic perspective on human functioning means that the environmental influence over one's behaviour is not deterministic but probabilistic (Bandura, 1997). In other words, the stimulus does not always guarantee the exact same response, which might differ between individuals or between contexts (Berzonsky, 2004). SCT describes how environmental influence on action can take three different forms (Bandura, 2012). An *imposed environment* acts on an individual regardless of their position towards it. *Selected environment* represents a "potentiality" (Bandura, 2012, p. 12), which comes to exist only when actively selected and activated by the individual. *Constructed environment* is actively created by the individual in a way which will allow them to exercise control over their actions and lives in general. The type of environment with which individuals interact varies depending on the level of their self-efficacy and human agency. The more efficacious and agentic an individual, the less they succumb to the imposed environment and the more active they become in constructing their own environmental context (Bandura, 2012). In the context of teacher education, teachers with higher teacher self-efficacy have been shown to be "less sensitive to the contextual influence", less likely to succumb to the pressure, and more selective, confident and proactive in responding to the environmental expectations (Cho & Shim, 2013, p. 18).

2.1. Self-efficacy theory

According to SCT and the theory of self-efficacy, human action is guided by motivational and affective states, which are more affected by what individuals believe they can do than what is objectively true. Here, we are reminded that "unless people believe they can produce desired effects by their actions, they have little incentive to act" (Bandura, 1997, pp. 2–3); and that "[t]here is a marked difference between possessing knowledge and skills, and being able to use them well under diverse circumstances, many of which contain ambiguous, unpredictable, and stressful elements" (Bandura, 2012, p. 24). The self-assurance with which people approach and manage different tasks determines whether individuals make good or poor use of their capabilities. While insidious self-doubt can overrule even the best of skills (Bandura, 1997), a slight overestimation of one's self-capabilities can have a positive

effect on performance (Bouffard-Bouchard, Parent, & Larivee, 1991). Even with a relatively low level of competence, strong confidence in one's abilities can be a powerful motivator to act (Bandura, 1997). This representation of self-efficacy sheds light on a dynamic and reflexive relationship between thought and action (Bandura, 1997; Fives, 2003).

This assertion of self-efficacy as a major basis for action and an important aspect of human agency situates it as a key factor in human functioning. Bandura defines self-efficacy in terms of "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performance" (Bandura, 1986, p. 391). As such, self-efficacy must not be seen as a general character trait but rather as a domain- and context-specific judgement related to executing a particular task (Bandura, 1997, 2012). The former means that a strong self-efficacy in one domain (for example, speaking a second language) does not necessarily guarantee a strong self-efficacy in a different domain (for example, teaching mathematics); the latter means that a teacher might have different levels of self-efficacy for the same task depending on varying degrees of difficulty or when teaching different students or in different circumstances (Bandura, 1997). Careful definition of the domain- and task specificity is essential for producing valid conceptualisations of self-efficacy (Bandura, 1997). If the task is defined too broadly or too narrowly, self-efficacy can become meaningless. Moreover, a considered task must require a high level of regulatory functional skills, meaning that conceptualising self-efficacy in simple, routine tasks, like tying shoelaces, is simply nonsensical (Bandura, 1997).

Self-efficacy judgement plays a crucial role in individuals' exercising of control over desired outcomes, within given contexts, through influencing their motivation and perseverance in the face of challenges (Bandura, 2012). It affects choices on the level of challenge one might perceive to be manageable—those with higher self-efficacy tend to focus on more challenging goals. As such, self-efficacy determines "the choices people make at important decisional points [which] ... can profoundly affect the courses life takes" (Bandura, 2006, p. 171). It affects the way in which individuals think; determines the individual's pessimistic or optimistic views of the world; affects the individual's emotional states, determining their level of vulnerability towards stress, anxiety or even depression (Bandura, 2006). In the context of human behaviour, human action is considered to be directed by thought in which self-efficacy influences the construction and rehearsal of anticipatory scenarios (Bandura, 1997). Utilising selective mechanisms, individuals assess situations they wish to attend to and activities they wish to pursue. Naturally, humans tend to pursue activities which are within the grasp of their capabilities and avoid those that exceed them (Bandura, 2012). This is particularly significant, since "[p]eople do not regard options in domains of perceived inefficacy as worth considering, whatever the benefits might be.

They [simply] exclude entire classes of options rapidly on self-efficacy grounds after controlling for relevant skills” (Bandura, 2012, p. 26). In other words, unaddressed perceived inefficacy can lead to the development of evasive behaviours which can have serious consequences for challenging professions which require frequent individual change (such as teaching).

Rooted in cognitive constructions are motivation and purposeful behaviour, where motivation is understood as “the process whereby goal-directed activity is instigated and sustained” (Schunk, Pintrich, & Meece, 2009, p. 4). Self-efficacy is an important motivational construct as it “influences individual choices, goals, emotional reactions, effort, coping, and persistence” (Gist & Mitchell, 1992, p. 182). Higher levels of self-efficacy result in individuals employing more ambitious goals and perseverance, while lower levels of self-efficacy make it more likely for a person to imagine failure or lack of success (Bandura, 1993). Cognitive constructions shape human behaviour by making predictions of likely outcomes for a variety of courses of action, based on previous experience. These include individuals’ assessment of the perceived success of previous experiences and the attribution of their ability as well as individual effort in the achievement of successful outcomes or lack thereof. Such cognitive constructions are affected by self-appraisal of personal capabilities which influence the way individuals construe and visualise situations and anticipate outcomes (Bandura, 1997). While those who are efficacious focus on opportunities and visualise successful scenarios, those with weak self-efficacy focus on personal deficiencies, difficulties, and uncertainties within. Self-efficacy plays a significant role in the self-regulation of affective and emotional states (Bandura, 1997). It creates attention biases, affects the ways in which life events are stored in memory as emotionally challenging or unthreatening, and affects individuals’ perceptions of their ability to control unsettling trains of thought. It affects the construction of strategies and courses of action which help transform the environment from affectively challenging to benign (Bandura, 1997).

Importantly, however, to aid effective functioning and to drive learning and development, it seems necessary for individuals to strike a self-efficacy balance. Although low self-efficacy can easily undermine an individual’s learning process, it has been argued that very high levels of self-efficacy are also not always desirable if one is to continue developing skills within a certain domain (e.g., Wheatley, 2002). As Woolfolk Hoy, Wayne and Heather (2009) warn, high levels of teacher self-efficacy might prevent individuals from seeking new avenues in their teaching, by simply encouraging them to stick with the routines that already bring success and simply ‘work’. Moreover, high teacher self-efficacy, gained through the process of easy successes, may lead teachers to expect quick results in the future, which in the face of challenges can prove to be discouraging and lead to lack of perseverance (Bandura, 2012; Woolfolk Hoy, et al., 2009). In other words, in the process of teacher self-efficacy development and learning, individuals

need to experience moments of doubt in their skills (i.e., weak self-efficacy; Wheatley, 2002) and face situations in which they have to overcome “obstacles through perseverant effort” (Bandura, 2012, p. 13). Such moments can lead to reflection, to an increase in motivation to learn, to development of flexibility in responding to task demands and situations, and to action which, through development of functional and coping skills, will help develop a firmly appraised sense of self-efficacy (Wheatley, 2002).

2.1.1. Self-efficacy appraisal

Bandura (1997) explains that self-efficacy is appraised based on information conveyed enactively, vicariously, socially, and affectively and physiologically. Based on these, he proposes four sources of self-efficacy. *Enactive mastery experiences* (ME) are those experiences in which individuals engage with a particular activity of interest and experience first-hand a level of success in this activity. While enactive failures can shake one’s self-efficacy, success can lead to its positive appraisal. *Vicarious experiences* (VE) relate to the fundamental aspects of observational learning in which individuals observe behaviour modelled by others. If individuals observe others succeeding in a particular activity, they grow in confidence that they might also experience such success. The greater the similarity between the model and oneself, the greater the persuasive power of the modelled behaviour. *Social and verbal persuasion* (VP) represents specific support provided by others, which can take the form of general reassurance or specific feedback related to a particular activity. Verbal persuasion from knowledgeable others can contribute to individuals mobilising and sustaining greater effort in their actions, particularly in cases where they are prone to experience self-doubt or “dwell on personal deficiencies” (Bandura, 1997, p. 101). Finally, *physiological and affective states* (PAS) represent all somatic and affective states which individuals experience and make sense of in the moment. These can include, but are not limited to, heightened affect, mood states, physical impediments, perspiration, elevated heart rate, etc.

Importantly, self-efficacy appraisal is not based solely on performance success or failure as it is often incorrectly understood (Morris et al., 2017). It is rather based on how these successes and failures are cognised, interpreted and weighted. In other words, individual experiences do not immediately lead to immediate changes in teacher self-efficacy or further automatic action; rather, information about these experiences undergoes cognitive processing which involves an assessment of several aspects (Bandura, 1997; Morris et al., 2017). First, when assessing the success of their performance in a specific domain (ME) teachers consider attributing this success to their own expended effort, knowledge and skills. Secondly, they compare their performances with behaviour modelled by others (VE)—they make comparisons between actions as well as between the personal and professional profiles of the individuals.

Thirdly, they assess resources available to utilise while in further action. Finally, by considering their momentary affective and physical states (PAS) as well as contextual affordances and constraints, teachers create mental models of actions in which they believe they are likely to be successful; they then turn these models into actions. These subsequent actions, or enactive experiences (ME), then lead to a second iteration of learning which includes teachers' reappraisal of their capabilities and to planning further action. As individuals grow and accumulate experiences, they continue to develop their belief in their ability to cope with change and challenges which guide the path of their purposeful behaviour (Bandura, 1989, 1997).

3. Literature review

3.1. The concept of teacher self-efficacy

Although studies in teacher self-efficacy over the last three decades have continued to emphasise its value in educational research, they appear to have accrued a theoretical messiness around the concept which has the potential to undermine the powerful messages that the research conveys (Tschannen-Moran, et al., 1998). Despite numerous calls to address the issue (Philippou & Pantziara, 2015), this conceptual messiness continues to date, rooted in historical developments of theory that stem from two different theoretical strands (Skaalvik & Skaalvik, 2007): Rotter's (1966) *social learning theory* and Bandura's (1986) SCT.

Based on Rotter's (1966) social learning theory, researchers from the RAND organisation in the 1970s initiated an investigation into teachers' exercise of control in the context of student learning. They did so by asking teachers to rate their responses to two questionnaire items: RAND1: When it comes right down to it, a teacher really cannot do much because most of a student's motivation and performance depends on their home environment; and RAND2: If I really try hard, I can get through to even the most difficult and unmotivated students (Armor et al., 1976). Based on the results yielded from these, they introduced a concept of teacher self-efficacy defined as teachers' beliefs in their ability to control and influence students' performance over environmental factors (Tschannen-Moran et al., 1998). RAND researchers suggested three components to this teacher self-efficacy. Relating to RAND1, they suggested General Teacher Efficacy (GTE) which revolved around the concept of teachers' general ability to exert control over external factors, reflecting general views on whether particular students could or could not be motivated (Ashton, Olejnik, Crocker, & McAuliffe, 1982). This related to the general statement of *teachers can* (Greenwood et al., 1990). It contrasted with the statement of *I can* (Greenwood et al., 1990), stemming from RAND2 and relating to Personal Teaching Efficacy (PTE), which spoke to the concept of teachers' personal capabilities related to specific students. The third aspect of the concept was *personal efficacy* (PE) which related to teachers' appraisal of personal capabilities in reflected statements such as "I can motivate students" (Ashton & Webb, 1986).

In the 1980s, the aforementioned concepts were further developed into *Teacher Locus of Control* (TLC; Rose & Medway, 1981) and *Responsibility*

for *Student Achievement (RSA; Guskey, 1981)*, whose definitions related to “the extent to which the teacher believes he or she has the capacity to affect student performance” (Berman, McLaughlin, Bass, Pauly, Zellman, 1977, p.137, in Tschannen-Moran & Woolfolk Hoy, 2001) or “teachers’ beliefs or conviction that they can influence how well students learn, even those who may be difficult or unmotivated” (Guskey & Passaro, 1988, p. 4), respectively. Both concepts related to teachers’ responsibility for student learning; with responsibility being higher in teachers’ strong feelings of *internal control* (Tschannen-Moran & Woolfolk Hoy, 2001)—e.g., I can make things happen—and lower in *external control* (Tschannen-Moran & Woolfolk Hoy, 2001)—e.g., things happen to me, I have little control over an outcome.

All the above theoretical perspectives on teacher self-efficacy greatly oversimplified the concept of agentic control, confounding teacher self-efficacy with beliefs about one’s ability to exert control over external factors which would lead to certain outcomes. This is despite the emphasis that the two concepts (teacher self-efficacy and locus of control) should be treated separately (e.g., Skaalvik & Skaalvik, 2007; Skinner, 1996). The advocacy for separating teacher self-efficacy from the concept of control follows from a train of thought that the sense of control is twofold—the view of self as efficacious and competent, and a view of the world as responsive to the execution of one’s competencies (Skinner, 1996). Skinner (1996) refers to these two as *competence* and *contingency*, respectively. In a similar vein, Skaalvik and Skaalvik (2007) emphasise the difference between teacher self-efficacy and external control, characterising teacher self-efficacy as a malleable context-specific belief about what particular teachers can accomplish, and external control as “a general and relatively stable belief about limitations to what can be achieved through education” (Skaalvik & Skaalvik, 2007, p. 612). In line with these concepts, Bandura (1997) conceived the notions of two kinds of expectations under the umbrella of general locus of control. Relating to Skinner’s (1996) concept of competence, he defined an *efficacy expectation/perceived efficacy* as “a judgement of one’s ability to organise and execute given types of performances”; relating to Skinner’s (1996) concept of contingency, he defined *outcome expectancy* as “a judgement of a likely consequence such performances will produce” (Bandura, 1997, p. 21).

This second conceptual strand of self-efficacy, under the umbrella of SCT (Bandura, 1986, 1997), emphasises that there is a fundamental difference between whether actions can in general affect outcomes and whether an individual believes that they can execute those actions. It emphasises a distinction between exerting control over environment and cognitive processes in which people construct beliefs about their capacity to perform tasks, effective execution of which would allow them to exercise this control. Within this strand, self-efficacy is defined as “beliefs in one’s capabilities to organize and execute the courses of action, required to produce given

attainments” (Bandura, 1997, p. 3) and related to “the level of competence a person expects he or she will display in a given situation” (Tschannen-Moran et al., 1998, pp. 207–208). In short, self-efficacy relates directly to one’s performance and accomplishments in a particular situation, whereas outcome expectancy relates to outcomes, which follow on from that performance (Bandura, 1997).

The two concepts differ fundamentally in their specific relationships between *agents* (those who exercise the control), *means* (ways through which the control is exerted) and *ends* (the outcomes of the actions). These are illustrated in Figure 2. The competence or self-efficacy expectations relate to the agent–means relationship, whereas contingency or outcome expectancies focus on the means–end relationship. This is an important distinction since, although the two concepts are inextricably connected, their relationship is far from deterministic or simple. Although self-efficacy is said to be responsible for “most of the variance in expected outcomes” (Bandura, 1997, pp. 22–24) it is not the only determinant of this outcome. In fact, we can distinguish three different dependency scenarios between the two aspects: performance determining outcome, performance accounting only for part of the variation of outcomes (joint effect of performance and external factors on outcomes, such as, for example, students taking responsibility for their own learning [Wheatley, 2005]) and outcome being completely independent of performance (for example, in strictly segregated and discriminating circumstances; Bandura, 1997). Such a non-deterministic relationship only emphasises the importance of separating the concepts of control and self-efficacy.

The different theoretical roots of the theory of self-efficacy have led to a messy treatment of the concept of teacher self-efficacy in studies to date. While some studies clearly explain and operationalise Bandura’s concepts of control and self-efficacy (e.g., Charalambous, Philippou, & Kyriakides, 2008; Poulou, 2007; Samuelsson, Samuelsson, & Autio, 2015; Zee & Koomen, 2016), others either fail to align themselves with a specific theoretical stance or simply misinterpret Bandura’s conceptualisation and struggle to tune in to the definitional nuances of the concept. For example, Palmer (2006) asserts that *self-efficacy* is not dissimilar to *self-confidence*, blurring the difference between global and local aspects of the two concepts. Ozder (2011) defines teacher self-efficacy as beliefs related to teachers’ capabilities to affect the learning outcomes of students, alluding to the wider concept of control; a treatment also employed by Bruce and colleagues (e.g., Bruce et al., 2010; Bruce & Ross, 2008). Morris et al. (2017) operationalise teacher self-efficacy through concepts of success and failure and, although such a treatment is not necessarily incorrect (if one considers a teacher’s success in executing actions as opposed to the success of bringing about desired outcomes), if not approached with care this concept of success can easily be misconstrued by the reader.

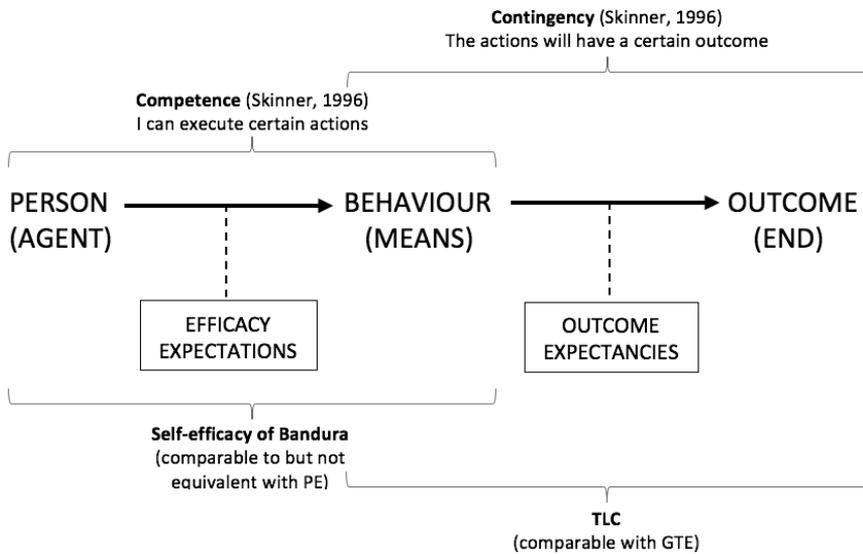


Figure 2: The conditional relationships between efficacy expectations and outcome expectancies (adapted from Bandura, 1997, p. 22) compared with the concepts of General Teacher Efficacy, Personal Efficacy, and Teacher Locus of Control

Further treatments of the concept involve: Soodak and Podell's (1996) suggestion that *teacher self-efficacy* comprises: *personal efficacy* (relating to teachers' beliefs about their individual skills), *outcome efficacy* (relating to Bandura's *outcome expectancy*, about actions having the ability to bring about required outcomes) and *teaching efficacy* (relating to the *external locus of control*, concerning the ability of teaching in general to overcome external influences). Such treatment follows on from the work of Ashton and colleagues from the RAND studies (e.g., Ashton, et al., 1982; Ashton, Webb, & Doda, 1983). A somewhat similar phrasing has been used by Lotter et al. (2018), who say that "self-efficacy beliefs can be further broken down into two dimensions: personal self-efficacy and outcome expectancy" (p. 258). Despite the linguistic discrepancies, however, the overall treatment of the concept by Lotter et al. (2018) appears to be aligned with that of Bandura. The work of Tschannen-Moran and colleagues also introduced a divergence of the definition of teacher self-efficacy from that framed by Bandura's SCT. In 1998, they suggested that teacher self-efficacy "is the teacher's belief in his or her capability to organise and execute the courses of action required to successfully accomplish a specific teaching task in a particular context" (Tschannen-Moran et al., 1998, p. 22). It is not clear, however, why in their 2001 article their definition of teacher self-efficacy shifts towards a teacher's "judgment of his or her capabilities to bring about desired outcomes of student

engagement and learning, even among those students who may be difficult or unmotivated” (Tschannen-Moran & Hoy, 2001, p. 783).

The definitional confusion of the concept of efficacy (exemplified above) appears to be prominent in literature and needs addressing. Although the issues are not always conceptual in nature, even the linguistic liberty with which the concept is described has the potential to obscure and threatening the validity of findings. Care must be taken when reporting as well as when reading studies in the field of efficacy theory if we are to better understand the concept itself, its development, and its role in teaching. In this study, I take the clear position of distinguishing between the concepts of control and teacher self-efficacy, treating teacher self-efficacy in line with Bandura and defined as teachers’ domain- and context-specific judgements about their capability to organise and execute specific courses of action required to successfully accomplish a particular teaching task (Tschannen-Moran et al., 1998). I focus on the teacher self-efficacy concept as a personally-constructed judgement about individuals’ own capabilities to execute particular tasks.

3.1.1. Domain and task specificity of teacher self-efficacy

As discussed earlier in the posits of self-efficacy theory, self-efficacy is domain-specific and oriented towards a particular task. To become meaningful, the concept requires a clear definition of the domain and task that it relates to. Research in the field of teacher self-efficacy has focused extensively on the domain-specificity of the concept. For example, Samuelsson, Samuelsson and Autio (2015) suggested five domains of teacher self-efficacy for: instructional skills, classroom management, motivating pupils, assessment competence, and establishing routines. In addition to these, Ho and Hau (2004) also considered teacher self-efficacy for building relationships with students. Skaalvik and Skaalvik (2007) considered six domains of teacher self-efficacy for: instruction, adapting instruction to educational needs, motivating students, maintaining discipline, collaborating with colleagues and parents, and coping with change. Friedman (2003) focused on efficacy for: instruction, human relations, and discipline control. In Mathematics Education, Charalambous, Philippou and Kyriakides (2008) considered efficacy for: instructional skills, classroom management, motivating pupils, competence assessment, and establishing routines. Bandura (unpublished) considered seven dimensions of teacher self-efficacy for: decision making, influencing school resources, instruction, discipline, enlisting parental involvement, enlisting community involvement, and creating a positive school climate.

Based on Bandura’s work, using factor analysis, Tschannen-Moran and Woolfolk Hoy (2001) developed the 24-item OSTES (Ohio State Teaching Efficacy Scale) instrument for measuring teacher self-efficacy within three domains: *efficacy for classroom management (EfCM)*, *efficacy for student*

engagement (EfSE) and *efficacy for instructional strategies* (EfIS). EfCM relates to a teacher’s belief in their ability to manage student behaviour and establish themselves in the classroom, which includes establishing particular classroom rules and routines. Within the EfCM, O’Neil and Stephenson (2011) distinguish six components: classroom organisation, routines and expectations, gaining and maintaining student attention, cooperative learning, maintaining respect and order, and general classroom management. EfSE represents a teacher’s belief in their ability to engage and motivate students. EfIS reflects teachers’ beliefs in their capability to use alternative teaching strategies, assess pupils, pitch the right level of challenge, and respond to unexpected situations. Table 1 provides a detailed characterisation of the three domains.

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 the characteristics	<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 - 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 - get 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

The OSTES categorisation of teacher self-efficacy domains has been continuously proved to be the most valid and reliable instrument across different cultural backgrounds (e.g., Klassen et al., 2009), resulting in its most frequent use in teacher education. Tschannen-Moran and Woolfolk Hoy (2001) themselves, however, raised concerns about utilising the instrument with pre-service teachers. Their own attempt at doing so resulted in overall data clustering around only one factor, leading the authors to conclude that subscales of teacher self-efficacy “may have little meaning for pre-service teachers who have yet to assume real teaching responsibilities” (p. 801). This

contention, however, was later challenged by Charalambous, Philippou and Kyriakides (2008) who, on the basis of their study with 89 pre-service primary school teachers in Cyprus, reaffirmed their confidence with the use of the scale in pre-service teacher settings.

Although in this study I did not administer instruments and did not intend to measure teacher self-efficacy in a summative way, I recognised the importance of considering specific teacher self-efficacy domains in my enquiry. Due to the prominence and high validity of the OSTES instrument, I considered focusing on the three domains (EfCM, EfSE and EfIS) to be the most appropriate.

3.2. Teacher self-efficacy development

It has been posited that, once established, teacher self-efficacy remains relatively stable (Bandura, 1997). Yet, Fives (2003) and Henson (2001) suggested that when teachers remain open to change, critical about their actions and reflective, their teacher self-efficacy can remain in a continuous state of flux throughout their career. What tends to be the case with experienced teachers, however, who have an abundance of accumulated experiences, is a heavy reliance on memories and routine actions, and hence a decrease in conscious assessment of and reflection on practice (Tschannen-Moran & Woolfolk Hoy, 2007). In contrast, during the period of initial teacher education, when individuals face a multitude of new tasks and challenges (Usher & Pajares, 2006), they tend to more explicitly engage with a thorough analysis of their practice (Gist & Mitchell, 1992). This might be the reason why teacher self-efficacy is generally considered to be at the stage of its greatest development predominantly during initial teacher education (Woolfolk Hoy & Burke-Spero, 2005; Tschannen-Moran & Woolfolk Hoy, 2007).

Despite the illusion of teacher self-efficacy stability, however, the collective efforts of numerous studies to date remain inconclusive regarding its ongoing development. On the one hand, teacher self-efficacy has been seen to continue to develop over the course of a teacher's career, showing strong positive correlations with the number of years of experience (Alrajhi et al., 2017; Cheung, 2008; Shoji et al., 2016; Wolters & Daugherty, 2007). On the other hand, others claim that such strong positive correlation between years of experience and teacher self-efficacy does not exist (e.g., Tschannen-Moran and Johnson, 2011), indicating non-linear changes in teacher self-efficacy over the course of teacher career (usually peaking in the middle of a teacher's professional life; Kim, Sihm, & Mitchell, 2014; Klassen & Chiu, 2010; Neumayer DePiper et al., 2021; Rupp & Becker, 2021). It has also been suggested that teacher self-efficacy during teachers' pre-service years is actually at its peak, decreasing significantly at the moment of entry to the

profession (Işıkşal-Bostan, 2016; Vadahi & Lesha, 2015; Woolfolk Hoy & Burke-Spero, 2005); although, encouragingly, this decrease does not usually result in levels below those prior to initial teacher education (showing an overall increase, even if incremental; e.g., Lotter et al., 2018). More specifically, there are further discrepancies in conclusions about teacher self-efficacy development which relate to aspects of its domains. For example, Vadahi and Lesha (2015) showed a positive correlation between years of experience and teacher self-efficacy in the domain of classroom management. Similarly, Samuelsson et al. (2015) showed such a correlation in all but one of the categories of efficacy defined by Charalambous et al. (2008); emphasising that teacher self-efficacy for instructional strategies (EfIS) appeared to be developing until mid-career, a point after which it appeared to stabilise.

The collective results lead to an important question: How, if at all, can we account for such discrepancies in the field? We can consider the following arguments. First, when interrogating the methodological executions of different research studies, one notices that the experience time span is not consistent across different quantitative studies. For example, in the studies of Kim, Sihm and Mitchell (2014) and Klassen and Chiu (2010) the number of years of teaching experience was much greater (over 40 and 20 years, respectively) than the one defined in the studies of Tschannen-Moran and Johnson (2011) (with mean age being 14.4 years). Such discrepancies often make direct comparisons between studies difficult. Moreover, questions remain about the validity of claims related to teacher self-efficacy development extrapolated from non-longitudinal quantitative studies which tested large number of teachers with a wide range of years of teaching experience at one single moment in time. Although one could argue that what could be said from such studies is that teachers towards the end of their careers seem to have lower teacher self-efficacy than those in mid-career, very little can indeed be said about the actual change of teacher self-efficacy over time. Further still, the ‘snapshot execution’ of quantitative data collection in studies fails to consider aspects such as teacher attrition, which is a particular concern within the profession (Klassen & Chiu, 2010; Weale, 2016). If one assumes that those who are less efficacious might have already left the profession before they reached a considerable number of years of experience, their absence from the sample would certainly contribute to the distortion of the collective results (Wolters & Daugherty, 2007).

Secondly, it has been suggested that the differences in the conclusions about teacher self-efficacy development in its different domains might depend on teachers’ personal profiles and experience. For example, some studies claim that novice teachers tend to be concerned mainly with their own performance and not the effect of that performance on student learning (Toom, Husu, & Patrikainen, 2015). This means that those teachers would inevitably focus predominantly on EfCM and EfIS (Meister & Melnick, 2003; Ozder,

2011; Pigge & Marso, 1997), developing EfSE later in their careers (Tschannen-Moran & Woolfolk Hoy, 2007). Such conclusions, however, remain unsubstantiated. For example, having reviewed 160 studies in the field of teacher self-efficacy and its role in the classroom, Zee and Koomen (2016) concluded that experienced teachers are more confident in their ability to implement different instructional strategies than their less experienced colleagues. They suggested that this might be due to the teachers becoming “more sensitized to students’ signals, needs, and expectations” (ibid., p. 998) with growing experience. In addition, it has also been shown that pre-service and novice teachers tend to assess their teacher self-efficacy for motivating and engaging students more positively than their more experienced colleagues (Poulou, 2007; Samuelsson et al., 2015), suggesting that such a phenomenon might be due to the novice teachers’ youth and their better ability to relate to students on a daily basis (Samuelsson et al., 2015).

Thirdly, it seems necessary to consider more nuanced aspects of teacher professional lives and teacher characteristics in their teacher self-efficacy development. For example, Klassen and Chiu (2010) pointed towards teachers’ tendency to disengage towards the end of their careers. Kim, Sihm and Mitchell (2014) suggested that the decline in teacher self-efficacy in the later stages of their careers seems to correspond with reduced professional development undertaken by more experienced teachers. Hull, Booker and Naslund-Hadley (2016) speculated that the lack of direct positive correlation between teacher self-efficacy and experience among Belizian mathematics teachers could be related to the teachers’ improving ability to recognise their own limitations and entertain more realistic expectations. Indeed, other studies have also speculated that experienced teachers might have more realistic and higher expectations of themselves than their less experienced colleagues, and might as a result judge themselves more harshly, despite their potentially greater effectiveness in teaching (e.g., Duckworth & Yeager, 2015).

Bruce and Ross (2008) discussed how, when entering a professional development activity which focused on a shift in professional practice towards reform-based mathematics teaching, primary mathematics teachers experienced dips in their teacher self-efficacy due to a sudden increased awareness of personal shortcomings and dissatisfaction with slow progress. Similarly, pre-service teachers are also often seen to be experiencing a sudden dip in their teacher self-efficacy at the point of entry into the profession. This has been frequently attributed to the sudden decrease in support provision (Woolfolk Hoy & Burke-Spero, 2005; Woolfolk Hoy, et al., 2009) or to the pre-service teachers’ previous lack of awareness of what executing particular actions might actually involve in practical terms, leading to an unexpected clash with reality (Chesnut & Burley, 2015; Wheatley, 2005). Ma and Cavanagh (2018) suggest that some engagement with any form of informal teaching, such as coaching, private tutoring, or activity supervision might help mitigate naïvely high teacher self-efficacy appraisals prior to entering the

classroom. Others, still, emphasised that the teacher self-efficacy development process is simply highly individual, affected by a myriad of situational factors which strongly affect inter-individual differences in teacher self-efficacy (Rupp & Becker, 2021).

What one can see from the above is that, although the research in teacher self-efficacy development is scattered with numerous important results, the conclusions related to this development lack consistency, leading to seemingly incoherent claims that teacher self-efficacy is both stable and malleable. Consequently, one might say that the phrase: “little evidence exists about how (teachers’) efficacy beliefs change or solidify across stages of a career” (Tschannen-Moran et al., 1998, p. 238) continues to be relevant. I argue that these inconsistencies in the field can be ascribed to the high saturation with quantitative correlative studies, which although important, do not engage with teacher self-efficacy at a conceptual level and, as a result, remain limited in their ability to tune in to the small-grain nuances of teachers’ profiles and their professional lives; nuances which play an important role in how teacher self-efficacy develops. Some mixed-method studies provide support for this argument by exposing discrepancies between findings in quantitative and qualitative methodologies. For example, in their study of pre-service primary teachers, Charalambous, Philippou and Kyriakides (2008) developed a teacher-efficacy scale for gathering quantitative data, results of which they then explored qualitatively. Within the quantitative enquiry, they reached general conclusions that teachers’ EfCM and EfIS increased over the course of the initial education. Yet, when following these results qualitatively, they discovered that this development did not proceed uniformly among the participants. Similarly, while Gresham’s (2008) quantitative enquiry illustrated strong negative correlation between mathematics anxiety and teacher self-efficacy, the follow-up interviews indicated that the pre-service teachers with the highest levels of mathematical anxiety were somewhat more optimistic about their capabilities to teach mathematics effectively; a relationship which they saw as mediated by the teachers’ attitudes towards mathematics. Finally, Harrington and Walsh (2020) illustrated that although survey results did not show a statistically significant impact of district-provided teacher support on teacher self-efficacy, interviews indicated a positive correlation between the two. Collectively, such findings support the claim that quantitative research alone, although informative, “may miss the opportunity to identify and study different trajectories in the development of [teacher self-efficacy]” (Charalambous, et al., 2008, p. 140) since it remains limited in its ability to attune to individuals’ specific characteristics, and personal circumstances and experiences, to pay attention to the teachers’ reflections and thinking (Siwatu, Chesnut, Alejandro, & Young, 2016) and their own interpretations of their classroom actions (Putney & Broughton, 2011).

To summarise, the implications of the above elaborations are twofold. First, they illustrate a research problem, or a gap around the understanding of teacher self-efficacy development (Klassen et al., 2011; Mohamadi & Asadzadeh, 2012). Secondly, they emphasise the need to shift the field's methodological approach when investigating such development (Philippou & Pantziara, 2015; Rupp & Becker, 2021)—an approach which will focus on the complexity of the concept of teacher self-efficacy and which might help explain the contradictory findings about its development. I shall return to these later when discussing the implications of this study's empirical design. But first, I turn the focus towards the process of teacher self-efficacy development, which in research to date revolves around its sources and related interacting factors.

3.3. Sources of teacher self-efficacy

Research suggests that professional learning opportunities (especially those which provide focus on additional practice) have the potential to raise teacher self-efficacy (Althausser, 2018; Katz & Stupel, 2016; Liu & Liao, 2019; Perera, Calkins, & Part, 2019). This research indicates that, beyond an accumulation of successful teaching experiences (Cheong, 2010; Samuelsson et al., 2015), in the process of which teachers improve their skills and observe their own impact on student enthusiasm and learning (Althausser, 2018; Bates et al., 2011; Katz & Stupel, 2016), increased and quality support (Charalambous et al., 2008; Cheong, 2010; Richter et al., 2013) and ongoing engagement with professional development have the potential to protect and develop teacher self-efficacy (Ekici, 2018; Kim et al., 2014; Thompson, DiFrancesca, Carrier, & Lee, 2017; Vadahi & Lesha, 2015). Among many such listed professional development activities have been, for example: self-regulated and reflective learning (Bruce & Ross, 2008; Katz & Stupel, 2016) which engages in critical assessment of practices (Neumayer DePiper et al., 2021; Vadahi & Lesha, 2015); analysing students' work, their experiences in the classroom and responsiveness to specific instructional activities (Neumayer DePiper et al., 2021); peer coaching (Bruce & Ross, 2008) and provision of social support and feedback (Charalambous et al., 2008; Phan & Locke, 2015; Richter et al., 2013; Tschannen-Moran & McMaster, 2009); engagement with observational learning of practice (Bruce & Ross, 2008; Palmer, 2011; Skaalvik & Skaalvik, 2007); engagement with hands-on activities (DeCoito & Myszkal, 2018; Mongillo, 2016; Palmer, 2011); collaborative working and sharing of experiences (Bautista & Ortega-Ruiz, 2015; Cheong, 2010; Lotter et al., 2018); innovative team work (An, Li, & Wei, 2021); setting up and actively participating in supportive communities of practice (Ekici, 2018); active participation in professional development activity design (Cinici, 2016); and engagement with field-based research (Matney & Jackson II, 2017) or

methods coursework (Swars, Smith, Smith, & Hart, 2009; Thompson et al., 2017). In terms of posits of self-efficacy theory within these activities, the roots of teacher self-efficacy appraisal have been broadly categorised according to the four self-efficacy sources (Bandura, 1997).

3.3.1. Enactive mastery experiences

Enactive mastery experiences (ME) are considered the most significant sources of teacher self-efficacy (Holzberger et al., 2013; Ma & Cavanagh, 2018; Neumayer DePiper et al., 2021; Newton et al., 2012; Skaalvik & Skaalvik, 2010; Usher & Pajares, 2008; Yada et al., 2019), since they are regarded as the only actual experiences of undertaking tasks of interest which provide the most realistic and tangible feedback about whether a person is capable of carrying out the task or not (Bandura, 1997). Teachers focus on both enacting a particular activity and assessing the level of success of this enactment (Althauser, 2018; Bates et al., 2011; Katz & Stupel, 2016). This might be the reason why, Bandura (1986) himself frequently referred to enactive mastery experiences as *enactive attainments*. While no evidence of success often results in no change in teacher self-efficacy (Bandura, 1997) and failure has strong potential to undermine the individual's teacher self-efficacy (Charalambous, et al., 2008), satisfaction from classroom experiences often strongly and positively correlates with boosts in teacher self-efficacy (Althauser, 2018; Klassen et al., 2009; Tschannen-Moran & Woolfolk Hoy, 2007). Indeed, if one is successful in executing a particular action or a task, their teacher self-efficacy is bound to increase. Consequently, ME perceived to be successful raise teacher self-efficacy and create an expectation that, when repeated, the actions will bring further success in the future, positively affecting the sustainability of teachers' effort in this action (Mohamadi & Asadzadeh, 2012). In contrast, lack of success may lead to an anticipation of future failure regardless of actual ability and available resources (Mohamadi & Asadzadeh, 2012).

Importantly, although teachers may often report that their teacher self-efficacy developed due to opportunities to practise particular pedagogies (Bautista & Boone, 2015; Siwatu, 2011), both research and theory advocate that it is not just the mere act of doing but rather the individual's reflections on actions which play the most significant role in this development (Neumayer DePiper et al., 2021). These reflections and cognitive processing include: interpretations and weighting of the importance of particular experiences (Bandura, 1997a; Morris et al., 2017), interpretations of the level of success achieved in enactive experiences and the attribution of this success to one's own expended effort, ability to utilise available resources, and the task difficulty. (Bandura, 1997). For example, to boost teacher self-efficacy, the success of a particular ME must be directly attributable to the effort or ability of the acting individual. When a teacher feels that their students made

satisfactory progress in their lesson because of their own effective planning and execution of the lesson and management of behaviour, then such an experience of success will boost their teacher self-efficacy. However, serendipitous classroom successes will not contribute to boosting teacher self-efficacy, as these occurrences might simply be attributed to other factors such as, for example, students' own diligence (Bandura, 1997). In addition to this, success has little effect on boosting teacher self-efficacy if it has been achieved with extensive reliance on the assistance of others or if a task at hand was either too simple or unimportant (Bandura, 1997). In other words, significant ME are those which require exerting some effort. Easy successes beget an expectation of quick results which, in the long run, in the event of an unexpected failure can lead to quick discouragement (Bandura, 1997). However, some experience of setback and failure plays a crucial role in developing resilient teacher self-efficacy. Such mastery experiences "provide opportunities to learn how to turn failure into success" and help in appreciating the importance of sustained effort in teaching (Bandura, 1997, p. 80).

The significance of ME often leads to other sources of teacher self-efficacy becoming overshadowed as teachers progress in their profession (Woolfolk Hoy et al., 2009). This has led to frequent calls to create multiple opportunities for enactive experiences especially early on in teacher education (Klassen & Durksen, 2014). Despite the importance of ME, however, these experiences have often proved to be insufficient in aiding and explaining the process of teacher self-efficacy development (Rupp & Becker, 2021; Woolfolk Hoy & Burke-Spero, 2005), particularly for those new to the profession and with relatively little practical experience, those whose teacher self-efficacy is still relatively low and those who are likely to distrust their success experiences (Bandura, 1997).

3.3.2. Vicarious experiences

Vicarious experiences (VE) play a crucial role in our everyday life, since individuals continuously compare themselves to similar others in similar situations, or to individuals in different settings but engaged in similar activities (Bandura, 1997). As Bandura emphasised, since there is no such thing as an "absolute measure of adequacy, (...) people must appraise their capabilities in relation to the attainments of others" (Bandura, 1997, p. 86). Observing others allows teachers to develop their pedagogical knowledge and an understanding of criteria for a successful outcome (Palmer, 2011). Through vicarious experiences individuals can assess their own capabilities on the basis of the attainments and successes of others (Bandura, 1989). When observing others, teachers make decisions about the manageability of a task and judge whether, like others, they themselves can also be successful in executing it. Such experiences are particularly important when one has little prior

experience on which to base judgements or if one has low efficacy for executing a particular task (Skaalvik & Skaalvik, 2007).

The comparison of performance between individuals, however, can be a double-edged sword, leading as much to an increase in teacher self-efficacy as to discouragement. This effect is mediated by how easily the observer can identify themselves with the person being observed. For example, if the person being observed succeeds in an activity but their characteristics and capabilities are far superior to those of an observer, the VE might not have any effect or may even diminish one's sense of teacher self-efficacy. For example, Charalambous, et al. (2008) showed that, while some teachers can be encouraged by their mentors' performance, others can feel intimidated, worrying they would never be able to perform as well as their experienced colleagues. On the other hand, if the person being observed is unsuccessful, the effect on the observer might be twofold. If the observer identifies themselves with the observed person, their self-efficacy might suffer as a result of the observation. If, however, the observer considers themselves to be more effective than the observed, their teacher self-efficacy might receive a further boost (Bandura, 1997).

VE play an especially important role in teacher self-efficacy development for teachers with relatively weak mathematical knowledge (Newton et al., 2012), and those who are new to the profession or to a particular context (Tschannen-Moran & Woolfolk Hoy, 2007). Inevitably, those who have limited previous experiences will look to others to model approaches leading to classroom success (Tschannen-Moran & Woolfolk Hoy, 2007). The same can often be true for those who are experienced but who are suddenly forced to change the context of their work. For example, an experienced primary teacher in Bruce and Ross's (2008) study particularly appreciated VE opportunities in a coaching-like professional development programme when after many years of experience she was forced to change a year group that she was teaching. This aspect of modelling, although sparse in the literature, represents an important aspect of VE as a teacher self-efficacy source (Bautista, 2011; Martinussen et al., 2015; Palmer, 2011; Posnanski, 2002).

Palmer (2006) describes five different forms of vicarious experiences, which include: 'actual modelling', where individuals conduct direct observations of colleagues (Bruce & Ross, 2008); 'symbolic modelling', which involves observations of lessons provided through different media (Bautista, 2011; Posnanski, 2002); 'self-modelling', which are observations and examining of recordings of one's own teaching (Bautista & Boone, 2015); 'cognitive self-modelling', in which individuals do not observe but visualise themselves executing certain actions; and 'simulated modelling', in which pre-service or novice teachers observe experienced colleagues teaching them in a simulated classroom scenario. In special cases, VE can also be represented by a description of a situation by an experienced other (Bandura, 1997). In addition to these, some pre-service teachers pointed also to VE which involved

observing the success of their own former teachers (e.g., Ma & Cavanagh, 2018).

Despite the fact that ME have generally been regarded as the most influential sources of self-efficacy, they can sometimes be overshadowed by VE (Bandura, 1997). This happens when, for example, an individual with weak efficacy observes a similar failing in the execution of a particular task. Such an experience can then make them accept their failures and avoid further efforts to improve. In contrast, when such an individual observes others succeeding in a domain where they perceive themselves to be weak, they might experience a feeling of encouragement to try harder to also succeed. This relates to what Bandura (1997) refers to as “aspirational modelling” (p. 88).

Interestingly, the conclusions about the contribution of VE to teacher self-efficacy appraisal differ somewhat between quantitative and qualitative studies. While some qualitative studies continue to report that pre-service teachers learn and gain confidence in their abilities from watching their mentors or peers (Bruce et al., 2010; Cakir & Alici, 2009; Gunning & Mensah, 2011), quantitative studies often fail to show this effect (Morris, 2010; Rots, Aelterman, Vlerick, & Vermeulen, 2007; Yada et al., 2019). It has been suggested that this might be due to the fact that teachers have limited opportunities for observing practice and hence do not often reflect on the significance of VE (Yada et al., 2019). An alternative explanation has been that quantitative enquiry struggles to draw consistent conclusions from different instruments (Morris et al., 2017) and remains limited in its ability to explicitly capture learning which often occurs implicitly (Ahn, Bong, & Kim, 2017; Usher & Pajares, 2008). Consequently, the significance of VE’s role in teacher self-efficacy development remains uncertain and requires further research attention (Morris et al., 2017; Yada et al., 2019). Methodologically speaking, such attention needs to enable access to nuanced individual aspects of teachers’ development.

3.3.3. Social and verbal persuasion

Social and verbal persuasion (VP) plays an important role in teacher self-efficacy development since it provides teachers with feedback on their particular performance (Morris et al., 2017). It can be provided by students who show enthusiasm, smile, hug or reward their teachers following successful learning moments or at the end of an academic year (Houtz, 2014; Poulou, 2007). It can also take the form of a chat with or a feedback from an experienced, trustworthy, knowledgeable, respected and credible other (Bandura, 1986; Pajares, 2006; Palmer, 2011).

VP can provide teachers with information about the nature of teaching, strategies for overcoming difficulties and obstacles, as well as encouragement to persevere with particular actions (Tschannen-Moran et al., 1998). As such,

it is particularly poignant at the start of teachers' careers, when ME are sparse (Milner, 2002; Morris & Usher, 2011; Tschannen-Moran & Woolfolk Hoy, 2007). If an individual is persuaded that they have the capacity to achieve a particular level of success, this will have an influence on the outcome of their performance (Bandura, 1997). Bandura emphasised that "it is easier for an individual to sustain a sense of efficacy, especially when struggling with difficulties, if significant others express faith in one's capabilities" (Bandura, 1997, p. 101). He warns, however, that social persuasion does not substitute skills development (Bandura, 1997) but rather that its power relates to supporting individuals who already possess or who are close to having the skills to complete a certain task. If social persuasion is unrealistic it can significantly discredit the persuader and undermine the individual's sense of their efficacy (Bandura, 1997). The most effective VE is based not solely on encouragement and praise but on sober assessments of situations, frank discussions and the provision of tools which will enable the individual to move forward (Tschannen-Moran & McMaster, 2009). This means that successful "persuasive mentors must be good diagnosticians of strengths and weaknesses and knowledgeable about how to tailor activities to turn potentiality into actuality ... [They are also individuals who] encourage people to measure their successes in terms of self-improvement rather than in terms of triumphs over others" (Bandura, 1997, p. 106).

Verbal persuasion has to be honest and specific (Hattie & Timperley, 2007) but it also needs to be executed with care (Klassen & Durksen, 2014). Well-executed VP must not be too harsh since, as such, this might easily undermine teacher self-efficacy; instead, it needs to be specific and constructive (Tschannen-Moran et al., 1998), focusing on individual particular capabilities as opposed to mere deficits which are in need of external support (Morris et al., 2017). VP needs to focus on how much progress has been made towards achieving a certain goal, as opposed to how far one has still to go or what goal one missed (Bandura, 1997). The crucial aspect of successful VP is that the recipient is open and susceptible, reflective and flexible (Poulou, 2007). In other words, if an individual is convinced that they 'know better', VP will have limited or no effect (Bandura, 1997).

3.3.4. Physiological and affective states

The fourth self-efficacy source relates to an individual's somatic, physiological and affective experiences, particularly in the moment and when anticipating a specific experience (Bandura, 1997). Although low levels of stress and mild anticipation can motivate action, highly stressful situations can become overwhelming and make individuals feel vulnerable and dysfunctional. This is especially relevant in areas related to physical accomplishments, health functioning and stressful situations (Bandura, 1997),

and particularly important in careers such as teaching where high levels of stress are experienced relatively frequently.

But stress is not the only PAS factor affecting how efficacious one might feel in a particular situation. Feeling ill or being in a bad mood, experiencing tiredness, excitement, happiness from the experienced success, anxiety, experience of failure will all have an additional impact on the extent to which individuals believe they can be successful in future actions. For example, feeling relaxed and positive (Bandura, 1997), excited and happy after a successful enactive experience (Morris & Usher, 2011) or satisfied from own efforts (Aloe et al., 2014; Katz & Stupel, 2016; Klassen & Chiu, 2010) might enhance one's anticipation of future success.

According to Bandura, PAS and ME are the most influential source of self-efficacy. Yet, among the four self-efficacy sources, PAS have shown the weakest (Mohamadi & Asadzadeh, 2012; Poulou, 2007) or even no correlation with teacher self-efficacy in previous research (van Rooij, Fokksen-Bruinsma, & Goedhart, 2019). This has often been ascribed to the fact that teachers tend to omit the role of such experiences in their discussions unless specifically probed to do so (Palmer, 2006, 2011). Moreover, the highly nuanced and personal nature of PAS makes them difficult to capture in quantitative research, which tends to focus on more general sources of teacher self-efficacy (Morris et al., 2017). This might be the reason why the research relating to PAS as a self-efficacy source remains the most limited among all four sources (Morris & Usher, 2011).

3.3.5. The reliance on and the interaction between the four self-efficacy sources in the process of teacher self-efficacy development

The evidence of the significance of the four sources of self-efficacy in teacher self-efficacy development is already undeniably strong, although their respective roles in the process are often discussed somewhat discretely. It is important to remember, however, that an individual's "self-efficacy is not the simple product or sum of one's experiences" (Morris et al., 2017, p. 798) but rather a result of one's cognitive processing of those experiences (Bandura, 1997). In considering their possibilities of success, individuals consider all their past experiences (ME, VE, VP, PAS) and subjectively weigh the importance and significance of these in the past and for future performance. Such cognitive processing will vary from individual to individual and be shaped by their understanding of the world and their system of values. This will inevitably result in different appreciation of usefulness of the different sources, depending on an individual.

The different reliance on and significance of different self-efficacy sources among individuals has been reported in numerous studies. For example,

research suggests that subject knowledge appears to influence primary mathematics teachers' reliance on different efficacy sources, with those with greater subject content knowledge relying mostly on ME, those with moderate knowledge on VP and those with no or little initial subject knowledge resorting mostly to VE (Chang, 2010; Newton et al., 2012). It has been speculated that this is because individuals with higher mathematical content knowledge are simply better able to imagine themselves as successful in the classroom in the near future and rely more frequently on VE to learn about pedagogical strategies for dealing with students (Newton et al., 2012). Others have pointed out that different self-efficacy sources might play distinct roles depending on the stages of individuals' careers. For example, although it has often been suggested that ME are the most influential source of teacher self-efficacy (e.g., Bandura, 1997; Bong & Skaalvik, 2003; Chesnut & Cullen, 2014; Tschannen-Moran & Woolfolk Hoy, 2007) this is not true in the case of novice teachers who have relatively sparse ME and tend to rely more heavily on colleagues' support (using VP as well as VE as main sources of self-efficacy; Labone, 2004; Milner, 2002; Tschannen-Moran & Woolfolk Hoy, 2007). Others, still, emphasise the significant role of culture in affecting individuals' reliance on different self-efficacy sources. For example, in their studies of Finnish and Japanese teachers, Yada and colleagues (e.g., Yada et al., 2019) reported how, although teachers in both countries relied mostly on ME in developing their teacher self-efficacy, Finnish teachers also valued social and verbal persuasion, which in the case of Japanese teachers had a negative effect on their teacher self-efficacy. The authors speculated that, in the case of Japan, this might be due to the highly hierarchical society where feedback is mostly associated with formal appraisal from powerful individuals as opposed to a developmental activity with peers or supportive knowledgeable others.

Although theory and literature discuss discrete sources of self-efficacy, often emphasising the importance of some of these over others, these different sources do not, in fact, work in isolation but rather in a complex synergy which we have yet to understand fully (Bruce & Ross, 2008). Bandura emphasised:

The different forms of efficacy influences rarely operate separately and independently. People not only experience the results of their efforts but also see how others are fairing in similar pursuits and, from time to time, receive social evaluations of the adequacy of their performances. Because these influences affect one another, the power of a given mode of efficacy influence can change markedly depending on the strength of the other modes of influence (Bandura, 1997, pp. 87–88).

Consequently, it is important to consider not only how a collective of sources might boost teacher self-efficacy but also how symbiotic they actually are. Despite this advocacy, we are only very slowly developing our understanding of how exactly the four sources of self-efficacy interact with each other in teacher self-efficacy appraisal (Bruce & Ross, 2008; Klassen et

al., 2011; Labone, 2004). So far, only a handful of studies have discussed the symbiotic relationship between self-efficacy sources in teacher self-efficacy appraisal. For example, when considering VE in the form of research, Matney and Jackson II (2017) observed that teachers engaging in field-based research had greater gains in teacher self-efficacy than those conducting text-based research, ascribing the results to the fact that the former is more closely related to and intertwined with mastery experiences. Tschannen-Moran and Woolfolk Hoy (2007) found mastery experiences to be a function of social verbal persuasion provided by colleagues, staff and the parent community; an indirect role which was also discussed by Brand and Wilkins (2007) with regard to all three VP, VE and PAS. Although some studies described participants pointing to VP as the sole influence on their teacher self-efficacy (e.g., Phan & Locke, 2015), most research emphasised that for VP to make a real impact, it needs to be accompanied by other self-efficacy sources. For example, Bruce and Ross (2008) described a teacher, for whom “verbal persuasion was insufficient on its own” (p. 361). Throughout her teaching her lack of confidence in executing a specific mental mathematics teaching strategy continued until she observed her experienced colleague execute it successfully (VE). Ross (1994) emphasised that VP provision alone is insufficient, unless supported by immediate opportunity to put new knowledge into practice (ME). Labone (2004) and Palmer (2011) emphasised building of teacher self-efficacy through feedback (VP) which follows directly after mastery experiences, arguing that ME are powerful sources of self-efficacy only if combined with reflective processes (Labone, 2004).

Beyond these examples, specific interactions between self-efficacy sources have not yet been explicitly explored in research and understanding of these remains relatively limited. Researchers have called for further explorations of the role of self-efficacy sources in teacher self-efficacy development (Morris et al., 2017). Others have emphasised that this needs to be done with a specific focus on VP, VE and PAS due to the particular importance for novice teachers who have not yet accumulated many ME (Van Maele & Van Houtte, 2012). Generally speaking, researchers opine that “growth in the field will be restricted until a more sophisticated understanding of the sources of teacher efficacy is developed” (Klassen et al., 2011, p. 39).

Henson contended that “[t]o fully understand the relationships between the sources of efficacy information, the meaning teachers attach to this information, and any ultimate change in their efficacy beliefs, in-depth study of teachers is necessary” (Henson, 2002, p. 147). Morris et al. (2017) emphasised that this should be done both qualitatively (exploring what and how) as well as quantitatively (how many times, how frequently). While the latter is already rather prominent in the literature, the former still requires our attention. The qualitative approaches could make use of ‘thinking-out-loud’ or recall methods (recalling with the teachers what has been done and dismantling the fine details “ask[ing] teachers to describe even minor changes

in their sense of efficacy on a moment-to-moment basis” (Morris et al., 2017, p. 824). They could also make use of observations of teachers’ actions and follow-up discussions. All these have been considered in the process of this study.

3.4. Factors significant in teacher self-efficacy appraisal

As discussed above, teachers appraise their teacher self-efficacy based on information experienced enactively, socially, vicariously, and somatically and affectively. The cognitive processing of these experiences is affected by a variety of personal and external resources and factors (Bandura, 1997). Research to date has emphasised the importance of paying attention to the role of different factors in teacher self-efficacy appraisal (Austin, 2013). These include: students’ academic and personal profiles (Ma & Cavanagh, 2018), teachers’ personal characteristics such as positive personality, conscientiousness, openness to new experiences, willingness to face challenges or proactiveness (Djigić et al., 2014; Ma & Cavanagh, 2018; Marschall & Seah, under review; Poulou, 2007; Shakeel, Khan, Khan, & Mujtaba, 2021), emotional intelligence (Alrajhi et al., 2017), motivation and desire to improve (Poulou, 2007), teacher valuing of professional development (Rutherford, Long, & Farkas, 2017), culture (e.g., Cheung, 2008; Klassen et al., 2009), school’s structure and students’ economic status (e.g., Adams & Forsyth, 2006), school leadership (Liu et al., 2021), social interaction (e.g., Skaalvik & Skaalvik, 2007) and student-teacher relationships (An et al., 2021), social identity (Guan & So, 2016), environmental circumstances (Bandura, 1997), or teacher knowledge (Bates et al., 2011; Morris et al., 2017; Palmer, 2006; Sinclair, Naizer, & Ledbetter, 2011; Tschannen-Moran & Johnson, 2011). A more recently developing research area relates to exploring what role cultural aspects might play in TSE appraisal (e.g., An et al., 2021; Fackler, Sammons, & Malmberg, 2021; Yada et al., 2019). For example, Fackler et al. (2021) illustrate numerous differences in TSE in the three domains (EfCM, EfIS, EfSE) between teachers from Nordic, Anglo-Saxon and Easter educational cultures, such as generally higher levels of EfIS and EfCM for female teachers in more egalitarian cultures, or higher correlation between teacher knowledge and EfIS in Confucian educational cultures.

In mathematics education, additional frequently discussed factors include: teachers’ past mathematics performance and experience (Bates et al., 2011; Charalambous et al., 2008; Newton et al., 2012; Phelps, 2010) and mathematics anxiety (Swars, Daane, & Giesen, 2006; Swars, et al., 2009), teachers’ beliefs about mathematics (Swars, Hart, Smith, Smith, & Tolar,

2007), teacher knowledge and mathematics understanding (Bates et al., 2011; Hossain, Mendick, & Adler, 2013; Ma & Cavanagh, 2018; Swars et al., 2007; Thompson et al., 2017), teachers' mathematics efficacy (Esterly, 2003) or their individual interest in and passion for mathematics (Alrajhi et al., 2017; Craft, Hall, & Castello, 2014; Ekstam, Korhonen, Linnanmaki, & Aunio, 2017; Long & Woolfolk Hoy, 2006). Among these, teacher knowledge has been the most prominently explored.

3.4.1. Mathematics teacher knowledge

Research shows that teachers often mention their knowledge and mathematical experiences in their elaborations on their capability to teach the subject (Charalambous et al., 2008). Consequently, in the field of mathematics education, teacher knowledge has been one of the most frequently explored factors affecting teacher self-efficacy (e.g., Bautista & Boone, 2015; Morris et al., 2017; Palmer, 2011; Phan & Locke, 2015; Wang, Tsai, & Wei, 2015). Research to date suggests that teachers with greater subject knowledge in and understanding of mathematics tend to have stronger teacher self-efficacy for teaching the subject (Bates et al., 2011; Hossain et al., 2013; Newton et al., 2012; Palmer, 2006; Stevens, Aguirre-Munoz, Harris, Higgins, & Liu, 2013; Swars et al., 2007; Thompson et al., 2017), although it has been speculated that such an effect might be more pronounced in countries which put an emphasis on teachers being seen as experts in their subject field (Fackler et al., 2021).

Teachers who feel better prepared for their lessons as a result of a professional development activity (preparation which includes improving subject content knowledge) often proclaim stronger teacher self-efficacy for executing these lessons (Garvis & Pendergast, 2011; Tschannen-Moran & Johnson, 2011). Similarly, teachers confident in their pedagogical knowledge (e.g., having strong competence in using technology for teaching (Wang, Tsai, & Wei, 2015) or enhanced understanding of executing inquiry-based learning (Palmer, 2006, 2011)), report stronger teacher self-efficacy in these areas. Numerous effects of enhanced subject knowledge during the course of professional development positively affecting teacher efficacy for teaching have been reported by studies to date (e.g., Bates et al., 2011; Morris & Usher, 2011; Sinclair et al., 2011; Thompson et al., 2017).

The prominence of teacher knowledge in teacher self-efficacy has led researchers to go so far as to suggest that knowledge should be seen as the fifth source of teacher self-efficacy (Morris et al., 2017). Bandura pointed out, however, that “[t]here is a marked difference between possessing subskills and being able to use them well under diverse circumstances” (Bandura, 1986, p. 391). This means that although knowledge is a prerequisite for success, it is not a sufficient condition for that success (Bruun & Evans, 2020; Ma & Cavanagh, 2018). In other words, strong knowledge alone does not guarantee

success in teaching (Ma & Cavanagh, 2018) as it does not directly provide one with information about one's ability to act. As a teacher in Ma and Cavanagh's (2018) study pointed out: having knowledge means that "in theory, I believe I can do the above [but] in practice I'm not sure that's true yet" (ibid., p. 142). Indeed, although those who do not appear to have strong subject knowledge frequently struggle with confidence in teaching (an issue often emphasised by those working with primary school teachers with weak mathematics subject knowledge [e.g., Gresham, 2007]), it is also known that those who have strong subject knowledge are still not immune to experiencing doubts about their ability to teach (i.e., having low teacher self-efficacy). Illustrative of these, are examples such as: Maya—a pre-service primary teacher in Bjerke's (2019) study who despite her own success in learning mathematics in school had low efficacy for teaching the subject; or attendees of Evans's (2011) mathematics methods course on an alternative teacher education recruitment programme, who despite showing great improvements in their mathematics pedagogical and content knowledge, showed no such improvements in their teacher self-efficacy for teaching mathematics.

The discrepancy in the results of studies aiming to directly link teacher knowledge with teacher self-efficacy relates to the mediation of this relationship by one's experiences. As it has been posited before, teacher self-efficacy does not stem directly from knowledge but is appraised on the basis of information about experiences (one's own—ME, VP, PAS, and those of others—VE) which relate to individuals utilising that knowledge (Bandura, 1997). For example, Tschannen-Moran and McMaster (2009), who showed the enhancing effects of professional development activity on teaching strategies in primary school reading, emphasised that although participants indicated teacher self-efficacy gains as a result of their participation in the course, they attributed these gains to authentic mastery experiences and coaching sessions during the teaching year as opposed to mere knowledge gain. Similarly, the pre-service primary teachers in the study of Charalambous et al. (2008) who displayed weak efficacy for teaching mathematics at the start of their professional development programme, attributed this weak teacher self-efficacy to their early experiences of learning mathematics and not weak mathematics knowledge. Ekstam, Korhonen, Linnanmaki and Aunio (2018) showed that mathematics content knowledge has only an indirect effect on teacher self-efficacy and that this effect varies between different domains. They showed that teachers with strong mathematical content knowledge judged their teacher self-efficacy in the domains of motivating students or adapting instructions to individual needs as low. In contrast, their colleagues, who were "special education teachers had higher efficacy beliefs regarding the teaching of mathematics to low-performing students" (Ekstam et al., 2018, p. 64), despite reporting lower subject content knowledge. Similarly, Stevens et al. (2013) suggested that teachers with higher subject content knowledge might not have the added benefit in terms of their teacher self-efficacy,

particularly in managing difficult or disruptive students. The authors proposed that this might be due to their less-frequent exposure to effective models in this domain compared to their less-mathematically prepared colleagues, whose teacher courses might focus on a wider context of teaching.

Briefly put, although teacher knowledge appears to feature frequently in studies investigating teacher self-efficacy development, the effect of that knowledge on teacher self-efficacy is neither direct nor simple. Other characteristics, such as teachers' previous experiences or personal characteristics affecting their ability to utilise this knowledge need to be considered in exploring the relationship between knowledge and teacher self-efficacy.

3.5. Models of teacher self-efficacy–performance relationship in the iterative process of teacher self-efficacy development

Briefly describing the process of teacher self-efficacy appraisal, Bandura explained:

Performance alone does not provide sufficient information to judge one's level of capability, because many factors that have little to do with ability can affect performance ... The extent to which people will alter their perceived efficacy through performance experiences depends upon, among other factors, their preconceptions of their capabilities, the perceived difficulty of the tasks, the amount of effort they expend, the amount of external aid they receive, the circumstances under which they perform, the temporal pattern of their successes and failures, and the way these enactive experiences are cognitively organized and reconstructed in memory (Bandura, 1997, p. 81).

Based on this explanation and on collective empirical research findings, several models of teacher self-efficacy have been proposed in literature to date. Among these, the most prominent and comprehensive are Gist and Mitchell's (1992) cyclic model and its successor—Tschannen-Moran et al's. (1998) model, presented in figures 3 and 4, respectively.

The two models of teacher self-efficacy clearly present how contextual and individual aspects of learning collectively influence the teacher professional learning process. In appraising teacher self-efficacy, teachers continuously judge what is considered to be good quality performance and their ability to execute it (Bandura, 1997). The appraisal of teacher self-efficacy is based on information from the sources of self-efficacy, which are both culturally situated (VE, VP) and individual (ME, PAS).

Although ME, PAS, VE, and VP are main sources of self-efficacy, “cognitive processing determines how the sources of information will be

weighed and how they will influence the analysis of the teaching task and the assessment of personal teaching competence” (Tschannen-Moran et al., 1998, p. 230), both of which will be judged against each other (Tschannen-Moran et al., 1998). The assessment of personal competence relates to the question: “Am I capable of doing this?” It is based on teachers’ previous experiences and feedback from the environment, current physiological and affective, internal and external resources, state and readiness for task execution, as well as an assessment of current contextual affordances and constraints. The assessment of the task relates to questions such as: “What does the task require of me?” and “How difficult will it be to execute this task within this context and with available resources?” (Tschannen-Moran et al., 1998). This assessment is based on several aspects. First, it considers context specificity (Bandura, 1997). For example, teachers might display different levels of teacher self-efficacy towards the same task in different circumstances. Secondly, the assessment of the task difficulty draws on the outcome expectancy component. If the task itself does not promise success, even with its best execution, it might not be worth pursuing. The assessment of the task also involves a consideration of what the teacher will be required to attend to and do. This includes everything from the demands of the task to motivation of the students, availabilities of technology and teaching space, etc.

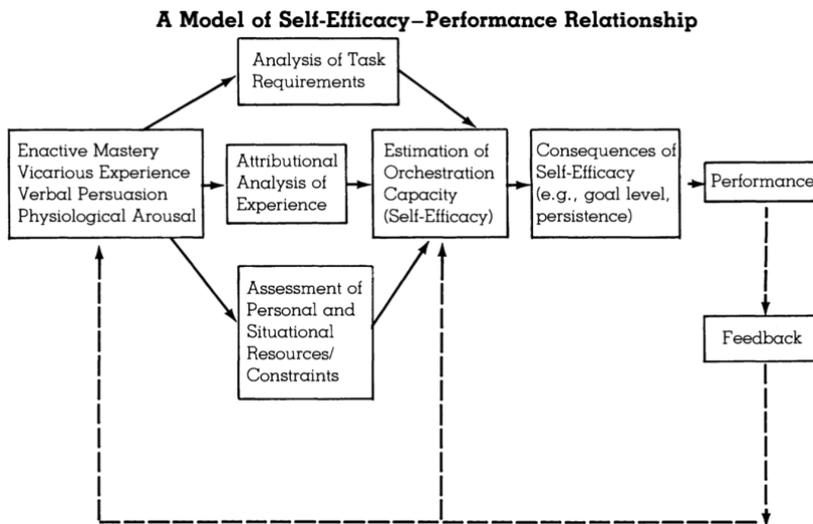


Figure 3: A Model of Self-Efficacy–Performance Relationship, from Gist and Mitchell (1992, p. 189)

Importantly, the two models emphasise that teacher self-efficacy is cyclical, where the proficiency of a particular performance creates a new mastery experience. The level of success of this experience, combined with one’s assessment of their expended effort and success attribution, provides

new information which is used to reappraise teacher self-efficacy. Greater success, attributed directly to one's effort, leads to greater motivation, effort and further persistence (Tschannen-Moran & Woolfolk Hoy, 2007). These in turn lead to improved performance, which leads to strengthening teacher self-efficacy judgements. Importantly, the reverse is also true—failure despite effort can lead to a decrease in persistence and motivation to act further (Tschannen-Moran & Woolfolk Hoy, 2007).

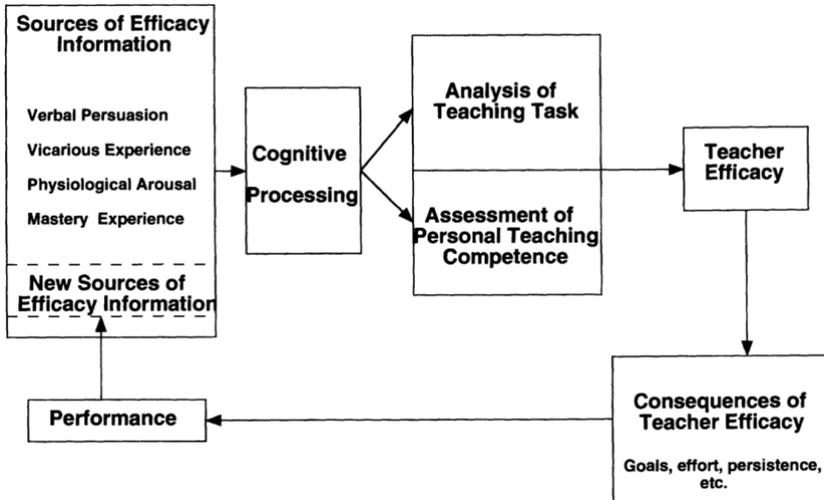


Figure 4: The cyclic teacher self-efficacy model of Tschannen-Moran et al. (1998, p. 233)

To summarise, the current models of teacher self-efficacy appraisal pay particular attention to widely accepted theoretical posits which centre around cognitive processing of information from four self-efficacy sources, internal resources, as well as particular task assessment. Importantly, however, these models focus mainly on performative aspects of teachers' professional lives and ignore the overall complexity of individuals' characteristics and attributes as well as their personal circumstances and life stories. Yet, the reviewed literature indicates that teacher self-efficacy is affected by a myriad of personal and external factors and teacher professional journeys. This leaves the current models relatively limited in their ability to comprehensively represent the process of teacher self-efficacy appraisal.

4. The implications for the study

My review of literature in the field of teacher self-efficacy development called for numerous reflections which were instrumental in planning my study. These reflections related to the research gap in the field—naming our limited understanding of the process of teacher self-efficacy development. What was puzzling and particularly interesting to me, as it had been to many colleagues before me, were the many contradictions in the conclusions presented (related, for example, to the stability of teacher self-efficacy, developmental trajectories of teacher self-efficacy, or the role of different sources in teacher self-efficacy appraisal) and the role of specific methodologies in contributing to these contradictions. It had previously been suggested that the historically predominantly quantitative focus of the field was to blame for many of the discrepancies; and although much of what is understood about the concept and its ‘development’ today is thanks to those studies, quantitative enquiry might have reached its limits in helping us move meaningfully forward (Philippou & Pantziara, 2015). Having reviewed the literature, I classified the issues within the field into two categories. On the one hand, there are issues related to teacher self-efficacy scales themselves (their validity and their struggles to capture the complexity of the teacher self-efficacy development process). On the other hand, there are issues which, influenced by the historically predominantly quantitative research enquiry, have later also influenced the qualitative field. These revolve around a simplistic and narrow conceptualisation of teacher self-efficacy which, I argue, while necessary in aiding the execution of quantitative studies, affected engagement with the complexities of the concept in qualitative enquiries. Below, I discuss each of these issues, briefly elaborating on how my engagement with each contributed to the design and the execution of the study.

4.1. Issues within quantitative enquiry

Quantitative studies in the field of teacher self-efficacy brought to light numerous important findings related to various aspects of its development. These findings emphasised and partly explained the role of the four sources in teacher self-efficacy development, highlighted the role of different factors interacting with teacher self-efficacy, and, most importantly, they allowed us

to appreciate that changes in teacher self-efficacy do happen. As discussed earlier, however, these results have reached their limit in contributing meaningfully to the field. First, the quantitative field is highly saturated with correlative as opposed to explanatory findings, which contribute little to an in-depth understanding of the process of teacher self-efficacy appraisal. Secondly, the accumulation of these results has led to many discrepancies, such as those related to the stability of teacher self-efficacy and its developmental trajectories, discussed earlier. This has been ascribed to numerous issues related to the validity of quantitative instruments and their ability to effectively capture nuanced aspects of the concept of teacher self-efficacy and its development. These include, for example, aspects such as struggles with coherently and unambiguously defining the domain and context specificity of teacher self-efficacy, resulting in many existing scales not being specific enough (Schunk & DiBenedetto, 2016; Wheatley, 2005; Woolfolk Hoy et al., 2009). They also include difficulties with incorporating context (Labone, 2004) and other important variables into teacher self-efficacy scale items (Wheatley, 2005), particularly those which are unpredictable and full of ambiguity (Bandura, 2012). Consequently, teacher self-efficacy measures tend to focus predominantly on the cognitive aspects of the theory, despite Bandura emphasising that they should also focus simultaneously on an individual's capabilities to manage "social, motivational, and affective aspects of learning" (Bandura, 2012, p. 26). Moreover, reflecting the historical messiness of the concept, many teacher self-efficacy scales continue to confound teacher self-efficacy with teacher self-esteem, locus of control or outcome expectancy (Bandura, 2006). In other words, they often fail to distinguish between the agent-means-end relationship within the concept of control (Skinner, 1996)—with most scale items reflecting the agent-ends relationship (judgements about one's ability to cause specific student outcomes) rather than separating the agent-means and means-ends relationships (Wheatley, 2005). This goes contrary to Bandura's (2006) emphasis that self-efficacy instruments should pay attention to the significant differences between self-efficacy, outcome expectancy and general locus of control.

In addition to these, further limitations in quantitative studies of teacher self-efficacy relate to the subjectivity in its self-appraisal, which might often be prone to social pressure and expectations, or which might stem from unrealistic and unsupported-by-experience confidence level. (Wheatley, 2005). Such "genuine faulty self-appraisal" (Bandura, 2012, p. 11) is particularly common when an inexperienced individual attempts a novel, difficult task or among inexperienced teachers (Schunk & DiBenedetto, 2016; Wigfield, Cambria, & Eccles, 2012). For example, Gabriele and Joram (2007) showed that teachers interpret situations, experiences and self-efficacy in different ways, with novice teachers' assessments being often unsupported by experience and much less realistic (Bruce & Ross, 2008; Duckworth &

Yeager, 2015). Tschannen-Moran and Hoy (2001) reported on pre-service teachers' faulty appraisals stemming from possible lack of initial understanding of real issues underlying teaching. Cohen's (1990) reported on teachers with high teacher self-efficacy in implementing innovative, student-centred teaching approaches who executed these very superficially. This gives rise to the question of how to interpret teachers' scale appraisal of their teacher self-efficacy without an understanding of how these teachers interpret the domain of behaviour related to specific scale items. It has implications in obscuring the results related to trajectories of teacher self-efficacy development. For example, if a teacher assesses and interprets their teacher self-efficacy differently in the middle of their career to when they were novice, their potential teacher self-efficacy improvement might not be revealed through a mere quantitative approach; in fact, it might even indicate a dip in teacher self-efficacy (Wheatley, 2005).

The issue of interpretation also revolves around teacher self-efficacy instruments which use bi-polar Likert-type scales (Bandura, 2012) and which make use of responses such as: strongly disagree, mostly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, mostly agree, and strongly agree, and which force a gradation of rating within two polar extremes, centred around a neutral point. Such scales are simply meaningless in contexts such as teacher self-efficacy appraisal—where, for example, a neutral efficacy makes no sense or where a complete incapability (with assigned value of zero) can have a lower negative gradation (Bandura, 2012). In addition, as we know, teacher self-efficacy appraisal is highly affective and dependent on the moment in which it is discussed. Although a teacher may generally appraise their self-efficacy highly, a new stressful situation might well affect this confident appraisal negatively (Bandura, 1997). This amplifies the necessity of capturing not only the teacher 'assessment' of their teacher self-efficacy along the given scale but also the complexity of the moment in which this assessment is made.

Finally, there remains the thorny issue of reliability of various teacher self-efficacy instruments across contexts. For example, Kieftenbeld, Natesan and Eddy (2011) showed the lack of reliability of the MTEBI instrument when used with less confident teachers. Duffin, French and Patrick (2012) suggested that TSES lacks reliability when used with pre-service teachers who lack pedagogical knowledge and teaching experience as its items do not differentiate between the different aspects of teaching measured by the instrument.

4.2. Issues within qualitative enquiry

The limitations of quantitative enquiry in the field of teacher self-efficacy have led to an increase in mixed-method and qualitative research in the last

decade (Philippou & Pantziara, 2015). I argue, however, that this type of research is still in its infancy, for two prime reasons. First, the qualitative research to date remains predominantly descriptive, as opposed to explanatory or conceptual. Consequently, although it provides rich accounts of various aspects of teacher self-efficacy in a variety of contexts, it is still limited in its ability to explain the process of teacher self-efficacy appraisal in a way that would go beyond Bandura's four self-efficacy sources framework and the two developmental models presented in section 3.5. Secondly, the qualitative research appears to be highly influenced by the quantitative field's narrow treatment of the concept of teacher self-efficacy as an individual belief which, when articulated in a specific way, is expected to be easily expressed and measured. This uneasiness with conceptualising self-efficacy as a belief is not new. Indeed, it has already been suggested elsewhere that self-efficacy can represent different conceptual premises. For example, Di Martino and Zan (2015) considered self-efficacy to be one component of a three-dimensional model of attitudes which includes emotions, beliefs and visions, and perceived competence; in other words, they treat it as a separate concept in its own right. Considering students' attitudes towards mathematics, they explain that students' different emotional dispositions may be associated with different attitudes, depending not only on their emotions or vision of mathematics (beliefs) but also on their perceived competence (self-efficacy). Liljedahl and Oesterle (2014) suggested that teacher self-efficacy sits "on the boundary between beliefs and attitudes" (p. 584), although little explanation is provided of how this boundary should be defined.

I suggest that the reductive conceptual treatment of teacher self-efficacy is one of the reasons why the field continues to struggle to explore and understand the process of teacher self-efficacy or reaches nonsensical conclusions such as the one claiming that teacher self-efficacy is both stable and malleable. This relates not only to the usefulness but also the appropriateness of such treatment. As has been emphasised before, the concept of beliefs continues to suffer from a definitional confusion and messiness (Leder, 2019; Philipp, 2007) which limits our ability to not only interpret but also operationalise it in research (Pajares, 1992). Moreover, the term 'belief' has been seen as "a strong magnet for ontological collapses which obscure complexity and the situatedness" of human functioning (Heyd-Metzuyanim, 2019, p. 5). Such a treatment limits the scope for investigating teacher self-efficacy, defined as highly complex, domain-, context-, and task-specific (Bandura, 1997).

Returning to the theoretical underpinnings of the concept seems a sensible place to start if one wants to address the issues of its conceptualisation and its implications for further research. A close investigation of theory (Bandura, 1977, 1986, 1997) reveals that, although deploying the language of 'beliefs', the theory of self-efficacy clearly posits that self-efficacy represents a dynamic cognitive and affective self-schema or mental model of one's

competent self (Bandura, 1997); or in other words, one's view of oneself acting competently in the world. As such, teacher self-efficacy relates to one's set of memories, beliefs, experiences, perceptions and generalisations of self related to specific teaching domains (Bandura, 1997; Markus, 1977). Consequently, the development of teacher self-efficacy as a self-schema evolves through cognitive and transactional construction of one's view of self as a competent professional, as opposed to developing a simple conviction of what one 'believes' to be true (Bandura, 1997). As described earlier, such development would involve the processing of information related to one's effective behaviour and success attribution, which would be highly affected by specific circumstances and one's emotional and physiological wellbeing. Consequently, it is both limiting to think that such a process aligns with the way research conceptualises beliefs change and naïve to expect that such a complex process could be adequately captured or measured by quantitative scales. An investigation of teacher self-efficacy and its development requires more theoretically sophisticated tools and a phenomenological approach (Philippou & Pantziara, 2015). This study focused on employing such an approach in helping to address not only the gap in understanding of teacher self-efficacy development but also a meaningful reconceptualisation of teacher self-efficacy itself.

4.3. Research aims and research questions

Due to the current state of research in the field of teacher self-efficacy, our understanding of the process of its development remains relatively limited. Yet, such an understanding is essential in aiding further growth in the field (Katz & Stupel, 2016; Klassen et al., 2011). Like many others before me, I have come to realise that this understanding can be achieved only through an in-depth, qualitative study of teachers (Henson, 2002; Labone, 2004; Woolfolk Hoy et al., 2009):

researchers investigating the development of teacher efficacy beliefs should consider use of more intensive qualitative methodologies that enable detailed investigation of the processes involved in such reflective practices and the impact of these practices on the development of teacher efficacy beliefs (Labone, 2004, p. 346).

Such engagement can only be achieved through a rich interpretative qualitative approach (Labone, 2004), which focuses on teachers' interpretations of their learning (Wheatley, 2005) and appreciates differences and underlying factors (Charalambous, et al., 2008) and the role of sources in teacher self-efficacy appraisal (Klassen et al., 2011; Van Maele & Van Houtte, 2012). Moreover, such an approach should necessarily be lengthy

(longitudinal; Holzberger et al., 2013) and should engage in an elaboration of theory which goes beyond currently prevalent frameworks of teacher self-efficacy development (Klassen et al., 2011).

I used the aforementioned considerations as a general guidance in the design of this study which addressed two general aims related to the concept of teacher self-efficacy and its development. These aims align with Philippou and Pantziara's (2015) calls "for a clearer meaning of the construct, deeper examination of its genesis and development, reconsideration of measures and methodologies, and more relevance to educational practice" (Philippou & Pantziara, 2015, p. 99). As will be illustrated in this thesis, the two aims are inextricably connected and laced together in one research enquiry. This means that addressing one of these aims required a simultaneous attention to the other.

Initially, the predominant goal of the study, around which the specific research questions were designed, related to developing an understanding of the process of teacher self-efficacy development (the second concern mentioned by Philippou and Pantziara, 2015). As discussed before, although the theoretical underpinnings of teacher self-efficacy development (related to the four self-efficacy sources, personal and contextual factors as well as affective and cognitive processing) have been widely accepted in research to date, they have not yet been explored in a meaningful qualitative way with a deliberate focus on the process of this development (Tschannen-Moran & Hoy, 2001). Responding to this perceived gap, and considering the posits of SCT and the theory of self-efficacy, this study was designed to address this aim (informed by Philippou and Pantziara, 2015) through the following research questions:

RQ1: What constitutes Bandura's (1997) four self-efficacy sources and their role in the process of teacher self-efficacy appraisal?

RQ2: What role do personal factors (such as personal characteristics or knowledge) play in the process of teacher self-efficacy appraisal?

RQ3: What is the process through which teacher self-efficacy is appraised?

In order to address these, the focus of the study had to be drawn towards the concept of teacher self-efficacy itself (the first concern mentioned by Philippou and Pantziara, 2015) and the appropriate philosophical and methodological approach of the study (the third concern mentioned by Philippou and Pantziara, 2015). First, recognising the limitations of the previous treatments of teacher self-efficacy as a general trait of character or a belief, this study focused on the wider definition of the concept, relating to the social-psychology of self-schema. Such was seen as both more appropriate and less limiting in enabling the exploration of the process of teacher self-efficacy development. Moreover, starting from this theoretical premise, the study focused on developing this concept further; a move inextricably

connected to the process of its development. Secondly, recognising the theoretical and methodological limitations and gaps in previous research (Henson, 2002; Labone, 2004), the study drew on phenomenology, which focused on participants' interpretations of their lived experiences. Guided by a theory-driven goal, the approach of this phenomenological study was abductive (Tavory & Timmermans, 2014), and utilised IPA (Smith et al., 2009) in the process. Consequently, the two aims of the study (informed by Philippou and Pantziara, 2015) can be summarised as follows:

Aim 1: To develop an understanding of the process of teacher self-efficacy appraisal.

Aim 2: To reconceptualise teacher self-efficacy.

5. Further theoretical considerations

Although the premise of the study rested on the foundations of SCT (Bandura, 1986, 1989) and the theory of self-efficacy (Bandura, 1997a), the aims related to theory expansion necessitated an abductive analysis that considered multiple theoretical lenses. Indeed, it was during this abductive analysis that I observed that the posits of SCT and the theory of self-efficacy alone were insufficient for fully explaining the process of teacher self-efficacy development. Consequently, when theorising about teacher self-efficacy development, I further networked these theoretical perspectives with social psychology and the theory of narrative self (Bruner, 1990; Markus and colleagues, various sources; Polkinghorne, 1991; Smith, 2014), as well as sociological perspectives on human agency (Archer, 2000). In what follows, I describe the posits of the additional theoretical perspectives and discuss their overall compatibility with the foundational theories of the study. Later, in the methodology section, in relevant publications—Article 4 and Article 5—and in the findings of the study, I discuss networking the theories in the process of constructing a coherent model of teacher self-efficacy development.

5.1. The narrative self—social psychology and the sociology of human agency perspective

According to Bruner, social psychology (or as he refers to it, folk psychology) is concerned with human agents acting in the world based on their beliefs, and desires being driven by goals. Within this, he sees individuals as constituted of a multitude of ‘selves’, which relate to who the individuals see themselves currently (the Now Self) and who they might, would like to, or are afraid of becoming (the Possible Selves; Markus & Nurius, 1986). Speaking generally, in social psychology, the concept of self is seen as an actively, experientially, reflectively and transactionally realised understanding of self, emerging within one’s historical and sociocultural tradition (Martin & Sugarman, 2001; Smith, 2014), and which necessarily incorporates internal physical and psychological, as well as external social and environmental aspects (Smith, 2014). The dynamic cognitive representations of self-related information or active knowledge structures about the self have been referred to as self-schemata (Markus, 1977; Sherman, Judd, & Park, 1989; Trzebinski, 1995).

These can be defined as "...cognitive generalizations about the 'self' derived from experience that organize and guide the processing of the self-related information contained in an individual's social experience" (Markus, 1977, p. 64). In these terms, self represents an experiential, dynamic system of past self, current actual self as well as future possible or ideal selves (Smith, 2014). Throughout life (or here, throughout one's journey towards becoming a teacher) individuals have a specific momentary life structure—a current or actual self which, having evolved from the past, exists in an unceasing present moment (Maturana, 2002). At the same time, they consider values, goals and directions which help them visualise future possible, ideal or designated selves (Mosvold & Bjuland, 2016; Smith, 2014) that they aspire towards. This means that, as generalised dynamic models of self acting in the world, self-schemata are developed in the present, with reference to past experiences and past selves, and imagined possible future selves (Stangor, 2019). This relates to the human propensity to create narrative structures which, in an autopoietic process of becoming (*auto*-self, *poiesis*-creation; Smith, 2014), individuals utilise as a vehicle for organising experiences (Bruner, 1990).

In constructing a narrative self an individual "configures temporal elements into a whole by grasping them together and directing them toward a conclusion or ending" (Polkinghorne, 1991, p. 141). In any given moment we affectively negotiate the present and the current self by retrospectively bringing our past self into consideration and by considering future or possible selves. This is consistent with posits of psychology which explain that as generalised dynamic models of oneself acting in the world self-schemata interact not only with one's present actions in the current context but also with the past self and imaginaries of the future self (Stangor, 2019). The process of self-schema (re)construction involves iterative meaning-making by relating experience and events to a person's view of themselves (Stangor, 2019).

Schechtman explains that the meaning-making process should not only help us remember or explain past experiences, but should also help us to anticipate the future (Schechtman, 2005). Narrative structure is "used to interpret and give coherence to past episodes in our own lives and to configure future activities that we expect to lead to desired outcomes" (Polkinghorne, 1991, p. 143). In the same way, Archer (2000) points out that the entity of life entails the things we have done, are doing, and could do, which means that in the meaning-making process we continuously necessarily engage in a dialogue between the reflective, the retrospective and the prospective; or as Märtsin says, we "lace together" (Märtsin, 2019, p. 677) the past, present and future in one continuous process of becoming (May, 1983). In other words, we create a biography of ourselves that provides a momentary closure. As individuals accumulate experiences within a context, a kind of stability is achieved and individuals may see themselves as approaching their aspired-to selves (Markus, 1977).

Encompassing all of the above, Trzebinski (1995) coins the term self-narrative schema, which he defines as a cognitive schema in which self-narratives frame how individuals understand themselves and reality through an on-going engagement with the world. In the process of self-narrative schemata (re)construction, he summarises, self-narratives focus the process of meaning-making on providing continuity concerning one's experience, by attending to situations, events and actions which are particularly important—being highly affective or having a particular explanatory power (Trzebinski, 1995). In this, he draws our attention to the significance of affect in the schema construction (Trzebinski, 1995); a significance which is also emphasised by Bruner (1990) who considers affect to be a thumbprint of self-schema reconstruction. In a similar way, Archer (2000) defines emotions as commentaries upon concerns—the things that matter to us. She considers emotions to be the main constituents of our lives, which fuel our inner conversations. As a continuous running commentary of our lives, emotionality often remains invisible but in sudden and urgent situations it can be immediately brought to our consciousness. In such instances, emotions become “affective modes of awareness of situation” (Archer, 2000, p. 195); a situation which occurs when we encounter deviations or discrepancies between what we experience and what we previously expected (Archer, 2000; Bruner, 1990). This (re)initiates the process of self-narrating as a way of managing the affective moment and guiding future emotions and actions (Archer, 2000). Through cognitive (bringing reason to emotions) and evaluative (organising the importance of our concerns) reflections, we transform our immediate (first-order) affective response in the present moment into (second-order) emotions which are to survive in the future, in order to strike a liveable balance within our concerns, and to aid narrative continuity (Archer, 2000; Bruner, 1990).

In this sense, narrative self-schemata act as selective mechanisms in human functioning and development, playing an imperative role in bridging perception and action (Lord & Levy, 1994). Such a perspective aligns with the construction of narrative identity (Sfard & Prusak, 2005), which through a narrative construction “makes us able to cope with new situations in terms of our past experience and gives us tools to plan for the future” (Sfard & Prusak, 2005, p. 11). This alignment, however, is not surprising since in socio-psychological terms identity is seen as a representation of the system of self (Smith, 2014).

5.2. The compatibility of theories

While focusing on the perspective of the individual, the ontological standpoint of all three perspectives (SCT, Bruner's folk psychology, and Archer's sociological perspective of human agency and functioning) is based on the

assumption that the self is constructed both from the inside out and from the outside in (Bruner, 1990). In triadic reciprocal causation, social cognitive theory (Bandura, 1986) treats individuals as “neither driven by inner forces nor automatically shaped and controlled by the environment [and sees the development of individuals evolving] within a network of reciprocally interacting influences” (Bandura, 1989, p. 8). These influences include a myriad of external (environmental) and internal (personal) factors. In the same way, in *transactional contextualism*, Bruner (1990) emphasised that we are both the creatures of history and autonomous agents, and that the construction of meaning is “realized only through participation in the symbolic system of culture” (ibid., p. 33). Archer (2000) refers to this as a-reductionist *central conflation*, in which the individual and the collective are “mutually constitutive” (ibid, p. 6), with neither holding an absolute autonomy over the other.

Philosophically speaking, all three perspectives can be seen to be guided by phenomenology, which focuses on individuals’ making meaning of their experiences (Neubauer, Witkop, & Varpio, 2019). Their point of departure is individual experience, or “practice in the environment” (Archer, 2000, p. 7)—with language representing a particular type of one’s deeds/practice—and the meaning-making revolving around this experience in the process of sustaining and developing a coherent sense of self in the social world (Archer, 2000; Bruner, 1990; Markus & Nurius, 1986). This relates to the process of *autopoiesis* (Smith, 2014) in which, while changing, individuals have “the power to know [themselves] to be the same thing over time” (Archer, 2000, p. 7). The three perspectives do not dichotomise the subject from the object but rather emphasise that, in the evolutionary process, it is the same person who is doing and thinking.

From the perspective of self-efficacy theory, the cognitive meaning-making engages with three temporal spaces (Bandura, 1997). That is because individuals do not automatically react to their environment/immediate experiences (which can be enactive, vicarious, social and affective) but, being guided by forethought, they process their past experiences in light of their future aspirations and goals (Bandura, 1997). In social-psychological terms, we say that individuals make sense of their actions and experiences by drawing attention to their past as well as imaginary and aspirational future selves (Stangor, 2019). In the same way, Archer (2000) pointed out that “at any time, life entails the things we are doing, the things we have done and the things we could do” (p. 233), seeing the meaning-making process as a dialogue between the reflective, the retrospective and the prospective. In this sense, all three perspectives emphasise the importance of past, present and future in the meaning-making processes.

These processes are centred around significant sudden affective experiences in the moment (Archer, 2000). Considering ‘emotions’ as running commentaries of our lives, Archer (2000) emphasised that most of the time

our emotionality remains invisible but that in urgent situations it is instantly brought to our consciousness through immediate affect. These ‘urgent’ situations are those which emphasise a particular concern that requires our immediate attention, due to exposing a ‘kind of’ disturbance in our sense of self. Considering the practical performative order (relating to one’s assessment of one’s performative capabilities—i.e., self-efficacy), these “occur at junctures where pre-formed plans and expectations have not worked” (Archer, 2000, p. 212), or in other words, where our projections of our capabilities did not align with our performance. In the same way, Bruner (1990) explained that in our ongoing existence, when things are as they should be, reflection is unnecessary, but when we encounter a deviation from the canonical, we are forced to process this deviation cognitively. Both align with Bandura, who posited that “if performance matches the standard, the person does nothing” (Bandura, 1989, p. 49); however, a perceived discrepancy between experience and future reference standard gives rise to an affective response which triggers the urge to reduce the incongruity (Bandura, 1989). But in such a case action is not automatic, following on from a reflection on the experiences and on the discrepancy itself. This cognitive meaning-making process serves two significant functions: it helps us make sense of the experiences and it helps regulate affect in the process of organising these experiences in the coherent continuity of self (Archer, 2000; Bandura, 1989; Bruner, 1990). In the practical performative order (Archer, 2000), this regulation takes place through a continuous (re)appraisal of one’s self-efficacy, which plays a central role in human functioning, driven by individual agency (Bandura, 1997).

The above-described posits of the three theories in question illustrate the alignment of their theoretical foundations. As such, the theories can be considered compatible.

6. Research paradigm and its ontological and epistemological assumptions

The epistemological and ontological position of the study is informed by phenomenology, guided by an interpretive paradigm. The epistemological assumption of interpretivism does not rest on the idea of a universal and objective (i.e., positivistic) truth but rather on the foundation that knowledge stems from an act of interpretation and that, as such, it cannot be thought of as independent of individuals' thinking and reasoning (Bryman, 2016). This is not to say, however, that the world exists only in the mind of the individual but rather that the mind influences how we perceive and understand reality (Coe, 2012). Importantly, however, in interpretivist terms this individually understood reality does not necessarily imply relativism, where knowledge is considered to be entirely individual; it is rather a meaning derived from a social consensus which is founded on and achieved over the course of individuals' lives (Scott, 2009). Such a position recognises that our view and understanding of reality is influenced by our shared understanding, shaped by our sociopolitical environment and culture (Stryker, 2002). In other words, the interpretivist ontological standpoint sees reality as socially constructed (Carson, Gilmore, Perry, & Gronhaug, 2001) and what constitutes the social world or reality is what individuals bring to existence (Coe, 2012).

With these epistemological and ontological assumptions, the interpretivist approach is concerned with understanding “the subjective world of human experience” (Cohen, Manion, & Morrison, p. 17) through utilising observations, which give access to information about events, and (more importantly) interpretations and meaning-making of these events (Cohen et al., 2011). In other words, it aims to “get inside the person and to [build the] understand[ing] from within” (Cohen et al., 2011, p. 17). Within this paradigm,

phenomenology can be defined as an approach to research that seeks to describe the essence of a phenomenon by exploring it from the perspective of those who have experienced it. The goal of phenomenology is to describe the meaning of an experience—both in terms of what was experienced and how it was experienced (Neubauer et al., 2019, p. 91).

Husserl and Heidegger, the fathers of phenomenology, emphasised that our “lifeworld (the taken-for-granted, everyday life that we lead) provides the experiential grounding for what we might call the objective or scientific world” (Smith et al., 2009, p. 15). In a similar vein, Merleau-Ponty (1962) explained that all scientific knowledge of the world is gained either from one’s own particular point of view or “from some experience of the world without which the symbols of science would be meaningless” (Merleau-Ponty, 1962, p. ix). In other words, science represents second-order knowledge, which depends upon first-order personal experience (Smith et al., 2009). These experiences of the world include those in the mind and those that are embodied, since the body provides the means for communicating with the world (Merleau-Ponty, 1962).

Importantly, although in phenomenological terms, in making sense of experience, individuals make use of free imaginative variation, this freedom is not absolute but situated (Heidegger, 1962). That is, individuals’

realities are invariably influenced by the world in which they live. As such, individuals are understood as always already having an understanding of themselves within the world, even if they are not constantly, explicitly and/or consciously aware of that understanding (Neubauer et al., 2019).

In other words, individuals are not able to make sense of their experiences without referring to their historical backgrounds, even if this is done subconsciously (Heidegger, 1962). In this sense, the ontological stance of this study is critical since it engages deeply with the participants’ philosophical questions about the sociohistorically situated self (Meyer, 2011)—how they see themselves and how they make sense of their capacity and capability to act in their professional context, gaining an appreciation of the self-producing aspect of self in the sense-making process (Kincheloe, 2011).

Considering all the above, it remains important to clarify how phenomenology differs from social constructivism. After all, on the most fundamental level, both phenomenology and constructivism are concerned with subjective knowledge construction of one’s experience (Wilkinson & Hanna, 2016). Constructivism assumes that one’s individual meaning-making rests upon constructing representations of the world in one’s thoughts (Wilkinson & Hanna, 2016). Within the social constructivist view, knowledge is constructed collectively within the sociocultural belief structure (Powell & Kalina, 2009) and rests on coherence, which assumes that knowledge is justifiable as long as its structure is logically consistent. This coherence does not have to be grounded in a precise understanding of the world but rather in the individual’s or socially sanctioned belief and knowledge structures (Wilkinson & Hanna, 2016). In contrast, in phenomenological terms knowledge construction rests upon not only coherentism but also foundationalism, which maintains that knowledge is justifiable as long as it is

verifiable or evidence-based (Wilkinson & Hanna, 2016). As such, knowledge construction is seen as intersubjective—that which links individuals through shared conscious connection (Wilkinson & Hanna, 2016). With this consideration in mind, phenomenology demands that one

(a) rigorously explores one's experience of the world to grasp potentially fundamental aspects therein, and then (b) coordinates one's exploratory efforts to arrive at an understanding of the world as it is. So there is indeed a valid—rather than merely viable—basis to one's knowledge according to phenomenology, and individuals can work together to arrive at a more accurate understanding of what that might be (Wilkinson & Hanna, 2016, p. 6).

Although social constructivism is similar to phenomenology in that it focuses on hermeneutics, it differs from phenomenology in that it dichotomises the subject and the object—the world is seen through a subjective lens but is still considered something that is out there and something that can be co-constructed by a collective, through shared mental constructs (Stein, 1986). In contrast, phenomenology rejects the dichotomy between subject and object since it is concerned with a view of the world which does not exist and is not significant outside of our experience and our making sense of it. As such, it asserts that human conscious thought accesses the world as it is lived by the subjects (Wilkinson & Hanna, 2016); it considers both one's experience and how one thinks about this experience as part of one phenomenon. In other words, phenomenology connects constructivism with experience. It does so by reminding us that we both experience the objective world and abstract from it. It promotes the idea of collective knowledge construction through intersubjectivity, based on individuals' shared aspects of experiencing the world—such as empathy or agency (Stein, 1986). This intersubjectivity depends on shared and culturally accepted signs, symbols, and language, and on the correspondence between these and what they represent.

7. Methodology

Since the predominant goal of the study was to address the question of *how* teacher self-efficacy develops, a qualitative case study approach was employed. With this in mind, the methodological position of the study was idiographic, focusing on the “particular and individual” (Cohen et al., 2011, p. 6). The main aim was to develop “an understanding of the way in which individuals create, modify and interpret the world in which they find themselves” (Cohen et al., 2011, p. 6); focusing on the teachers’ representations of reality—listening to what they perceived to be important and how they made sense of their experiences (Smith et al., 2009). This methodological approach drew on both phenomenology and hermeneutics. Phenomenology represents a philosophical approach to the study of experience, particularly from the perspective of what matters to the individual (Smith et al., 2009). Hermeneutics seeks to understand the world through the eyes of participants (Cohen et al., 2011); it aims to uncover and understand the individual’s meanings (Smith et al., 2009).

The study was conducted in two distinct parts. Although the analytical process of both parts was phenomenological, the design and data collection of each part was significantly different. The first part, which I refer to as a ‘pilot study’, investigated the process of teacher self-efficacy development framed by the theory of teacher self-efficacy, based on the four self-efficacy sources of Bandura (1997) and an extended version of the three teacher self-efficacy domains discussed by Tschannen-Moran and Woolfolk Hoy (2001). The pilot study was executed retrospectively, which posed difficulties for investigating the process of teacher self-efficacy in greater depth. This led to the second, purposefully designed part of the study (the ‘main study’), which enabled a more meaningful engagement with participants’ meaning-making processes in their teacher self-efficacy development. In what follows, I first provide a brief discussion of the case study methodology (employed in both parts of the study) and the context of the study. I then describe the research design of each part separately.

7.1. A case study approach

A case study is an empirical, in-depth enquiry which allows close examination of a particular contemporary phenomenon of interest (Yin, 2018). An intrinsic case study is one which focuses on developing an understanding of the case itself, and an instrumental case study focuses on illuminating a particular research question (Stake, 1995). As discussed earlier, this study has an interpretivist phenomenological orientation, which focuses on individuals' meanings of reality; meanings which are bound by social consensus and which emerge over the course of individuals' lives (Scott, 2009). The focus is on individuals, their lived experiences, thoughts and feelings. The study was aimed at developing an understanding of the perspectives of different participants, focusing on how similarities and differences in those meanings illuminated a specific research question (Yin, 2018). As such, this study used an instrumental multiple case study design (Stake, 1995).

Advocates of the case study approach often emphasise that its significance lies in its ability to illustrate and elaborate on the existence of specific phenomena (Yin, 2018). Within this view, Yin (2018) describes four main functions of a case study: describing, illustrating, explaining and enlightening. As such, case studies can focus on questions of *what*, *how* and *why*, which means that their purpose is not only descriptive or confirmatory, but also explanatory. Case studies can be more explicitly categorised into: story-telling, picture-drawing, evaluative, theory-seeking and theory-testing (Bassegy, 1999), with the final two categories being particularly instrumental in exploring and explaining phenomena from the perspective of both theory and empirical data (Stake, 1995). Referring back to Campbell (1975) and Platt (1988), Smith et al. (2009) emphasise that instrumental case studies provide a means for uncovering unexpected aspects of phenomena that can disconfirm, question and trouble our longstanding assumptions and existing theories. As such, instrumental case studies lend themselves well to abductive research processes, which through a detailed examination of particular cases aim to develop an understanding of and provide explanations for any elements of surprise, which current theories struggle to account for or address (Tavory & Timmermans, 2014). All these affordances were critical in the study design, whose main aims were to seek new theoretical avenues, provide new theoretical explanations and advance theory related to the process of teacher self-efficacy development.

Since the goal of the study related to theory advancement, it was important to address one of the main reservations about the case study, which relates to its generalisability. It is frequently argued that since case studies do not lend themselves to be directly compared or replicated experimentally, their findings cannot be meaningfully generalised or utilised in addressing general educational issues. Yin (2018) argues, however, that such an argument is fundamentally flawed due to a general misinterpretation of the meaning of

generalisability and the role of case studies in establishing it. While it is true that case studies provide no direct means for extrapolating findings according to their probabilities (statistical generalisation), they focus explicitly on illuminating phenomena that can otherwise become obscured and misunderstood in standardised studies. This means that case studies give rise to analytical generalisations. Referring back to Galton (1883), Smith et al. (2009) argue that the development of all knowledge must always necessarily start with the particular if one is to avoid fragmentation and misinterpretation of human life. At the same time, they remind us that the particular must never be too distinct from the general, as both the particular and the general are part of one iterative hermeneutic cycle—the particular always underlies the general, and the general always has to comply with the particular. As such, case studies not only can but should hold an important place in the construction and revision of theory (Platt, 1988). This study takes this position, recognising that what was already known and understood about the process of teacher self-efficacy development was limited and that a more in-depth, qualitative and theoretical engagement with the phenomenon from the perspective of the particular was necessary.

In the study design process, two distinct features of case studies were taken into consideration (Yin, 2018). First, the case studies' design, data collection and analysis were to be strongly grounded in previously developed theoretical positions. To ensure this, the foundational design of the study was guided by the posits of social cognitive theory (Bandura, 1986, 1989), the theory of self-efficacy (Bandura, 1997), and previously reviewed literature. In an abductive approach, this was further extended to considerations of additional sociological and psychological theories of identity and human functioning (described in later chapters). Second, case studies often rely on multiple sources of data, which allows a phenomenon to be explored from a multitude of perspectives (Yin, 2018). Using this opportunity, the study relied upon five different data sources, discussed later.

7.2. The context of the study—initial teacher education programme

This study investigated pre-service secondary mathematics teachers' development of teacher self-efficacy during their initial teacher education (ITE) programme at the University of Cambridge (where I worked) in academic years 2017/2018 (the pilot study) and 2018/2019 (the main study). The ITE programme is a one-academic-year, university-led programme, the successful completion of which leads to a Postgraduate Certificate in Education (PGCE) and Qualified Teacher Status (QTS). All entrants to the programme hold at least an undergraduate degree with 50 per cent or more

mathematical content. Therefore, the participants are considered to have sufficiently strong mathematics subject knowledge to teach mathematics at secondary and post-16 levels. Throughout the year, the subject knowledge of all programme participants is also verified through a university-based subject audit.

Despite being university-led, the ITE programme is founded on a university-school partnership, where both partners are equally involved in and responsible for the pre-service teachers' education and progress. Teaching on the course is done by both university- and school-based professionals. University subject and professional studies lecturers run subject-specific sessions on mathematics teaching pedagogy, and more general sessions related to wider educational context and issues, educational research, theories of learning, professional conduct, and many more. The university subject lecturers are also responsible for overseeing the progress of the pre-service teachers over the year. This includes support with and marking of academic assignments (one of which is an empirical research project related to the pre-service teachers' practice in placement schools), conducting lesson observations (usually towards the end of the academic year), liaising with the pre-service teachers on a weekly basis regarding their weekly plans and their execution, engaging with the pre-service teachers' written weekly reflections on practice, holding supervision-like meetings, and liaising with the school-based team. School-based mentors (who are mathematics teaching specialists) are responsible for managing the pre-service teachers' education and training in the context of practicum. They oversee the pre-service teachers' programme in school—allocating classes that the pre-service teachers teach, liaising with colleagues whose classes are taught by the pre-service teachers, observing the pre-service teachers' lessons and providing regular feedback, partaking in regular weekly meetings during which they review weekly progress and support the pre-service teachers' weekly target-planning, and providing general guidance and support as and when necessary. School-based professional tutors (members of the school leadership team who manage subject mentors in school) are responsible for presenting a programme of school-based professional studies to pre-service teachers across all subjects.

A substantial part of the course (over 80% of the 36 weeks) pre-service teachers spend in practicum, which is spread across two different school placements. During the first part of the programme, from September to December, their time is divided between the university and the first school placement (PP1) in the ratio of 3:2 days per week, respectively. In January, the university-based sessions pause and from then on they spend all their time in practice in their second school placement (PP2).

During their time in schools, the pre-service teachers engage in a wide range of activities which relate to all aspects of teachers' professional lives: in the role of form tutor they are fully responsible for an allocated group of students; they participate in all school and departmental meetings; they

communicate with parents, observe classroom practice, plan and teach lessons, and assess students' work. Their teaching load increases gradually over the year, until, by the end of the course, they are teaching at least 60% of a qualified teacher's full contractual timetable.

The overall ITE course is designed to focus on the individuals and their particular journeys. Although there is guidance on minimum expectations for passing the course, each pre-service teacher's individual journey is considered unique and evolving according to their specific needs and progress. Among the fixed elements of the course are, for example, academic assignments, numerous opportunities to observe and enact practice in school, and regular meetings with mentors and subject lecturers. At the very core of the programme is the focus on developing an autonomous, reflective practitioner. Consequently, one of the most important activities throughout the year revolves around reflection on learning and practice (which is expected to take place on a regular basis; both in oral and written form). The reflective element of the course involves receiving, reflecting on and responding to experienced teachers' feedback on taught lessons, weekly discussions with the school mentor, writing weekly reflections, and regular communication with the university mentor.

7.3. Research design: part 1—pilot study

7.3.1. Case selection

The case selection in the pilot study was based on an *intensity sample* approach (Cohen et al., 2011), where the data associated with the case allowed the phenomenon of interest to be explored. At the end of the 2017/2018 academic year, all pre-service teachers in the cohort of the ITE programme were approached and asked for permission to use their written weekly reflections (which were held centrally on the university's virtual learning platform) for research purposes. Five of these pre-service teachers agreed to participate. After reading all their reflections, the case of Alison (pseudonym) was selected. This selection was based on the fact that Alison's diary gave a particularly detailed account of her experiences, which provided unique insights into her thinking about her progress and development throughout the programme, and into how she developed her confidence in her capabilities as a teacher.

Prior to enrolling in the ITE programme, Alison attended a state school in England, where she performed well in public examinations, and then went on to study mathematics at university where she gained a master's degree in the subject. Alison was considered to have excellent subject knowledge in preparation for a teaching career. Her interest in becoming a teacher had been

prompted both by a teacher at her school and her university tutor. Alison came across as confident, enthusiastic and thoughtful. Her general characteristics are presented in table 2.

Table 2: Alison’s profile

Pseudonym	ALISON
First language	English
Educated in the UK?	Yes
Highest academic qualification	Master’s degree in Mathematics
Previous working experience	None
Personal characteristics	Confident, enthusiastic and thoughtful. Has strong subject content knowledge.

7.3.2. Data collection

The data source for the pilot study was the written weekly reflections which form a compulsory part of the ITE programme and which are completed on the university’s online learning platform. These reflections set foundations for a dialogue between the pre-service teachers and their university mentors. The university subject lecturers read the reflections and then respond to the queries and worries or elaborate on the reflections in a more general way. To enable a meaningful dialogue throughout the programme, pre-service teachers are encouraged to be as explicit and open in their reflections as possible, but they are not directed on the type of content in the reflections. Inevitably, reflections are executed differently, depending on the individual. In the case of Alison, the written reflections data consisted of 25 weekly reflections, amounting to 46 pages of single-spaced plain text and just over 23100 words. An example of Alison’s weekly reflection is attached in Appendix I.

It is important to point out that, although rich in accounts, this type of data source is not free from limitations. First, reflections can be scarce at certain times of the ITE year, particularly when pre-service teachers come under pressure to plan and teach an increasing number of lessons or to engage with demanding academic assignments. Inevitably, there is a balance to be struck between in- and out-of-school responsibilities. This poses the threat that there will be insufficient data, particularly in a retrospective study. One of the reasons behind the choice of Alison as the case was that her weekly reflections were not affected by this issue.

Second, even though reflecting teachers may provide very explicit references to their developing confidence and teacher self-efficacy in various aspects of teaching, we know that inexperienced teachers’ understanding of particular teaching tasks or their execution is often limited (Schunk & DiBenedetto, 2016). This can often lead to ‘authentic’ teacher self-efficacy appraisals (Wheatley, 2005), which do not reflect the circumstance visible only to the more experienced eye. Critics might say that such ‘authentic

appraisals' poses a validity threat to a retrospective study, in which the researcher has no opportunity to query the pre-service teachers' understanding of the context and the tasks they attend to. In this pilot study, I dismissed such criticism by holding a strong position regarding the fact that teacher self-efficacy appraisal, as a highly individualistic process, is inevitably always affected by individual factors.

7.3.3. Data analysis

The process of analysis involved preliminary coding of the data to identify Alison's reflections relating to her teacher self-efficacy. First, examples were sought where Alison reflected on her confidence, her enactive, vicarious, and affective experiences, and her thinking in response to the professional learning process on the school-based part of the course. From these, there was an attempt to identify each of the three domains of self-efficacy (EfCM, EfSE, EfIS) and the sources of their development (ME, VE, VP or PAS). The coding was undertaken independently by two researchers and verified upon completion.

At heart of the analytical approach was maintaining a narrative or biographical coherence that reflected Alison's overall experience throughout the year and avoiding a fragmented treatment of themes. This meant that in the process of the analysis the coded data were always considered in the context of the entirety of expressions, as opposed to being extracted and isolated. This allowed a sense of Alison's learning trajectory to develop. Since the study was conducted retrospectively, to ensure the accuracy of the analysis, Alison verified the findings before the results were published, which confirmed that the analysis truly reflected her experience as a pre-service teacher.

7.4. Research design: part 2—main study

7.4.1. Cases' selection

A multiple case study design requires specific consideration of sampling which does not follow the common sampling approach used in other studies (Yin, 2018). In its aim to remain robust, a multiple case study employs a so-called *replication design* rather than focusing on validity, reliability and replicability usually associated with quantitative research. Such a design, acknowledging the fact that every case is unique and particular, focuses on documenting the fine details and variables of each case, identifying them in a specific way. As such, should the possibility of selecting another case with the same variables arise, there would be an expectation that results would be

theoretically replicable between the two cases (Yin, 2018, p. 55). In other words, no part of the analysis and conclusions should leave any detail to interpretation but rather be supported by carefully detailed explanations and documentation of the particular cases. In short, at the forefront of the case selection process stands a consideration of “what can be learnt from the particular case” (Cohen et al., 2011, p. 129) and what similarities and differences can be observed between distinct cases.

Table 3: The participants’ profiles

Pseudonym	JACOB (Born in France to an English family)
First language	Bilingual (French and English)
Educated in the UK?	No (Educated in France up to and including secondary education)
Highest academic qualification	Master’s degree in General Engineering (UK-based)
Previous working experience	None
Personal characteristics	Confident and pro-active. Has very high expectations of himself. Doubts he has the pedagogical knowledge required to teach in the UK.
Pseudonym	NATHAN
First language	English
Educated in the UK?	Yes
Highest academic qualification	Master’s degree in Physics
Previous working experience	None
Personal characteristics	Confident, outgoing, positive and enthusiastic. Has strong confidence in his subject knowledge and in his ability to teach.
Pseudonym	KATIE
First language	English
Educated in the UK?	Yes
Highest academic qualification	Master’s degree in Astrophysics
Previous working experience	None
Personal characteristics	Quiet, shy, softly spoken and dislikes confrontations. Has a tendency to worry and to expect pessimistic outcomes. Has strong subject content knowledge. Feels unsure about her teacher persona due to looking young.
Pseudonym	LAURA
First language	English
Educated in the UK?	Yes
Highest academic qualification	Bachelor’s degree in Mathematics
Previous working experience	Financial industry (8 years)
Personal characteristics	Confident, ambitious, independent and pro-active. Has the drive to persevere despite difficulties. Doubts her subject content knowledge due to the break between her own education and the present.

Following this approach, two types of case have to be considered. First, the focus should be placed on cases which are expected to predict similar results (aiming for literal replicability). This refers to cases with the same/similar variables. Second, selection should be widened to cases which would “predict contrary results but for anticipatable reasons ([supporting] a theoretical replication)” (Yin, 2018, p. 55).

All the above was taken into consideration in the process of case selection. All pre-service teachers who enrolled in the ITE programme in September 2018 were invited to participate in the study. Of these, 12 volunteered, all of whom took part in an initial interview which focused on their current experience in the field of mathematics learning and teaching, their thoughts about the role of a mathematics teacher, as well as their thoughts, worries and anticipations in relation to the upcoming ITE year and their future role as mathematics teachers. The interview data and information about each volunteer (from their university applications) were used to select four unique cases from the volunteer pool. All four participants were under the age of 30. Their profiles are described in Table 3.

It is important to add that the sampling did not come without limitations, since the sample pool was a specific cohort of pre-service teachers on the ITE programme. As mentioned before, all those accepted onto the programme already held at least an undergraduate bachelor’s degree either in mathematics or with a substantial amount of mathematical content (at least 50%). As part of their application for the programme, they had also undergone an interview process, which judged their suitability for the course. As such, the study participants already had a particular profile, which is not representative of the general national context.

7.4.2. Data collection process

The study employed a longitudinal approach, with multiple data collection points spread out over the academic year (between September 2018 and June 2019). Compared to previous studies, which quantitatively measured the teacher self-efficacy of teachers with diverse lengths of teaching experience, this study did not aim to measure but rather qualitatively explore teacher self-efficacy development, using teachers’ reflections, descriptions, and explanations. Since teacher self-efficacy is context- and domain-specific, such an approach was considered desirable since it allowed sensitive factors such as context or specificity of situations and domains to be incorporated into the process.

A case study design operates with the assumption that multiple variables operate in a particular case at any given moment (Cohen et al., 2011). To capture the complexity of this aspect, a case study approach should employ multiple data collection methods, which can include: interviews, observations,

documents (such as reports, diaries, notes, etc.) and artefacts (such as objects, photos, etc.) (Yin, 2018). Collectively, the multiple sources of evidence can provide convergent data which allow conclusions to be drawn from a chain of evidence (Yin, 2018). With this in mind, the study drew on multiple data collection modes consisting of: participant written weekly reflections, weekly planning documents (referred to as Mentor Meeting Record Sheets—MMRS), lesson observations, a written survey and interviews.

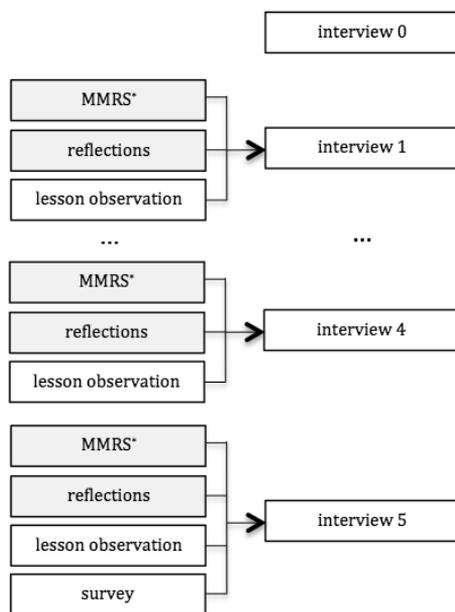


Figure 5: Data collection process at a glance (grey—collected weekly; *— mentor meeting record sheet)

The data collection process took place throughout the academic year with multiple, relatively evenly spread out data collection points (see Figure 5). The process started with an initial interview (interview 0), conducted at the start of the academic year. This was followed by five data collection blocks (each lasting between 4–6 weeks), each of which included engagement with multiple data sources. Participants’ written weekly reflections and MMRS documents were collected regularly throughout each block. Towards the end of each block, a lesson observation was performed (recorded in field notes). Data collected with these three methods were pre-analysed and used to construct one part of the interview conducted at the end of the block. Data collection block 5 resembled the previous four blocks with the exception of including an additional written participant survey. A detailed data collection schedule is presented in Figure 6. A description of each data collection method follows in subsequent sections.

Schedule			
PG wk	Date	Data collection method	Programme planner
1	10-Sep		
2	17-Sep	Initial reflections	
3	24-Sep		PP1 induction week
4	01-Oct	Initial interview 0	
5	08-Oct		
6	15-Oct		
7	22-Oct	Half-term break	
8	29-Oct	Observation 1	4th week of PP1
9	05-Nov	Interview 1	
10	12-Nov		
11	19-Nov		
12	26-Nov		
13	03-Dec	Observation 2	Last week of PP1
14	10-Dec	Interview 2	Faculty Mon-Tues, Thurs-Fri
17 Dec-6 Jan		Christmas break	
15	07-Jan		Start of PP2
16	14-Jan		
17	21-Jan		
18	28-Jan		
19	04-Feb		
20	11-Feb	Observation 3	3rd full week of PP2
21	18-Feb	Half-term break—reading week	
22	25-Feb	Interview 3	Mon only faculty day
23	04-Mar		
24	11-Mar		
25	18-Mar		
26	25-Mar	Observation 4	
27	01-Apr	Observation 4	Faculty Thurs-Fri
8 Apr-21 Apr		Easter Break	
28	22-Apr		
29	29-Apr		
30	06-May		
31	13-May	Issue survey	
32	20-May	Observation 5	
33	27-May	Half-term break—reading week	
34	03-Jun	Observation 5 Collect survey	Last week of PP2
35	10-Jun	Interview 5	Faculty week
36	17-Jun	Interview 5	Last faculty week

Figure 6: Detailed data collection schedule across the academic year 2018/2019

7.4.3. Data collection methods

Written weekly reflections

As in the pilot study, the written weekly reflections provided a rich source of data related to the participants' thoughts on their ITE experience. Written weekly reflections are a compulsory aspect of the ITE programme. In these, the pre-service teachers are asked to reflect on any significant aspects of their journey. The specific content, the amount of detail and the length of the reflections are not prescribed.

In this main part of the study, the written weekly reflections represented a preliminary source of data; analysed continuously throughout the year, they were used in the construction of the follow-up interviews at the end of each data collection block.

Mentor Meeting Record Sheets

Throughout the academic year, the pre-service teachers on the secondary mathematics ITE programme have weekly meetings with their assigned mentors in their placement schools. These meetings focus predominantly on monitoring their progress, discussing and reflecting on activities undertaken in the previous weeks, and planning and setting targets for the following week. These discussions are recorded on the MMRS documents, which are shared with the university lecturer, who contributes to monitoring student progress and the appropriateness of the documents, and who may engage in further discussion about the planned activities. An example of an MMRS can be found in Appendix II.

The MMRS documents were a useful source of data in two ways. First, the initial section of the MMRS document invites reflections on the previously undertaken activities. These reflections help shape the overview of the pre-service teachers' experience. Second, although the predominant focus of the weekly MMRS documents does not relate directly to the development of teacher self-efficacy, it was expected that these documents might provide additional contextual information or provide additional lines of enquiry to be explored during interviews. For example, a particular pre-service teacher's repetitive inclusion of a specific target in several consecutive MMRS documents might be suggesting that they are finding a particular aspect of their teaching challenging to address. Such actions might be related to relatively low teacher self-efficacy, and this can be queried during the subsequent interview.

Lesson observations

The main purpose of the lesson observations was to capture "the dynamic nature of events, to see intentionality, to seek patterns and trends" (Cohen et al., 2011, p. 458) in the pre-service teachers' journeys. Unlike interviews and

written reflections, which give access to participants' accounts of their classroom behaviours and reality, observations give access to more authentic, real-life data in natural settings (Cohen et al., 2011). A common phenomenon observed in education is the divergence between teachers' beliefs and their actual actions (Schoenfeld, 2015). Such a possibility was also considered in this study although it was approached from a different perspective to that commonly advocated in educational research. Following the assumption that, in describing reality, the significance of enacted behaviour takes precedence over proclaimed beliefs, observations are frequently considered to represent a superior source of data and are often used to discredit or dismiss participants' elaborations in the light of any exposed discrepancies. This, however, goes contrary to the tenets of interpretative phenomenology and social psychology, which put emphasis on individual interpretations and meaning-making. Indeed, Bruner (1990), who also acknowledges that what people do does not always align with what they say they do, warns us against favouring observable behaviour over individuals' accounts of what they do and explanations about why they do it. He emphasises that in the same way behaviour cannot be fully understood without an account of one's intentions and circumstances, individual expressions and interpretations cannot provide full clarity for the researcher without the observed behaviour. In this sense, observations allow the researcher to scrutinise the participants' elaborations to gain a better understanding of how their sense-making develops. In addition, any surprising elements emerging during the observations can subsequently be queried in the follow-up interviews. This includes aspects of one's life which might have already become routinised and are no longer mentioned in conversations (Cohen et al., 2011).

This study made use of unstructured direct observations in a natural setting, with the researcher's role being that of complete observer (Cohen et al., 2011). The participants were asked to plan and conduct lessons which they would normally do as part of their regular teaching routine. The main agenda of the observations was to gain insights into how the pre-service teachers progressed through the year, how they behaved in the classroom, how ambitious they were in their teaching and in pushing themselves out of their comfort zones, and into how they responded to unpredictable situations (Cohen et al., 2011).

Data collected during the lesson observations were recorded through field notes and artefacts (photographs of the classroom board, where relevant). These were recorded *in situ* (notes—typed on a laptop, photographs—taken with a phone), in real time. Since the predominant focus of the study was on the pre-service teachers' interpretations and individual constructions of meaning and not their exact actions, and since the lesson observations played a secondary role in the process of the study, field notes were considered to be a more appropriate medium of recording the data than video recording. The notes included accounts of situations taking place in the lesson as well as the researcher's immediate thoughts, reflections and questions relating to these

observations. Immediately after the observation took place, summary reflections on the lesson were also typed into the document. An example of the field notes document format is attached in Appendix III.

Since Cohen et al. (2011) explain that information gleaned during the process of observation is rapidly lost over time, it was decided to take notes *in situ* to ensure that data loss was kept to a minimum. Inevitably, observing a lesson and recording field notes simultaneously is a difficult endeavour which requires experience. In my 10-year experience as a teacher mentor, line manager in a school and a teacher educator on a secondary mathematics ITE programme, I had gained sufficient experience in recording field notes *in situ* (accounting for several dozens of observations per year) to be able to effectively deal with the demands of the task. Over that time, I had developed ways of managing time, equipment and focus in ways which allowed me to maximise the quality and quantity of recorded data. As a result of this experience, it was assumed that I was appropriately prepared for this type of data collection.

Interviews

The first interview of the study (Interview 0) was conducted with all 12 volunteering pre-service teachers before their first school placement. This was a semi-structured interview, whose predominant aim was to gather additional information about the volunteers and to discuss the sum of their experiences in the field of mathematics learning and teaching, their thoughts about the role of mathematics teacher, as well as their thoughts, worries and anticipations in relation to the upcoming ITE year and their future role as mathematics teachers. This semi-structured interview was guided by questions such as: *What, in your opinion, is the role of a mathematics teacher? To what extent do you think teachers have control over how they teach? Do you think teachers can have an impact on the students they teach? Which aspects of teaching do you feel particularly confident about?*

The remaining five interviews in the study were conducted at the end of each data collection block (described earlier). The interpretive paradigm of the study meant that the interviews were aimed at “gaining understanding of the lived experience of [the pre-service teachers] ... and the meaning they make of that experience” (Seidman, 2006, p. 9). In contrast to the unprompted written reflections, the interviews allowed greater scope for discussing teachers’ beliefs and perceptions which might otherwise have remained hidden. They also allowed exploration of multiple focal points (Cohen et al., 2011) and opened up new lines of enquiry. Semi-structured interviews were considered most appropriate for this purpose.

The semi-structured interviews, conducted with an interview guide (Bryman, 2016), had two distinct sections. The first section consisted of questions related to the pre-analysed data collected during the particular block (weekly reflections, MMRS documents and lesson observations). These

questions were aimed at broadening specific elaborations of interest, verifying inferences made in the process of pre-analysis, raising queries, and seeking clarification about surprising or difficult-to-explain events. Here is an example of the interview question from this section: *In your reflection in week 10, you mentioned that you found out that one of the teachers who struck you as very confident was the same age as you and that this helped you realise that you were not as young and naive as you kept thinking you were. Your age is something you have been talking about a lot and as you said, 'impacted how confident you have been in the classroom'. Can you tell me whether and how this observation impacted on your own confidence in teaching?*

The second section of the interviews related to general discussions about teacher self-efficacy, its changes, development, contributing factors, etc. This part of the interview focused broadly around themes such as, for example, teachers' general confidence in their ability to execute specific teaching tasks. Within those broadly defined themes, teachers were asked a variety of open-ended questions which aimed to allow the teachers to elaborate on what *they* thought (Bryman, 2016), detaching as much as possible from school, political or curricular agendas and from any assessment tools and procedures. Examples of the interview questions in this section include: *Which aspects of teaching do you feel particularly confident about? How do you feel about your ability to control the students during lessons? What do you think were the factors contributing to changes in the level of your confidence? Did any of these play a greater role than others?* At times, if there was a need to clarify or expand on participants' responses, supplementary questions were asked (Cohen et al., 2011). The use of leading or suggestive questions was avoided.

The intention of keeping the interview questions broad and open (and not focused solely on the theoretical framework) was twofold. First, it was believed that open-ended questions would broaden the scope of the pre-service teachers' elaborations. Second, it aimed to minimise the interviewers' influence over the answers provided. This was considered important in the abductive enquiry which aimed to create opportunities for theory expansion.

To ensure the participants' comfort, the interviews were conducted according to the pre-service teachers' wishes (either at the pre-service teachers' placement schools, at the university or via Skype). The interviews were conducted individually and lasted between 50 and 90 minutes each. They were conducted in English, which for three pre-service teachers was their first language and, in the case of Jacob (who was bilingual), one of his two mother tongues.

In preparation for data analysis, the recorded interviews were transcribed by the interviewer (me) using InqScribe software. The transcripts included interviewees' full word-for-word responses and were supplemented by aspects of the conversations such as intonations or pauses. These are presented in Table 4.

Table 4: Interview transcripts' elements

Presentation / Symbol	Meaning
(inaudible)	Inaudible, impossible to comprehend phrases used by the participant (either the interviewer or interviewees)
...	Text omission (used mainly in communicating results; publications)
(...)	Pause (the length of pauses was not the predominant focus and, as such, these were not recorded)
“ ”	Paraphrased responses (used mainly in communicating results; publications)
{ notes }	Researcher's comments relating to the context of the interviews (as appearing in the transcripts and used in the process of data analysis). For example: {external interruption, a student entered the room}.
[narrative connectors]	Narrative connectors used in some interviewees' responses to ensure coherence of the conversations (inserted at the stage of data communication)
CAPITAL LETTERS	Phrase intonations made by the interviewees (emphasis put on specific phrases or words; raised voice)

Summary survey

At the end of the study, the participants were asked to complete a short, written survey (see Appendix IV), the main purpose of which was to collect final qualitative data related mainly to the teachers' experiences and their teacher self-efficacy development throughout the year. Participants were given three weeks to complete the survey. Such an approach was considered beneficial for further data collection since, in contrast to the interviews, it gave participants time to reflect on the year before committing to a response. The completed survey, was submitted before the final interview took place. This enabled me to acquaint myself with its content and gave me an additional opportunity to query and discuss the aspects of the survey which would be of particular interest.

7.4.4. Data analysis—abductive Interpretative Phenomenological Analysis (abductive IPA)

As mentioned earlier, the study focused on the process of pre-service teachers' teacher self-efficacy development. As self-efficacy theory and SCT posit, self-efficacy is structured by experiences and reflective thought (Bandura, 1997). In other words, teacher self-efficacy appraisal is based on the processing of information stemming from individuals' vicarious, physiological, affective, enactive and social experiences, at the core of which is the act of sense-making of these experiences (Bandura, 1997). With this in mind, the most appropriate way of engaging with data was through an *Interpretative Phenomenological*

Analysis (IPA), which focuses on examination of how individuals make sense of their significant life experiences (Smith et al., 2009). The IPA approach is idiographic—it focuses on the particular, and hermeneutic—concerned with interpretation. At the core of IPA is attention to an interpretation and sense-making of “how particular experiential phenomena have been understood from the perspective of particular people” (Smith et al., 2009, p. 29). How individuals attend to meaning-making represents a “foundational unit of analysis [as well as] a core methodological process of the inquiry” (Tavory & Timmermans, 2014, p. 21). An IPA study aims to “get inside the person and to [build the] understand[ing] from within” (Cohen et al., 2011, p. 17).

As such, the IPA approach engages with double hermeneutics in which the researcher is making sense of the participant making sense of their experiences related to the particular phenomenon (Smith & Osborn, 2003). Aligning with the ontological and epistemological posits of phenomenology, the IPA approach views the understanding of reality as influenced by the individual and derived from a social co-construction of meaning and consensus (Scott, 2009); or put differently, as transactional. As such, it recognises the researcher (in this case me) as an important participant in the process of meaning-making about and understanding of the world.

The theory-driven analysis of the study—the sense-making of the individuals’ interpretations of their experiences, employed an *abductive* strategy which, based on Charles Peirce’s pragmatism, focuses on emphasising and making use of the interconnectedness between theory and empirical data (Tavory & Timmermans, 2014). It has been previously advocated numerous times that more empirically derived theory-driven studies are needed if we are to succeed in meaningfully advancing the field (Sriraman & Nardi, 2013). In this study I attempted to do just that. The abductive analytical approach moves away from the dichotomy between contexts of discovery and justification and, by attending to them simultaneously, focuses on empirically connected creative meaning-making in the process of theory construction. The abductive approach is particularly significant in studies such as this one—which by “forming an explanatory hypothesis” (Peirce, 1934, p. 171) aims to engage with the creative process of generating or revising theory (Tavory & Timmermans, 2014).

In its process of theory (re)construction, abduction differs significantly from the two more prominent methodological approaches, induction and deduction. In contrast to both induction and deduction, the abductive approach focuses its process not on amplification, confirmation or refutation of pre-existing theoretical ideas but rather on a creative process of theory advancement (or re-construction) (Peirce, 1934), in which the researcher moves between the ‘old’ and the ‘new’ theoretical insights (Timmermans & Tavory, 2012). At the very heart of abduction is the de-favouring of a single theoretical approach and the employment of a multiplicity of theorisations which enrich the theory-building process (Burawoy, 1998). This is not to say,

however, that abduction abandons an a priori theoretical lens. Starting from a specific theoretical premise (in this study, SCT and the theory of self-efficacy), abduction initiates the analytical process which, while employing the pre-prescribed lens, remains open to surprising phenomena difficult to explain within its current theoretical premise (Tavory & Timmermans, 2014). Hence, the very premise of initiating abduction rests on strong theoretical knowledge, which allows for the surprising event to be observed. Abduction then cultivates these “anomalous and surprising empirical findings against a background of multiple existing theories”. Different theoretical positions help to conjecture explanations for an occurrence of the even and suggest novel theoretical direction (Tavory & Timmermans, 2014) and “reframe empirical findings in contrast to existing theories” (Timmermans & Tavory, 2007, p. 174). This conjecturing, by way of searching for justifications where discovery and justification are inextricably connected and treated as one whole, emerges through an iterative and recursive process which leads to advancing the understanding of the phenomenon in question and triggering the emergence of a novel theory (Timmermans & Tavory, 2012, p. 169-180). Hence, the abductive approach neither limits the researcher to one theoretical approach, nor stems purely from empirical data. Following this logic of theoretical enquiry it can be seen how—unlike induction, which seeks to amplify and corroborate patterns of generalisation in the collected data, or deduction, which looks to a reanalysis of existing or newly-collected data in the light of the same theory—abduction focuses on an iterative dialogue between data and multi-theoretical stances in a uniquely creative process of theory development through explanatory accounts of causality between different phenomena (Timmermans & Tavory, 2007).

Theory revision in the abductive approach requires an engagement with rich particulars, which further warrants and emphasises the significance of case study methodology, which lends itself particularly well to illuminating important and interesting aspects of particular phenomena (Yin, 2018). Consequently, drawing on theory from different disciplines, this approach leads to richer accounts of the phenomenon in question (here teacher self-efficacy development), which allows not only the development of theory in relation to the context, but also for the enquiry to remain in dialogue with disciplinary knowledge.

The inseparable processes of discovery and justification in the abductive approach have methodological implications, necessitating a simultaneous and iterative attention to data and their ongoing interpretation and analysis in light of theory (Locke, Golden-Biddle, & Feldman, 2008). This process starts with cycles of data familiarisation and preliminary IPA analysis through the gaze of a specific theoretical position. This involves reading and re-reading of the text, and initial note taking and memo writing which help to articulate and understand the participants’ particular concerns and the reasons behind these. These written comments can have three different characteristics. They can be

descriptive—describing the content of what has been said, linguistic—attending to the use of language and ways in which participants share ideas, and conceptual—providing reflective and interrogatory accounts which relate to the participants’ meaning-making of their specific accounts (Smith et al., 2009).

The note taking stage is then followed by the development of emergent themes and the search for connections between these themes in one holistic structure of the phenomenon, based on the most important aspects of the participants’ accounts (Smith et al., 2009). This search for patterns and connections can make use of strategies such as: abstraction—creating a structure of ordinate and superordinate themes; polarisation—examining the differences and oppositions between themes; contextualisation—examining a contextual narrative of the elements of the analysis; numeration—frequency counting which might indicate the relative significance of the theme; and function—investigating the specific functions particular themes might play in the overall analysis. The final stage involves bringing the overall findings together into one connected whole, which can often be represented graphically (Smith et al., 2009).

During the IPA analysis, initial explanations are brought to the fore, and the surprising elements emerge. In an abductive move, this initiates an iterative cycle of further data collection and interrogation, which provides opportunities for pondering on doubt and for searching further explanations (Locke et al., 2008). The iterative nature of this process takes place in three distinct moves: *defamiliarisation*, *revisiting* the phenomenon, and *variation* (Tavory & Timmermans, 2014). Defamiliarisation forces us to step away from our preconceived understanding of the phenomenon and ask new questions about the aspects of this phenomenon that might have been taken for granted. It is achieved through further coding, meticulous memo writing and note taking. This then leads to the repeated revisiting of the phenomenon in the light of different and new theorisations, which creates opportunities to relive the phenomenon and spot new meanings, patterns and inconsistencies. Finally, variation paves the way towards generalisation of the theory, by denoting, accounting for and meaningfully explaining similarities and differences between elements of one set (here between cases). It is the variation which creates opportunities for noticing surprising aspects of the phenomena in question and gives rise to the abductive move. Naturally, each iteration of data analysis provides opportunities to revisit and verify previously coded information. If doubts or discrepancies arise during the revision, they can be rectified. The analytical process of the study is presented below.

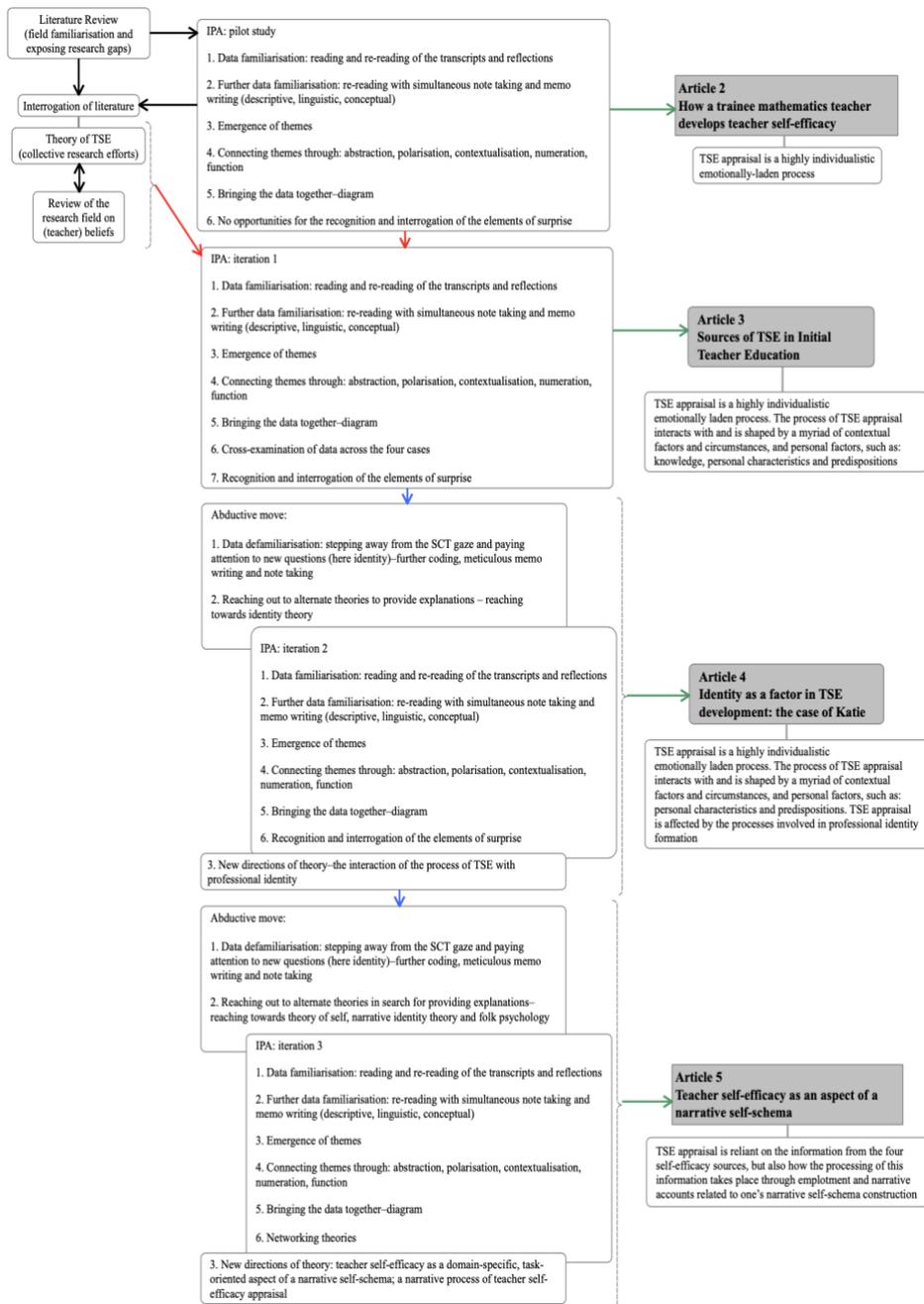


Figure 7: The iterative process of the study's abductive IPA; arrows = study redesign, abductive move, presented results

The overall abductive process of the study, presented in Figure 7, began with a familiarisation with the research field of teacher self-efficacy and its

theoretical underpinnings. The framing of the pilot study was guided by the gaps exposed in the process of the review and based on the facets of self-efficacy theory (Bandura, 1997) and a teacher self-efficacy theory emerging from the collective research efforts. Using IPA, the pilot study attempted to investigate the teacher self-efficacy development of one pre-service secondary mathematics teacher. It brought to light some initial results relating to teacher self-efficacy development and the role of self-efficacy sources in the process. It also provided reassurance about the appropriateness of the phenomenological approach for the whole study and specifically helped guide the design of the main study.

During the pilot study, an ongoing re-interrogation of the theory and literature took place. This re-interrogation focused more specifically on the treatment of the teacher self-efficacy concept in the literature, which not only brought to light discrepancies in the field (relating predominantly to the concepts of control, outcome expectancy and efficacy expectations) but also raised questions about the appropriateness of conceptualising teacher self-efficacy as a belief (discussed earlier). This necessitated a move to the field of beliefs, which initiated the cross-examination of the two concepts. What became clear at this stage was that teacher self-efficacy did not fit the idea of beliefs and that sharpening the definition of teacher self-efficacy was necessary (although it was not yet clear how this was going to be achieved). Learning from the review efforts and the empirical pilot study guided the design of the main study (a longitudinal multiple case study, which continued with the abductive phenomenological analysis).

Main study—abductive IPA, iteration 1

The analytical process of the main study started with data familiarisation where I addressed the reading and re-reading of all data sources. This was accompanied by initial note taking and memo writing, which included descriptions as well as digressions on the meaning of specific expressions (see example in Figure 8). Following this, I began the first phase of data coding. Starting from a specific standpoint of self-efficacy theory, the preliminary coding included recognition of phrases and descriptions related to confidence, emotional responses and professional learning, viewing teacher self-efficacy as the participants' perceived competence in enacting a teacher role through, for example, classroom management or responding to contingent situations in the classroom (Rowland & Zazkis, 2013). It is important to add that, in addition to the three domains afforded by the framework (EfCM, EfSE, EfIS), some aspects of the data appeared to relate to teacher self-efficacy in more general terms (i.e., they were difficult to categorise according to the three domains). For that reason, two additional categories were introduced (General Teacher Efficacy—GTE and Efficacy for Teacher Persona—EfTP). These codes, although difficult to position in relation to the framework, were considered important as they contributed to the appreciation of the overall

picture of the pre-service teachers' self-efficacy development. This coding was followed by a second round of coding, which focused on recognising sources of teacher self-efficacy and factors interacting with its development (examples of both codings can be seen in Table 6).

Initial coding	Initial notes and reflections	Katie's written reflection – week 2
Goals	Katie is excited about the prospect of teaching. Katie wants her teaching to be engaging and meaningful.	Over the last few days, I have become really excited at the prospect of engaging with students about maths whether with exposing them to engaging problems or helping them to understand key concepts. I want to be able to have a positive impact on my students as a future teacher, however the responsibility and large number of unknowns involved scare me.
PAS	Katie experiences negative feelings of anticipation for the upcoming teaching. Katie is acknowledging to herself that there are still many aspects of the teaching that she might not yet be aware of. The 'unknowns' scare her .	The thought of standing up in front of a class at the moment is extremely daunting.
TSE / EFTP?	High level of negative emotions – Katie is extremely worried about standing in front of the class. This might be connecting to teaching and other aspects of the lesson. Interesting that Katie does not say 'teaching' but 'standing in front of the class'?	however much you plan, it would still be a guessing game of how well the lesson would go with the students.
PAS		Getting the level of the lesson right as well as keeping it engaging and trying to maintain a 'flow' etc,
EIS	Worries about planning; No prior experience does not yet allow Katie to judge how what she plans will work in the lesson and how this will be received by the students.	there are so many variables and probably so many I haven't even considered!
EIS	Worries about keeping the flow of the lesson and engaging students. Katie seems overwhelmed by what she has realized so far about teaching – there are so many variables. She is also realizing that there is much more to expect.	(The mock lessons we've been doing in the afternoon with the university lecturer have definitely shown me that!)
EIS (including contingencies)		When I try to break down exactly what scares me of going up in front of a class it would be:
VE of modelled lesson	Katie reflects on a vicarious experience at the university which made her realise all of the above. Important aspect of her initial learning? The ! seems to be emphasising the worry?	<ul style="list-style-type: none"> losing the thread of what I'm saying/getting flustered and not making much sense to anyone
PAS	High negative emotions	
EIS	Katie connects the worries to her own character trait – lack of patience and ability to accept failure?	

Figure 8: Examples of memo writing and initial coding in the case of Katie

Table 6: Examples of coding related to teacher self-efficacy, self-efficacy sources, and factors in the case of Katie

Teacher self-efficacy	
Code example	Expression
Teacher self-efficacy (related to classroom management)	<i>I do not know how I will be able to manage the students</i>
Teacher self-efficacy (related to instruction)	<i>I can teach well and explain things well</i>
Teacher self-efficacy (related to student engagement and motivation)	<i>I think, engaging and motivating students is hard because when there's some student who just really doesn't want to learn 'cause they don't like maths, they put the wall up. And I didn't come across too many of those this year so that, you know, I'm not sure how confident I would be with [motivating] someone who already really thought they didn't like maths and didn't want anyone to be breaking that barrier down.</i>
General Teacher Efficacy	<i>I do feel like my confidence in my teaching is improving, though in a very non-linear way</i>
Efficacy for Teacher Persona	<i>I didn't REALLY feel up to the same level of confidence of standing in front of the class as before Christmas. Now I know that I CAN stand in front of students. I can stand in front of children and I can hopefully teach them something.</i>
Sources	
Vicarious experiences (VE)	<i>It's interesting, kind of, seeing classes misbehave with experienced teachers...</i>
Mastery experiences (ME)	<i>When it came to doing it though, as soon as I had started addressing the class there wasn't any space left in my head to be nervous! The class were well behaved, and definitely engaged with the task.</i>
Social verbal persuasion (VP)	<i>I felt pretty good after my first full lesson on Wednesday, the students were well behaved and were on task and my mentor was really positive at the end</i>
Physiological and affective states (PAS)	<i>I also realise that I could have just stopped them halfway through and just reiterated those instructions. But I was, kind of, too scared to do that at that point.</i>
Factors	
Personal characteristics	<i>I'm not, kind of, the loudest person</i>
Time	<i>It's just the time. I can make, I can make some really straightforward lessons really quickly but there just wouldn't be much to them. And they will be really boring and not that good.</i>

Table 7: Examples of data coding related to identity, as presented in Article 4 (the case of Katie)

Identity	
Code example	Expression
Identification (cognitive appraisal)	<i>I look too young. I'm not like... yeah, not like a normal teacher.</i>
Identification (reflected appraisal)	<i>I'm worried they'll not see me or respect me as a teacher</i>
Social verification (verbal)	<i>Unfortunately, one student asked whether I was in sixth form...</i>
Social verification (through social interaction)	<i>I think the main thing was, just, kind of, interacting with the pupils more. (...) When they're talking to you and they see you as a person ... and accept you as a teacher, as well, which is quite nice.</i>
Role enactment	<i>And in a way I guess making the plans my own makes it look like I'm more of a competent teacher</i>

During this iteration it became clear that specific significant aspects of the pre-service teachers' development were impossible to code using the self-efficacy framework being employed; speaking more specifically, emotions and affect, as well as aspects of identity were beginning to emerge as significant in this development. This pushed the analysis in two distinct directions. First, I once again attended to the aspects afforded by the employed framework and looked for connections between them. This unfolded in the process of block-by-block mind-mapping of the coded data. Second, I initiated a shift towards a new theoretical perspective—identity theory, necessary for developing a new analytical framework for the aspect of the data related to identity (the examples of which are presented in Table 7).

The work at this stage also included reviewing current literature that discussed the role of teacher identity in teacher self-efficacy development. This review indicated that, although teacher identity and teacher self-efficacy were considered to be interconnected in one process of becoming a teacher, this relationship was discussed predominantly from the perspective of teacher self-efficacy that represented an aspect of teacher identity formation. This led to the initiation of the second abductive IPA iteration of the analysis.

Main study—abductive IPA, iteration 2

This second stage of the analysis began with re-analysing all data with the extended theoretical gaze. As in the previous cycle, data were coded and themed utilising identity theory. This was followed by identifying connections between various aspects of the data and block-by-block mind mapping of the findings (an example of a mind map can be seen in Figure 9).

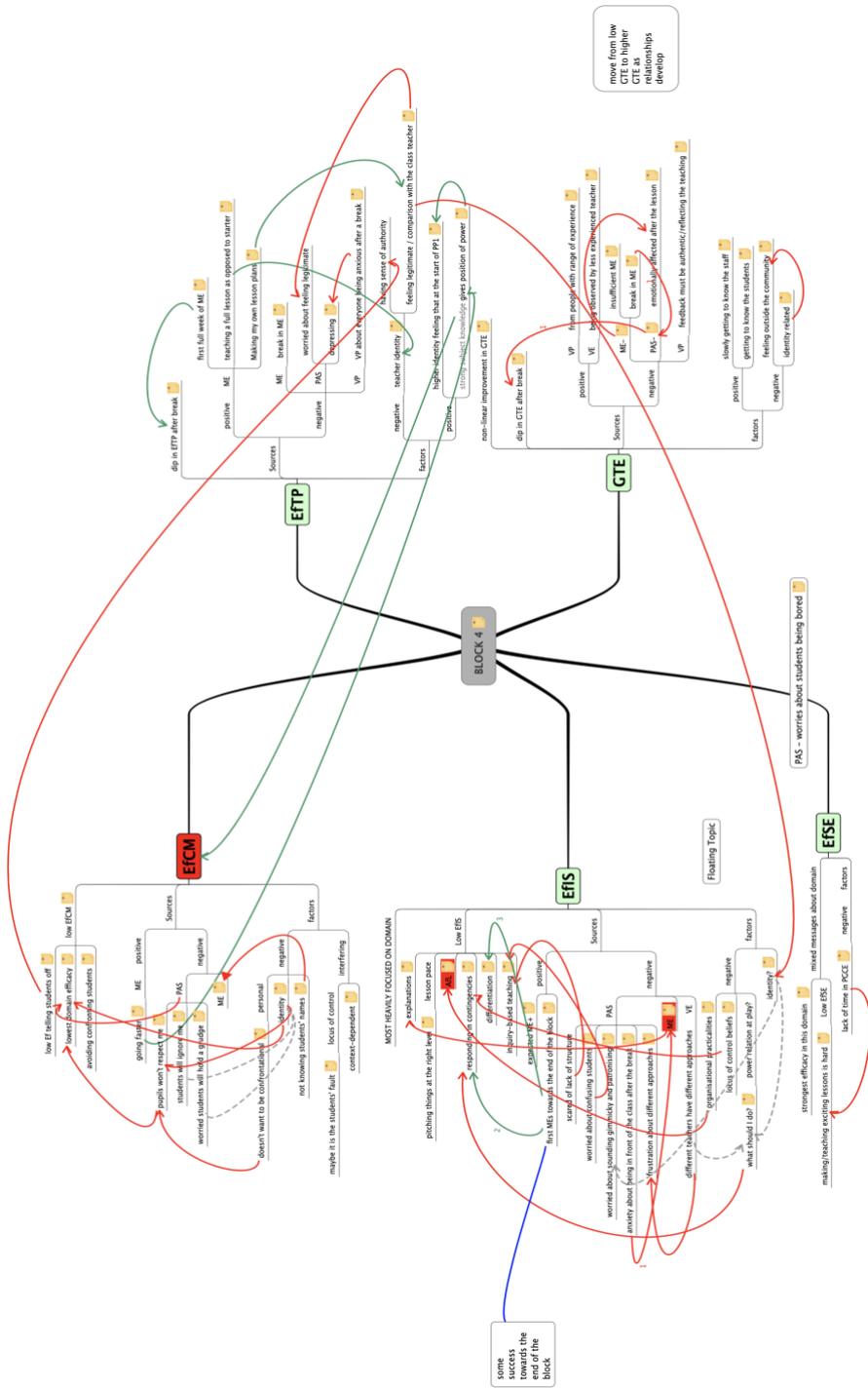


Figure 9: Example of a data connections mind map in block 4 in the case of Katie

Having located the connections between various aspects of the data, an in-depth analysis of the role of teacher identity in teacher self-efficacy development began. This necessitated a shift away from multiple cases towards a single case—that of Katie, selected through an “intensity sample” approach (Cohen et al., 2011, p. 156) since it proved particularly pertinent for exploring the phenomenon in question.

Excerpt	Codes	Comments
<p><i>KATIE: I do not know how I will be able to manage the students. ... students not respecting me as a teacher because I look very young ... scares me.</i></p> <p><i>INTERVIEWER: Why would they not respect you?</i></p> <p><i>KATIE: I look too young. I'm not like... yeah, not like normal teachers.</i></p>	<p>EfCM</p> <p>Identity (Identification through cognitive/reflected appraisal)</p> <p>PAS</p> <p>Identity (Identification through cognitive/reflected appraisal)</p>	<p>In this exchange we observe how Katie’s reflected and cognitive appraisals, seeing herself and expecting students to see her as looking “very young”, and “not like normal teachers”, give rise to strong negative emotions (PAS), which negatively affect her view of her own competence to manage students. (Indicated by the explicit phrase <i>because</i> and by the direct response to the question <i>Why?</i>).</p>

Figure 10: An example of an excerpt illustrating the influence of identity on Katie’s teacher self-efficacy appraisal (Article 4)

When re-interrogating Katie’s data, the focus was placed on instances where references to identity were prominent (located with the framework shown in Table 7). These instances were then analysed further, with the analysis focusing on the role that Katie’s identity played in her evolving view of herself as a competent professional (her developing teacher self-efficacy). These were first located in Katie’s written and verbal expressions, in which she explicitly referred to both her identity and teacher self-efficacy and categorised temporally (first focusing on her initially prevalent student identity and, at a later stage, transitioning towards her emerging teacher identity). An example of this role is illustrated in Figure 10. The connections between various aspects of data, now also including identity, were then explored further. An example of these is presented in Figure 11. The overall analysis and results are presented in Article 4.

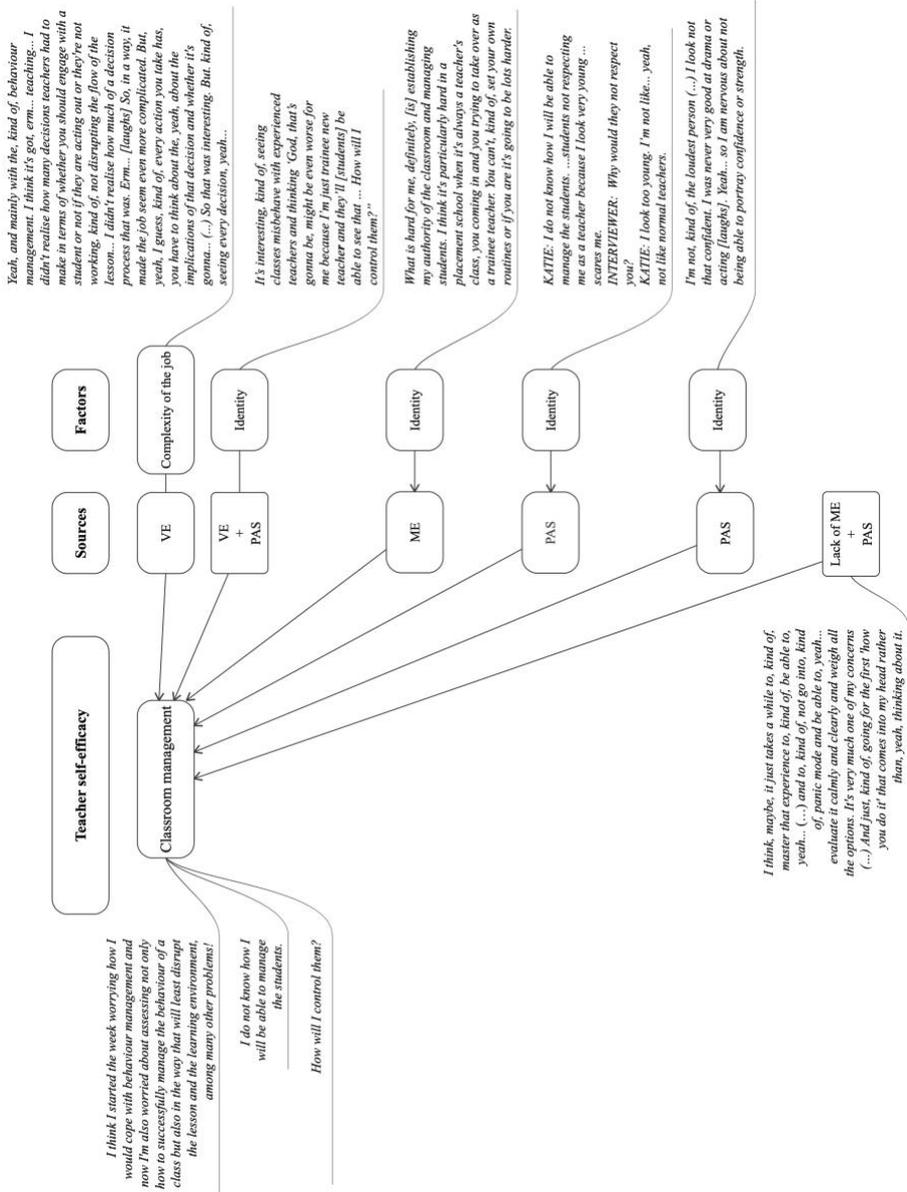


Figure 11: An example of connections between several aspects of data (including identity) in Katie’s teacher self-efficacy appraisal (Article 4)

The wider readings of teacher identity and teacher self-efficacy, and the analytical pursuit of narrative coherence in Katie’s teacher self-efficacy development (and the contributing role of identity in the process) initiated a

second abductive shift. During the analysis, it became more apparent that the theoretical lens of teacher self-efficacy was insufficient for explaining the process of its appraisal. While many facets of the empirical data aligned with the posits of theory (e.g., appraisal based on information from four self-efficacy sources—interaction of the appraisal with different factors such as time or school culture, processing involving considerations of success attribution, effort expenditure, and weighing up importance of experiences, etc.), there were also aspects of data which remained unexplained by affordances of the theory. The data indicated that teacher self-efficacy was a particularly individual process, which was highly affective, and which interacted with the way the individual pre-service teachers identified and talked about themselves throughout the year. Succinctly put, data indicated that the three aspects of self-development: narrative accounts, teacher self-efficacy, and identity were inseparably entwined and overlapping in one process of becoming. As in the first abductive move, this gap necessitated a shift towards theories which would help interrogate and develop an understanding of the phenomenon. These theories included: social psychology and the theory of narrative self (e.g., Bruner, 1990; Markus, 1977; Märtsin, 2019) related also to narrative identity (Sfard and colleagues, various sources), and Archer's (2000) sociological perspective on human agency and functioning. In the third iterative stage of the abductive IPA, further analysis of data was undertaken using the affordances of the new theoretical perspectives. To avoid the funnelling of the findings of the study (by limiting them to the case of Katie) a different case (Jacob) was selected for this part of the analysis. The next section illustrates the analysis process in this stage.

Main study—abductive IPA, iteration 3 and theory networking

The final stage of the analysis was based on interpreting Jacob's interpretations of his experiences as he developed throughout the academic year, and as he continued to construct a narrative account of himself as a pre-service secondary mathematics teacher. This analysis drew on the reflective stages of IPA (Smith et al., 2009), where the "bandwidth of reflection" (ibid., p. 189) begins with *pre-reflective reflexivity*, as an immediate reflection or simply an awareness of consciousness. The next stage is signified by a *glancing at pre-reflective experience* as intuitive undirected reflection. *Attentive reflection* takes place when the experience is considered to be an "experience of importance" (Smith et al., 2009, p. 189). The final most reflective stage, *deliberate controlled reflection*, involves a more formal analysis, or phenomenological reflection on spontaneous immediate reflections. At this stage of the analysis, I considered Jacob's attentive reflection and deliberate controlled reflection on his first experiences in the classroom. These experiences were poignant, significant and important, since they represented a first major step towards taking on professional responsibility. It was therefore imperative to make sense of these and construct

meaning, which also vividly involved the adaptation of Jacob's teacher self-efficacy self-schema as he assimilated the experience and imagined a future competent self. Moreover, as well as identifying Jacob's interpretations of his experience, narrative aspects of Jacob's meaning and how he constructed meaning biographically were also identified.

Since the analysis at this stage used several different theoretical perspectives, the abductive process involved a simultaneous attention to communication not only between the empirical data and theory, but also between the different theoretical perspectives. This communication was enabled through the process of theory networking.

Theory networking can be defined as a process of connecting theories, which respects the plurality and modularity of different theoretical approaches and which examines and cross-references different theoretical perspectives with each other, without changing their core assumptions or creating discrepancies or contradictions in the paradigmatic foundations (Kidron & Bikner-Ahsbabs, 2015; Prediger, Bikner-Ahsbabs, & Arzarello, 2008). Such process can lead to deepening our understanding of the phenomenon of interest (Prediger et al., 2008) and to theory expansion (Radford, 2017). Prediger and colleagues (e.g., Arzarello, Bosch, Lenfant, & Prediger, 2007; Kidron & Bikner-Ahsbabs, 2015; Prediger et al., 2008) describe multiple strategies for networking theories, which they locate on a virtual continuum between two extreme poles (ignoring other theories on one end of the continuum, and unifying theories globally on the other; see Figure 12), by positioning them according to the increasing degree of integration.

Prediger et al. (2008) explain that in any attempt to integrate theories, the process of networking starts with developing an understanding of the theories in question. This relates to their paradigmatic, ontological and epistemological assumptions and their articulations in research practice. Following this are contrasting and comparing strategies, which focus on exploring the similarities and differences between these theoretical posits. While similarities provide points for linking, strong differences emphasise the strengths of individual theories. Following this are combining and coordinating, which relate to structuring a conceptual framework or an analytical tool which can lead to a greater understanding of an empirical phenomenon. Importantly, while any theories (regardless of their paradigmatic posits) can always be compared or contrasted, coordination and combination of theoretical elements depend on the degree of theory compatibility. When theories are considered incompatible, we talk about combining. In such a strategy, theories are combined to provide a multifaceted understanding of the phenomenon under investigation. In mathematics education, such an approach has been referred to as patchworking (Sfard, 1998), the pluralistic two-lens perspective (Borko, 2004), or interconnectedness of theoretical approach (Clarke & Hollingsworth, 2002).

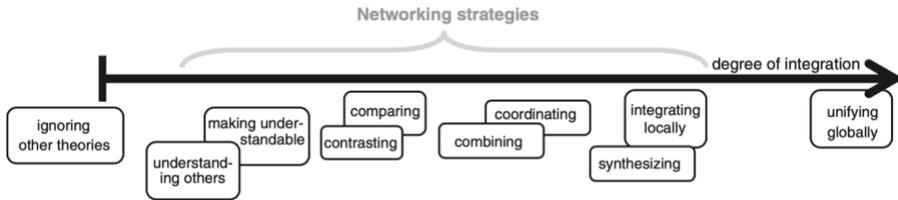


Figure 12: A landscape of networking strategies for connecting theoretical approaches as presented in (presented in Prediger et al., 2008).

In contrast, coordinating can only be executed with compatible theories; that is, when the elements of the theories fit together well within one conceptual framework. Coordination of such compatible theories “goes beyond the better understanding of a social empirical phenomenon and helps to develop a new piece of synthesized or integrated theory” (Prediger et al., 2008, p. 173). This process, however, should not be seen as a global unification of theories. Due to an inevitable asymmetry of the theories involved and the fact that only some concepts or aspect of the theories are taken into consideration, it is an approach which leads to a kind of evolution of the dominant theory through the integration.

In this study, the networking addressed interrogating the posits of the dominant theory of self-efficacy with those of social psychology and the theory of narrative self (e.g., Bruner, 1990; Markus, 1977; Märtsin, 2019) and Archer’s (2000). theoretical sociological perspective of human agency. The first steps of theory networking addressed comparing and contrasting, which were undertaken to ensure the compatibility of the theoretical perspectives in question (Prediger et al., 2008); this theory compatibility was discussed earlier in section 5.2.

The theory compatibility allowed the coordination and integration of the three perspectives into one coherent theoretical framework to be considered and, consequently, an expansion of the existing theory of teacher self-efficacy. The process of theory coordination was initiated by the need to address the specific struggles of teacher self-efficacy theory to explain the process of its appraisal, which revolved around meaning-making about individual experiences. The posits of Archer’s sociology of human functioning and social psychology both see narrative thought as a vehicle for organising experiences (Archer, 2000; Bruner, 1990; Märtsin, 2019). In such narrative process individuals “lace together” (Märtsin, 2019, p. 677) the past, present and future in one continuous process of becoming (May, 1983), directing them towards a satisfactory conclusion (Polkinghorne, 1991). When using a narrative structure, individuals shape an ongoing identity by attending to their present experiences as well as their past and future aspiring selves (Archer, 2000; Bruner, 1990; Märtsin, 2019).

This shaping, which addresses the totality of oneself as a person, was evident in the performative component of teacher self-efficacy appraisal. Although both the theoretical posits and empirical data indicated that this process involved weighing the importance of significant experiences, assessing the degree of success of one's actions in the light of a particular task difficulty, success attribution and effort expenditure (Bandura, 1997), the theoretical foundations did not explicitly explain how this processing took place. What was evident from the empirical data, however, was that the process of teacher self-efficacy appraisal did not only revolve around individual experiences but was also intertwined with the way the individual teachers viewed and talked about themselves. In other words, the process appeared inextricably connected to teacher identity, which exhibited narrative characteristics.

This led to an expansion of theory about the process of teacher self-efficacy appraisal. This involved: the reconceptualisation of teacher self-efficacy as a domain-specific, task-oriented aspect of narrative self-schema; and the construction of a model of the narrative process of its appraisal (see Figure 15 in section 9.3).

7.5. Ethical considerations

The project adhered strictly to the guidelines of the Swedish Research Council (Swedish Research Council, 2017) and the British Educational Research Association guidance on ethics (British Educational Research Association, 2018). These relate to the participants' wellbeing and protection, as well as ethical management of data collection and analysis (Tracy, 2010). The entire research process and ethical considerations were carefully explained to each of the participants separately and recorded and signed on a Participant Consent Form (attached in Appendix V). Each participant was guaranteed the right to withdraw from the project at any time, without having to justify themselves (Cohen et al., 2011).

Each participant gave written consent for all specific undertakings of the study. This included access to written weekly reflections, interviews and lesson observations, and the recording and storage of all data in a secure place for five years (the period required by the Ethics Board of Stockholm University). With the exception of the individual interviews and increased frequency of lesson observations, the overall demands that the data collection placed on pre-service teachers did not exceed their regular course-load demands. Discussions with mentors or writing and reading of weekly reflections were already part of the ITE programme, which was a highly reflective course by design. In light of this, the study participants were not required to go out of their personal comfort zones in any way that differed from their peers. In other words, what the participants shared in the process of

the study was what they would normally share with the teaching team throughout the academic year.

The interviews were conducted in each participant's place/mode of choice. These included their schools, the university faculty buildings and Skype. To avoid recording the data by hand, to enable the flow of conversation and to ensure accuracy of recall, the interviews were voice recorded (Cohen et al., 2011) and then transcribed verbatim, in "terms used by [the teachers] themselves" (Strauss, 1987, p. 33). Written copies of the transcripts were shared with the interviewees for verification and acceptance. Participants were also given an opportunity to request deletion or correction of any interview content. None of the participants chose to exercise this option.

Confidentiality and anonymity, to ensure that no participant could be directly identified (Cohen et al., 2011), were guaranteed in the following way. Recorded data were transcribed using pseudonyms allocated by the transcriber. At the same time, possible identifiers (such as the names of the schools) were also anonymised. The recorded data, transcripts and coding key have since been stored separately. All data analysis and publications made use of pseudonyms throughout. The participating teachers were reassured that the raw and transcribed data would be viewed and used only by the researcher and that no information would be shared with the participants' colleagues, schools, line managers or head-teachers.

An important ethical consideration relating to study's possible limitation, was my professional role. In addition to being the principal researcher in the study, I was also the university mentor on the ITE programme in which the pre-service teachers participated. This meant that, throughout the year, I was involved in teaching some aspects of the course to them, and personally mentoring and marking assignments of one of them. This could have created a situation where the pre-service teachers considered me to be in a position of power, which then might have affected the ways in which they wanted to portray themselves. That is, they could have hidden difficulties or worries from me, thinking this would give them a better chance of passing the course, which would have obscured key aspects of the data. However, such a possibility was not considered to be a threat, due to the particular design of the ITE programme, which focuses on helping pre-service teachers develop their critical skills with the support of mentors. During this programme, the summative assessment of the pre-service teachers' performance (i.e., passing/failing of the course) is not in the hands of the mentors or subject lecturers but rather the faculty board. Even the academic assignment marking on the course which I assessed was purely formative with no summative elements. As a result, it was expected that participants' discussion of worries or plans for improvement would have no effect on their passing of the course. I discussed this with the participants at the outset. It was evident throughout the study that they felt comfortable and remained open about sharing their experiences with me.

No monetary compensation for participation was provided to any of the pre-service teachers. To show my gratitude and appreciation for their participation, each received small chocolate tokens at the end of the study.

8. Findings

The findings summarised in this section relate to articles 2–5 which engaged directly with the empirical part of the study. The summary of Article 1, which provided a theoretical elaboration on SCT as a theory for investigating teacher professional learning, was presented earlier in section 2.1.

8.1. Summary of Article 2: How a trainee mathematics teacher develops teacher self-efficacy

Article 2 focused on how, during the one-year ITE programme, a pre-service secondary mathematics teacher—Alison—developed her teacher self-efficacy and how the four different sources of self-efficacy contributed to this development. When investigating this development, we focused specifically on each of the three domains of Alison’s teacher self-efficacy formulated by Tschannen-Moran and Woolfolk Hoy (2001; EfCM, EfSE and EfIS), aiming to contribute to an understanding of pre-service mathematics teachers’ learning trajectories discussed previously by Meister and Melnick (2003), Tschannen-Moran and Woolfolk Hoy (2007) and Schoenfeld (2011).

We reported on our longitudinal explanatory case study approach (Yin, 2018), which drew on empirical data from Alison’s weekly written reflections, collected throughout the programme. The case selection in the study was based on an intensity sample approach (Cohen et al., 2011) in which a specific case provides easy access to the phenomena one is interested in. Although we could have investigated teacher self-efficacy development in many other pre-service teachers on Alison’s course, in comparison to the rest of the group her written reflections gave particularly detailed accounts of her experiences, providing unique insights into her thinking about her progress and development through the programme. Importantly, however, although we did not consider Alison’s case to be representative of all pre-service teachers, our observations of those teachers during their ITE year revealed that Alison’s experiences were not uncommon to the rest of the group. Since the study was executed retrospectively (i.e., at the end of the ITE year) and provided no opportunities for probing beyond what Alison had already reflected upon in written form, it was important for us that the reflections we selected were as substantial as possible, in both size and content.

The main findings of this article shed some light on research question 1 by focusing on the trajectory of Alison’s teacher self-efficacy development. What we showed in Alison’s case was that her learning trajectory developed sequentially, beginning with EfCM from the first week of the first school placement, following with EfSE during the early stages of that placement, and leaving her EfIS relatively undeveloped even towards the end of the ITE programme (Figure 13). This meant that Alison started her ITE year full of anticipation and worries about her ability to control classroom behaviour; worries so great that they made her wonder whether she would “get kicked off the course”. The initial obsession with surviving in the classroom left no room for her to focus on developing other aspects of her teaching, such as student engagement or instructional strategies, which she managed to turn to only once having experienced some reassurance about her ability to manage students’ behaviour and classroom routines. Throughout the year we also continued to observe this EfCM taking particular precedence in moments of change or challenge (such as changing schools or experiencing periods of tiredness).

Our observation of Alison’s development was consistent with Schoenfeld’s (2011) teacher development trajectory through three planes (from classroom management to implementing engaging activities and then engaging in diagnostic teaching) and contradicted previous findings reported by Meister and Melnick (2003) and Tschannen-Moran and Woolfolk Hoy (2007) in the field of teacher self-efficacy. We attributed this discrepancy to the differences in our qualitative methodological approach and operationalisation of the concept of teacher self-efficacy from those employed in previous quantitative studies. I shall further elaborate on these teacher learning trajectories in my discussion.

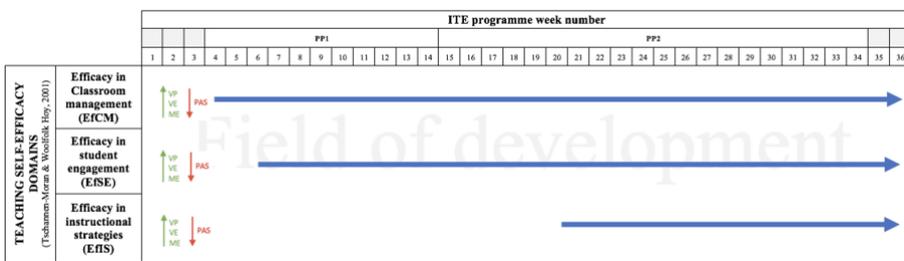


Figure 13: The sequential development of self-efficacy in the three domains in the case of Alison (from Article 2, p. 481).

The explanatory accounts of the study related not only to the aspects of Alison’s journey which contributed to the perturbation of her teacher self-efficacy (such as, mentioned earlier, changing school placements) but also to the role that the four self-efficacy sources played in her overall teacher self-

efficacy development. Similarly to previous studies, we showed that all four self-efficacy sources played a significant role in this development (e.g., Bruce & Ross, 2008), with a shift from the predominant importance of verbal persuasion and vicarious experiences at the start of the year (when Alison's enactive mastery experiences were still sparse; Tschannen-Moran & Woolfolk Hoy, 2007), to the greater significance of mastery experiences that came with Alison's accumulation of teaching experience (Bong & Skaalvik, 2003; Klassen & Durksen, 2014; Usher & Pajares, 2008). In addition to these findings, the study emphasised the importance of physiological and affective states in Alison's journey. Perhaps unsurprisingly, it was evident that Alison's teacher self-efficacy was frequently undermined by anxiety, stress and tiredness (Bandura, 1997a). Interestingly, however, what we also observed was how enactive mastery experiences and verbal persuasion from mentors helped mitigate these high affective states.

Generally, although we were not overly surprised by the majority of our results, the study reinforced our conviction of the need to explore teacher self-efficacy and its development in qualitative ways which enable following a pre-service teacher's journey as opposed to capturing isolated moments in this journey. As the case of Alison illustrates, the fine-grain approach to data collection allowed us to follow the narrative coherence of her development, which led to a greater understanding of her learning trajectory. By employing this approach, we were able to not only observe but also explain moments of fluctuation in Alison's teacher self-efficacy in the three domains. Consequently, we were able to understand why at different moments of the year Alison either thrived or struggled with her confidence in executing various aspects of her teaching.

The main limitation of this first part of the study—the case of Alison—related to the retrospective nature of data analysis, which was based solely on the pre-service teacher's already written weekly reflections. Although verification of the findings was undertaken before the submission of the report draft, we understood that the retrospective approach did not allow us to explore various aspects of teacher self-efficacy in greater depth. Although we were able to develop some understanding of Alison's teacher self-efficacy development trajectory and the role of self-efficacy sources in the process, we were aware of the rather speculative nature of the sense-making analysis (in phenomenological terms); we remained curious about the very process of teacher self-efficacy development, and the nature and the possible interaction of self-efficacy sources in the process.

These reflections led to the subsequent purposeful design of the main part of the study, which employed a longitudinal multiple case study approach with multiple data sources, and enabled opportunities for an ongoing analysis and sharing of findings during the data collection process. I expected that such an approach would allow me to investigate issues as they arose, clarify

participants' expressions, query puzzling aspects and, consequently, develop a more robust understanding of the phenomenon in question.

8.2. Summary of Article 3: Teacher self-efficacy sources during initial teacher education

In Article 3, my focus was explicitly on Bandura's (1997) four sources of teacher self-efficacy. In particular, using the data from all four participants, the article explored the nature and particular examples of the four sources, as well as their role and interaction in the process of teacher self-efficacy development. In summary, the findings of the study confirmed that all four self-efficacy sources played a key role in the teacher self-efficacy development of all four participants, in both direct and indirect ways.

Vicarious experiences (VE) were shown to play a significant, if secondary, role. This finding was particularly important in light of previous findings where qualitative research showed benefits of observational learning in teacher self-efficacy development (Bruce et al., 2010; Cakir & Alici, 2009), but where quantitative studies failed to show the same results (Capa Aydin & Woolfolk Hoy, 2005; Morris, 2010; Poulou, 2007; Rots et al., 2007). My conceptualisation of VE, however, was broader than the mainly referential one employed in most previous studies (Morris, 2010). It recognised the significance of modelling effective coping strategies as a teacher self-efficacy source (Bandura, 1997; Palmer, 2011).

As previously reported, affect and emotions played an important role in the pre-service teachers' journeys (Gabriele & Joram, 2007; Mansfield et al., 2016). Contrary to studies in the teacher self-efficacy field, however, which argued that affect and emotions represent the weakest teacher self-efficacy source (Mohamadi & Asadzadeh, 2012; Morris & Usher, 2011; Poulou, 2007) or even that negative emotions show no correlation with teacher self-efficacy (e.g., van Rooij et al., 2019), the findings of this study emphasised the importance of PAS in the process. The discrepancies between my findings and those previously reported can be ascribed to previous studies' narrow conceptualisation of physiological and affective states, which tended to limit these states predominantly to affect and emotions related to the particular performance in question, such as feeling nervous, tired, stressed or tense during or after teaching, worrying about internship, or getting irritated during teaching (e.g., van Rooij et al., 2019). My study illustrated, however, that the participants' emotions which did not revolve directly around the teaching itself also had a significant impact on their teacher self-efficacy appraisal. These included worries about one's lack of culturally relevant pedagogical content knowledge; worries about looking too young and "not like a real teacher"; emotional difficulties related to problems in personal life; physical

and mental exhaustion following a rapidly increased workload. Such findings were in line with those of Bandura (1997) who himself did not limit PAS merely to classroom episodes and who emphasised that PAS encompass all emotions which affect individuals' "vulnerability to disfunction" (p. 79).

In addition to the above, the study also illustrated that these different emotions, and the participants' personal characteristics, contributed to shaping the individual ways in which the pre-service teachers approached the process of their teacher self-efficacy appraisal. This helped explicate some of the nuances in pre-service teachers' teacher self-efficacy development which require further attention, both in research and in practicum. For example, in the case of Laura I observed how a sudden change in her emotional state due to personal difficulties increased her general vulnerability and affected the level of her independence in her learning. This resulted in a shift in her focus from predominantly on ME in the first part of the year to relying more on social support, reassurance and verbal persuasion from her mentor in the second part of the year. In the case of Katie (whose case is explored further in Article 4) I observed a persistence of strong negative emotions throughout the year related to her inability to see herself as a teacher due to looking too young, being too shy and disliking confrontations. Even though accumulating ME helped Katie overcome anxiety before particular lessons, those accumulating ME bore little significance for helping her alleviate negative emotions related to her identity. For that reason, she ascribed great importance to social support in her learning. This social support did not relate directly to performative aspects of her functioning, however, but related predominantly to providing reassurance and social acceptance of her as a teacher by both teacher and students, helping Katie develop her teacher identity.

Aligning with previous research, the findings also confirmed that ME were the most significant source of teacher self-efficacy (N. U. Bautista & Boone, 2015; Chesnut & Cullen, 2014; Ma & Cavanagh, 2018; Woolfolk Hoy et al., 2009; Yuksel, 2014). That was because, by enabling first-hand experiences of success or failure, they provided the participants with the most tangible and realistic evidence for appraising their teacher self-efficacy (Bandura, 1997). ME were also considered particularly significant due to their indirect role, which was illustrated by the effect that they had on the role, nature or significance of the other three self-efficacy sources. First, ME played a key part in helping to alleviate the participants' negative emotions which often accumulated prior to teaching (that is, either at the start of the academic year or after a break, such as school holiday). Secondly, ME significantly affected the role of VE over time; shifting it from being predominantly exploratory at the start of the year, towards more diagnostic and referential as the year progressed.

Summarising, the article emphasised that previous conceptualisations of the sources in empirical research were limiting and that a broader view of these sources must be considered to aid a better understanding of the process of

teacher self-efficacy development (which was particularly the case for VE and PAS; [Klassen et al., 2011]). In addition to these findings, the article advocates attention to particular characteristics of pre-service teachers that play a significant role in how they approach, undergo and manage their ITE. Moreover, it also emphasised that although ME are frequently considered to be the most significant teacher self-efficacy source, the importance of other sources must not be underestimated (Van Maele & Van Houtte, 2012). This is a particularly important implication for the profession which tends to significantly reduce opportunities for observational learning and social support (such as feedback) for those who move into the field following their ITE year.

The study further advocated the employment of a qualitative methodology in studies relating to teacher self-efficacy development, to provide better access to how teachers make sense of their lives (which are interwoven between personal and professional domains) and help capture the nuances of this development that are inaccessible in other ways.

8.3. Summary of Article 4: The role of teacher identity in teacher self-efficacy development: the case of Katie

Article 4 focused on the role of teacher identity in the process of teacher self-efficacy development, exemplified through the case of Katie. Although in the process of their development, aspects of identity were prominent in all four cases, the case of Katie was selected to illustrate these in detail.

Despite the fact that research advocates a symbiotic relationship between teacher self-efficacy and teacher identity, studies to date focus predominantly on the role of teacher self-efficacy in the process of teacher identity formation (Canrinus et al., 2012; Day & Gu, 2007; Garner & Kaplan, 2019; Hong, 2010; Kelchtermans, 2005; van der Want et al., 2019). Yet, throughout the year, during the ongoing analysis of Katie's teacher self-efficacy appraisal, it was apparent that the way Katie identified and talked about herself had an impact on her teacher self-efficacy development. Specifically, although the study corroborated the idea that teacher self-efficacy is appraised predominantly on the basis of information accessed through four self-efficacy sources (Bandura, 1997), it further explains the influence that identity has on this process.

The conceptualisation of identity in this study aligns with a socio-psychological perspective which describes identity as a dynamic narrative (or storytelling) that one constructs about oneself in the light of who one sees oneself to be and who one aspires to become (Archer, 2000; Bruner, 1990; Sfard & Prusak, 2005). In this sense, we can consider two aspects of identity: "actual identity, consisting of stories about the actual state of affairs, and

designated identity, composed of narratives presenting a state of affairs which ... is expected to be the case” (Sfard & Prusak, 2005, p. 16). As the article illustrated, both the actual and the aspirational aspects of Katie’s identity played a key role in her teacher self-efficacy development.

For most of the academic year, Katie continued to identify herself as a person who looked “too young” and “not like normal teachers”. This aligns with previously reported pre-service teachers’ expressed doubts in their teacher self-efficacy due to being young, short, or not having an authoritative demeanour (Ma & Cavanagh, 2018). For Katie, this gave rise to strong affect (PAS), which was frequently overpowering, and which led Katie to doubt her abilities to execute her actions as a teacher (predominantly in the domains of classroom management and responding to contingent situations). When reflecting on teaching older students (who she found “intimidating” due to their age) Katie often talked about experiencing a “mental block” and about her struggles to overcome fear of confronting the students. This meant that she was shying away from actions she knew were necessary and which would allow her to manage the students’ behaviour effectively. Consequently, Katie continued to express doubts in her ability to manage students’ behaviour.

In addition to this, being a student teacher who took over the teaching of classes that “belong[ed] to other teachers”, meant that Katie felt she had limited autonomy regarding her own actions. As a result, for most of the year, she found herself “adopting other teachers’ styles” in her teaching. Although Katie considered adherence to other teachers’ routines and styles to represent a way which would help her resemble her experienced colleagues and legitimise her as a teacher in the eyes of her students, she also recognised this adherence to be an obstacle to effective action. This adherence meant “losing the thread of what I’m saying/getting flustered and not making much sense to anyone” or affecting her ability to “develop flexibility in a lesson plan on the spot” when such was necessary. Consequently, she felt this prevented her from establishing her own authority with the students and contributed to difficulties with acting in the moment. This struggle to perform effectively in the classroom had a negative effect on Katie’s teacher self-efficacy in managing student behaviour, explaining concepts, or responding to contingent situations in the classroom.

Later in the year, following conversations with and receiving reassurance from her school mentor, Katie actively redirected her efforts towards enacting her teacher role in a more autonomous way. From then on, she focused on planning and executing her own lessons in ways which suited her own style and preference. This enabled a more successful execution of her actions in the classroom and calmed the nerves related to contingent situations. Consequently, this contributed to Katie’s developing view of herself as a legitimate teacher and had a positive effect on Katie’s appraisal of her teacher self-efficacy. These results confirm the postulates of theory which emphasise that individuals boost their own self-image through performing specific roles

well (Stets & Burke, 2000), which helps them “to feel competent and effective” (ibid., 2000, p. 233). This means that successful role enactment contributes not only to the development of one’s future designated identity but also one’s teacher self-efficacy (Brenner et al., 2014; Stets & Burke, 2000).

An important additional aspect of the findings of this study, however, emphasises that this enactive aspect of becoming a teacher must necessarily be accompanied by social support and social validation of the teacher role (which included building relationships with students [An et al., 2021]) to aid teacher self-efficacy development. What was evident in the case of Katie, was that when such social validation was present, Katie’s confidence in her own image as a competent teacher was reaffirmed, whereas when such validation was absent (when changing schools, for example) Katie experienced doubts about herself as a teacher and her actions. These findings emphasise the importance of paying attention to social aspects of teacher identity formation (An et al., 2021) which have an effect on wider aspects of teacher development (Friesen & Besley, 2013)—here on teacher self-efficacy appraisal.

The study concluded that, inevitably, as has been previously stated, affect and emotions play a key role during one’s journey of becoming a teacher (Gabriele & Joram, 2007), and that it is important for teacher educators to not only recognise those but also help pre-service teachers mitigate negative affect and emotions. The findings suggest that this could be achieved by providing student teachers with frequent opportunities for autonomous teacher-role enactment and for building relationships with students, and by providing strong social support and acceptance of pre-service teachers as teacher colleagues.

The case of Katie as well as data from the other three participants led to further conclusions about the concept of teacher self-efficacy and its inextricable connection to identity. What became obvious in the process was that if one was to look at teacher self-efficacy in a conceptually meaningful (as opposed to reductive) way, one would inevitably struggle to separate it from the aspects of individuality and emerging identity. Instead, what was necessary was to look at both concepts as part of one process of becoming (May, 1983) connected to one’s developing view of themselves as a competent teacher. This led to a reinterrogation of theories (in the field of psychology, sociology and philosophy), which provided an additional lens for investigating the concept of teacher self-efficacy and its development, and which culminated in the analysis presented in Article 5, discussed below.

8.4. Summary of Article 5: Teacher self-efficacy as a self-narrative schema and the narrative self

The research presented in Article 5 represents an abductive culmination of the analyses discussed in all earlier articles. As such, it responds directly to the issue of reductive treatment of the concept of teacher self-efficacy and, consequently, the limited understanding of how teacher self-efficacy develops (Labone, 2004; Philippou & Pantziara, 2015). The study engaged with a single case since it was recognised that such an approach provided opportunities for challenging assumptions and preconceptions about the issue in question (Platt, 1988)—teacher self-efficacy and its development. Engaging with rich particulars of one case allowed for an illumination of important aspects of the phenomenon (Yin, 2018) which, consequently, led to contributing to theory in new ways. Using this approach, this study presented teacher self-efficacy as a dynamic model of a competent self and characterised its development in biographical, narrative terms.

A key aspect of self-referential constructs is the human propensity to create narrative accounts of self which allow individuals to deal with emotionally demanding, complex situations. Consequently, past, present and future are all contained within one dynamic cognitive and affective self-schema which we constantly update in relation to present affect and sensemaking of the current self, the narrative past self, and evolving or changing possible future selves. In other words, the narrative structure is “used to interpret and give coherence to past episodes in our own lives and to configure future activities that we expect to lead to desired outcomes” (Polkinghorne, 1991, p. 143). What we argued in this article was that teacher self-efficacy can be considered a task-oriented aspect of an overall narrative self-schema and that the process of its appraisal reflects narrative self-schema construction. Utilising data related to both Jacob’s reflections and theory, we came to understand this process (illustrated in Figure 14) in the following way.

Bandura (1997) emphasised that teacher self-efficacy appraisal is not simply about being successful (or failing) in one’s actions, but more about a reflective process. It is about rationalising the successes or failures through cognition (Morris et al., 2017), coming to understand how one responds and reacts to task-specific situations, and about developing a sense of capability concerning future actions related to that task based on performance. What we saw in the process of Jacob’s teacher self-efficacy appraisal was that, as part of his professional journey, he was developing a model of a competent self by reflecting on his significant past experiences relevant to this development. In that, what we saw was his attempt to create a schematic narrative which attended simultaneously to his present, past and future (Polkinghorne, 1991). In this narrative account he was looking for continuity—things had to make sense to him both rationally as well as emotionally. Primarily, this process related to reflections on his affectively significant enactive mastery

experiences, which are generally recognised as the strongest source of teacher self-efficacy (Bandura, 1997; Bong & Skaalvik, 2003; Tschannen-Moran & Woolfolk Hoy, 2007; Usher & Pajares, 2008). These were further supported by vicarious experiences of observed practice in the classroom and university sessions and workshops, which not only provided him with practical ideas for further teaching but also initiated the process of enculturation into particular practices, contributing to his developing view of himself not as an isolated individual but rather a cultural participant.

This cultural aspect of the narrative played an important part in Jacob's teacher self-efficacy schema construction. The combination of the enactive and vicarious experiences evoked a strong affective response in the present by exposing discrepancies between his current narrative and the kind of self he wished to pursue (a teacher capable of practising a student-centred pedagogy). Making sense of this affective response, Jacob reflected on his past experiences, which had shaped his particular view of mathematics and its teaching, and on his urge to step outside of the boundary and engage in student-centred teaching (which was new to him and which he had recently developed an appreciation for). In other words, his appraisal of his own capabilities as a teacher involved considerations of a more general sense of self (both in the past and in the future). Moreover, this judgement about his teacher self-efficacy related to both the assessment of the present and projections into the future, where Jacob considered possible changes to his teacher self-efficacy in the light of possible increased difficulty of the task in different future circumstances. This initiated further reflections on the recalibration of his aspired-to self and a consideration of actions necessary to achieve this.

All these aspects of teacher self-efficacy appraisal (making meaning of affective present in the light of past experiences, success appraisal, task-difficulty consideration, and recalibration of action in goal pursuit) are consistent with posits of self-efficacy theory which in the context of goal-driven, task-oriented behaviour discusses teacher self-efficacy adaptation and its fundamental role in human functioning (Bandura, 1997), by helping individuals construct strategies and courses of action which transform the complexity of the environment and its affective potential from challenging to benign (Bandura, 1997). Yet, what Jacob's case additionally indicates is that, during the identification of tasks and goals within teaching, such as classroom management or instructional strategies (as described in Tschannen-Moran & Woolfolk Hoy, 2001), and the assessment of his enactive experience, a narrative is constructed which attempts to reconcile those with an overall sense of self. While assessing his capabilities in relation to specific tasks, Jacob was considering wider questions of: *Who am I?*, *What is my role?*, *What kind of person am I/ will I be?* and, *What kind of teacher will I become?* In other words, what we show in our analysis is that teacher self-efficacy appraisal does not take place in absence of wider conceptualisations of self, a

narrative self or narrative self-schema or professional identity (Article 5, p. 24).

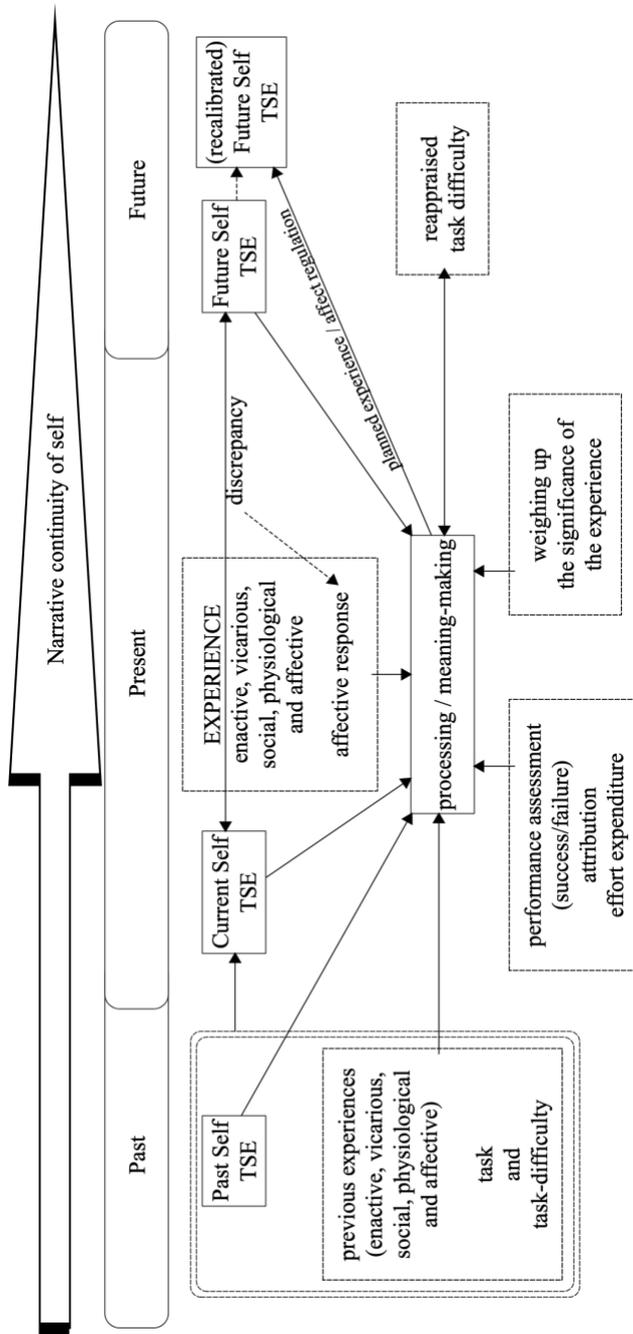


Figure 14: A theorised model of Jacob's narrative process of teacher self-efficacy appraisal (TSE—Teacher Self-Efficacy; as presented in Article 5, p. 25)

Consequently, we suggested that teacher self-efficacy should be seen as a domain-specific, task-oriented aspect of one's dynamic narrative self-schema. In addition, our research showed that narrative self-schema not only partakes in the process of teacher self-efficacy appraisal but also itself undergoes a self-recalibration during this process. This implies a reciprocal relationship between the processes of narrative identities formation and self-efficacy development. We thus argue that teacher self-efficacy has a much closer relationship with narrative identity (Sfard & Prusak, 2005) than has previously been suggested.

9. Discussion

In this study, I investigated teacher self-efficacy development during secondary mathematics initial teacher education. The following sections discuss findings of the study related to the two aims:

Aim 1: To develop an understanding of the process of teacher self-efficacy appraisal.

Aim 2: To reconceptualise teacher self-efficacy.

Due to the difficulty in separating aims 1 and 2, the two are discussed together.

The findings of the study contribute to the field of teacher self-efficacy in several ways—by illustrating new perspectives on teacher self-efficacy as a concept, on its development and on its sources, and by emphasising particularities of these related to the personal journeys of the pre-service secondary mathematics teachers participating in the study. The overall study set out to address the following research questions:

RQ1: What constitutes Bandura’s (1997) four self-efficacy sources and their role in the process of teacher self-efficacy appraisal?

RQ2: What role do personal factors (such as personal characteristics or knowledge) play in the process of teacher self-efficacy appraisal?

RQ3: What is the process through which teacher self-efficacy is appraised?

The discussion of the findings is presented in relation to each of the posed research questions.

9.1. Self-efficacy sources and their role in teacher self-efficacy appraisal

The findings of the study illustrate that although mastery experiences were considered to be the most important source of teacher self-efficacy by all five pre-service teachers participating in the study (Bautista & Boone, 2015; Chesnut & Cullen, 2014; Usher & Pajares, 2008; Woolfolk Hoy et al., 2009; Yuksel, 2014), the importance of other self-efficacy sources must not be

underestimated. This is an important implication for ITE during which accumulation of ME by pre-service teachers is still relatively sparse (Van Maele & Van Houtte, 2012). It is also significant in a profession which tends to reduce opportunities for observational learning and social support (such as feedback or social reassurance) for those who move into the field following their ITE. While emphasising the importance of all four self-efficacy sources, the study also expands our current understanding of the nature of and the symbiotic relationship between these sources in the teacher self-efficacy development process.

9.1.1. Mastery and vicarious experiences

Participants proclaimed ME to be the most significant source, which was not surprising, since these provided us with the most tangible and realistic evidence of the pre-service teachers' capabilities (Bandura, 1997; Morris et al., 2017). As the pre-service teachers frequently emphasised, how better to know if one is capable of doing something than to actually learn about it by doing it? In addition to this tangibility of evidence, however, ME played other significant roles in teacher self-efficacy appraisal, predominantly by affecting other self-efficacy sources. First, ME were seen as an important mechanism for helping alleviate a build-up of negative affect and emotional exhaustion (Ruble et al., 2011) which had the potential to become particularly overwhelming during teaching breaks (articles 2 and 3). Emphasising the importance of ME in such situations, Katie said that “(i)t [the teaching] just had to happen. Otherwise, your nerves are building up even more. And I knew it would happen at some point so I just thought ‘I just want to get it done’” (Article 3). This aspect of the findings provides further support for previous emphasis in the literature on the importance of creating multiple opportunities for enactive experiences early on in teacher education (Klassen & Durksen, 2014; Yada et al., 2019). As we can see here, a prolonged lack of opportunities to teach at the start of the year can contribute to an overwhelming build-up of negative emotions.

Secondly, ME played a key role in shaping the significance and the nature of VE, shifting their role from exploratory towards diagnostic. This shift was observable due to yet another important implication of the study—the broader-than-usual conceptualisation of VE as a teacher self-efficacy source and the greater understanding of its different contributions to the process. Although the findings align with those of previous studies in illustrating that VE played a particularly important role in teacher self-efficacy development at the start of the ITE year (Tschannen-Moran & Woolfolk Hoy, 2007) when the pre-service teachers had little prior experience or have relatively low teacher self-efficacy (Skaalvik & Skaalvik, 2007), they also emphasise that these experiences can potentially have negative effects on teacher self-efficacy—if VE continue to be unaccompanied by ME for a prolonged period (Article 3),

they can overwhelm the pre-service teachers with vast amounts of information. There appears to be a fine line between providing pre-service teachers with enough and too much vicarious learning at the start of the year.

Finally, the study illustrates how a broader conceptualisation of VE as a teacher self-efficacy source is necessary in order to better understand the process of teacher self-efficacy development. While studies to date, especially those in the quantitative domain, focus predominantly on referential aspects of VE where pre-service teachers judge their capabilities by comparing these with the capabilities of others (Morris, 2010), this study emphasises the necessity of also paying attention to other important aspects of VE. These can include: a transmission of knowledge about effectiveness of particular skills and strategies, or task manageability, or initiating and supporting the process or enculturation. As this study has shown, such types of VE “will [also] change beliefs in one’s capabilities” (Bandura, 1997, p. 88).

9.1.2. Physiological and affective states, and social and verbal persuasion

Although the significance of affect and emotions during ITE has long been recognised in research (Gabriele & Joram, 2007; Mansfield et al., 2016), surprisingly, such findings have so far been either underreported (Morris & Usher, 2011) or inconclusive in the context of teacher self-efficacy development. It has been suggested that this might be due to the previously limiting conceptualisation of these experiences as a teacher self-efficacy source (Morris et al., 2017). A significant contribution of the study relates to the emphasis on the prominence and role of physical and affective states in teacher self-efficacy development through broadening the conceptualisation of PAS as a teacher self-efficacy source.

For example, both articles 2 and 3 illustrate how physical and mental exhaustion, and stress related to a sudden increase in workload, negatively affect the pre-service teachers’ confidence in their ability to perform. It is not difficult to conclude that these states can have disastrous consequences for pre-service teachers, and that rectifying them is important in the pre-service teachers’ journeys. Addressing these influences both enables momentary stress relief and supports the development of coping mechanisms which will be important later throughout the profession. As the cases of Alison (Article 2) and Nathan (Article 3) indicate, the role of mentors becomes particularly important here—while a confident and mostly independent Nathan required only a gentle nudge and a suggestion to take a step back and momentarily decrease his workload, the more affectively vulnerable Alison relied heavily upon more general reassurance from her mentor.

The similarly vital role of social support (VP) was evident in the cases of Laura (Article 3) and Katie (articles 3 and 4), both of whom experienced

emotional struggles. While Laura was particularly emotionally vulnerable in the last six weeks of the year due to personal problems, Katie continued to be affected by negative emotions related to her struggles with developing her teacher identity throughout the year.

In addition to those mentioned above, PAS could also be seen in the build-up of negative emotions in the moments of prolonged anticipation of ME, either at the start of the year or following holiday breaks (Article 3). Laura explained how in her case this build-up was affected by an accumulation of information gathered through observations (VE) which made her think of teaching as “a big deal”. Finally, as Jacob’s case illustrates (articles 3 and 5), there was also PAS related to the lack of pedagogical subject knowledge (Gresham, 2007; Morris et al., 2017), which instigated doubt in his ability to deal with contingent situations in the classroom. Although previous studies suggested considering knowledge itself as a teacher self-efficacy source (e.g., Bautista & Boone, 2015; Phan & Locke, 2015; Wang, Tsai, & Wei, 2015), this study emphasises rather the affect and emotions associated with such knowledge as that source.

All these results help illustrate the importance of PAS in the process of teacher self-efficacy development (articles 2–5) and, perhaps, help explain the previous contradictory finding related to this aspect—i.e., no correlation between negative emotions and teacher self-efficacy (e.g., van Rooij et al., 2019) or considering PAS to be the weakest teacher self-efficacy source (Mohamadi & Asadzadeh, 2012; Poulou, 2007). What characterises this study is the broad way in which PAS as a teacher self-efficacy source is conceptualised—that is, beyond the narrow consideration of affect in the moment or in the imminent anticipation of a particular action. This broader categorisation of PAS in this study is in line with Bandura (1997) who emphasised that PAS, as a teacher self-efficacy source, are not limited to emotions about classroom episodes but rather encompass all emotions which affect individuals’ “vulnerability to disfunction” (p. 79). Such a conceptualisation of PAS also helped illustrate the greater importance of social verbal persuasion in the process of teacher self-efficacy.

The study helps emphasise that, although VP is important for providing feedback and reassurance for all pre-service teachers (Tschannen-Moran et al., 1998, p. 230), they become particularly significant for those who may be temporarily emotionally vulnerable (like Laura or Nathan), or more generally significant for others due to their specific traits of character (like Katie—articles 2–4), albeit perhaps in different ways. Extending beyond the specific feedback and general reassurance, VP is important for providing advice, a simple nudge to move forward, general social support, and acceptance of individuals into the community of the school and classroom. In addition to these roles, and perhaps most importantly, VP at the start of the year helped redirect the pre-service teachers’ focus away from negative aspects of their enactive experiences towards aspects that were positive. This helped them

keep the build-up of negative emotions at bay and develop their attentive and reflective skills, which were seen as crucial in developing the ability to self-regulate and utilise their agency in the process of development. This role of VP, where mentors do not direct or enforce ideas but guide and advise pre-service teachers, appears to align with the constructivist approach to mentoring discussed and advocated as most significant in teacher self-efficacy development by Richter et al. (2013).

9.2. Personal factors (including mathematics teacher knowledge) and their role in teacher self-efficacy appraisal

It has been advocated that the investigation of factors that interact with teacher self-efficacy development is essential in developing our understanding of the field (Kleinsasser, 2014; Olgan, Alpaslan, & Oztekin, 2014). My findings contribute to broadening our understanding of the role of personal factors in teacher self-efficacy development.

In the field of mathematics education, teacher knowledge has been one of the most frequently explored factors that influence the development of teacher self-efficacy (e.g., Bautista & Boone, 2015; Morris et al., 2017; Palmer, 2011; Phan & Locke, 2015; Wang, et al., 2015), with research frequently suggesting that teachers with greater subject knowledge in and understanding of mathematics tend to report stronger teacher self-efficacy for teaching the subject (Bates et al., 2011; Hossain et al., 2013; Newton et al., 2012; Palmer, 2006; Stevens, Aguirre-Munoz, Harris, Higgins, & Liu, 2013; Swars et al., 2007; Thompson et al., 2017). Other studies have also shown how teachers with weak mathematics subject knowledge frequently doubt their ability to teach mathematics (predominantly in the context of primary education [e.g., Gresham, 2007]). Conclusions suggesting a direct positive correlation between mathematics teacher knowledge and teacher self-efficacy are not uncommon in the field; even common sense suggests that those with weak subject knowledge would likely doubt their ability to teach the subject, leading to an expectation that helping teachers enhance their knowledge should also lead to teacher self-efficacy enhancement. Yet in line with Bandura (1986), other research emphasises that although knowledge can be considered a necessary prerequisite for teaching, it is by no means sufficient (e.g., Bruun & Evans, 2020; Evans, 2011; Ma & Cavanagh, 2018). In other words, we can say that knowledge alone does not guarantee one's affirmation of their successful teaching (Ma & Cavanagh, 2018; Zee & Koomen, 2016).

In this study I elaborate on the issue of mathematics teacher knowledge, supporting the conclusions that mathematics teacher knowledge although necessary is not sufficient for positive TSE appraisals. For example, the case

of Katie illustrates how good knowledge alone is not sufficient for success in the classroom (Bandura, 1997; Ma & Cavanagh, 2018; Zee & Koomen, 2016): Katie's mathematics subject content knowledge does not protect her from struggling and doubting her ability to act effectively in the classroom. Of course, in this case one might call on Thompson et al.'s (2017) argument that it is in fact pedagogical subject knowledge and not subject content knowledge that shows stronger positive correlations with teacher self-efficacy. On the basis of that, one might try to argue that perhaps it was Katie's pedagogical knowledge which was somewhat in deficit? Although we are not able to answer this question directly on the basis of the case of Katie, Jacob's case sheds some further light on this. Despite having strong mathematics subject content knowledge, initially Jacob frequently emphasised how perceived deficits in his pedagogical knowledge negatively affected his teacher self-efficacy. What could be seen later in this case, however, was that developing this pedagogical knowledge, through vicarious learning, was not sufficient for Jacob to develop confidence in his actions. Although Jacob indicated that knowledge development by saying that he had, "observed teaching practices, so [he was] more aware of what works and what doesn't" (Article 5, p. 17), he also emphasised the need to put this knowledge in practice in order to appraise his teacher self-efficacy positively. He explained clearly how developing pedagogical knowledge was essential but not sufficient for confident teacher role enactment. A similar issue was discussed by Laura in Article 3, where she said:

Although I may know about the theory about behaviour, or certain types of assessment strategies, I need to be put in place myself to be confident in it. Observing others was important and good but it wasn't until I actually started delivering the lessons myself that my confidence for being able to do things started to grow in myself (Article 3, p. 16).

This reminds us of a similar expression used by the teacher in the study of Ma and Cavanagh (2018) who pointed out that having knowledge means that, "in theory, I believe I can do the above [but] in practice I'm not sure that's true yet" (ibid., p. 142). In other words, having pedagogical knowledge does not necessarily mean being able to put it into practice—it is merely a necessary step towards one's development as a confident teacher.

This leads me to consider the necessary coupling of mathematics teacher knowledge with different experiences in their teacher self-efficacy development (particularly with enactment; Tschannen-Moran & McMaster, 2009); a necessity which was emphasised by all Katie, Jacob and Laura. Previous studies can provide some support to this contention, by suggesting that differences between teacher self-efficacy in particular domains might be often better explained not by differences in mathematics teachers' knowledge but rather by differences in the experiences they accumulate in those domains. I refer in particular to studies such as those of Ekstam et al. (2018) whose teachers with strong mathematical content knowledge judged their teacher

self-efficacy in the domains of motivating low-performing students or adapting instructions to individual needs as lower than special education teachers who reported lower subject content knowledge but who had a greater accumulation of experiences of working with such students; or of Stevens et al. (2013) who suggested that educational experiences of teachers with stronger subject content knowledge involve more focus on mathematics and less-frequent exposure to effective models of dealing with disruptive behaviour, hence leaving them more prone to experience doubts in their TSE in the domain of behaviour management. A similar contribution of experiences to TSE development was reported in studies of Tschannen-Moran and McMaster (2009) and Charalambous et al. (2008).

This view on the role of subject knowledge in teacher's professional development might help explain why many professional development programmes, designed to help teachers develop their subject knowledge, although important, do not prove sufficient in bringing about significant changes in classroom instruction (Mooney Simmie, de Paor, Liston, & O'Shea, 2017)—an issue discussed by Evans (2011) whose participants in a mathematics methods course on an alternative teacher education recruitment programme, despite showing great improvements in their mathematics pedagogical and content knowledge, showed no such improvements in their teacher self-efficacy for teaching mathematics.

Previous studies provide a glimpse into how subject knowledge can potentially interact with the process of teacher self-efficacy appraisal. For example, Chang (2010) showed how subject-matter knowledge appears to influence primary mathematics teachers' reliance on different efficacy sources—those with greater knowledge rely mostly on mastery experiences and those with limited or no initial subject knowledge resort mostly to vicarious learning. Similar findings were also reported by Newton et al. (2012) in their study of primary mathematics teachers who enrolled on a mathematics methods course. Teachers with the weakest subject content knowledge appeared to rely mainly on vicarious learning, those with a medium level of knowledge relied on social and verbal persuasion, and those with the strongest knowledge on mastery experiences. Based on these findings, the authors speculated whether teachers' stronger mathematical subject content knowledge helped them more easily imagine themselves as potentially successful in the classroom and hence made them more willing to focus on teacher role enactment.

To add to those findings, my study argues that the relationship between mathematics teacher subject knowledge and their reliance on different self-efficacy sources is not as direct as it might previously have been understood to be. Participants' personal characteristics appeared to mediate the way in which their respective processes of teacher self-efficacy appraisal were shaped. For example, it was evident that Nathan and Jacob, who were seen as outgoing, confident and generally positive, relied most heavily on ME and VP

as a form of feedback related to their performance, and that they did not seem to require social reassurance or acceptance in order to appraise their teacher self-efficacy positively. This was also evident in the case of the generally confident and independent Laura, who appeared to predominantly trust her own actions and judgement for most of the academic year. Although that was with the exception of a period when she was experiencing personal difficulties where she was more emotionally vulnerable and she began to rely more heavily on social reassurance. In contrast to these participants, the relatively shy and quiet Katie, who described herself as “disliking confrontations” and being overly pessimistic, relied heavily on both feedback and social reassurance (VP) in her teacher self-efficacy appraisal throughout the year, despite numerous successful enactive experiences. To an extent, these findings provide further support for previous research which showed that young and more introverted individuals have a greater tendency to doubt their teacher self-efficacy and expect failure than those who are more positive and proactive, driven by purpose in their education, and who tend to be more efficacious or tend to develop their teacher self-efficacy faster (Djigić et al., 2014; Ma & Cavanagh, 2018; Marschall & Seah, forthcoming; Poulou, 2007; Shakeel et al., 2021).

It is important for me to emphasise here that I do not underestimate the importance of mathematics teacher subject knowledge in TSE, teacher development and teacher professional life in general. I do not disregard the claims that greater levels of teachers’ mathematics subject knowledge and better understanding of mathematics (Bates et al., 2011; Hossain et al., 2013; Newton et al., 2012; Palmer, 2006; Stevens, Aguirre-Munoz, Harris, Higgins, & Liu, 2013; Swars et al., 2007; Thompson et al., 2017) or teachers’ stronger mathematics efficacy (Esterly, 2003) frequently correlate positively with mathematics teacher self-efficacy. I also recognise the fact that all participants in my study were considered to have very good mathematics subject content knowledge. What I advocate, however, is the rejection of the idea of a direct correlation between teacher knowledge and TSE, and I support the move in teacher professional learning and development agendas beyond knowledge enhancement. What I also advocate is that TSE appraisal is a complex and highly individual process, affected by a myriad of personal and external factors (Rupp & Becker, 2021). While research considering personal factors in teacher self-efficacy appraisal remains sparse (Kleinsasser, 2014; Olgan, Alpaslan, & Oztekin, 2014), this study emphasises its utmost importance.

9.3. The concept of teacher self-efficacy and the process of its appraisal—the model

The growing appreciation of the role of personal factors, life journeys and identity in teacher self-efficacy development indicated that teacher self-efficacy needed to be considered as a much more dynamic and individual concept than had been previously suggested. Although in previous studies descriptions of the relationship between teacher identity and teacher self-efficacy have often focused on emphasising teacher self-efficacy as an important aspect or an indicator of teacher professional identity (Canrinus et al., 2012; Day & Gu, 2007; Garner & Kaplan, 2019; Hong, 2010; Kelchtermans, 2005; van der Want et al., 2019), this study claims that there is a more interactive relationship between the two aspects of self. By drawing attention to the process of teacher self-efficacy appraisal, this study reveals connections between this process and the way in which individuals construct their narrative biography (articles 4 and 5). In particular, the study argues that it is useful to think of both teacher identity and teacher self-efficacy in terms of aspects of a narrative self-schema—a mental image of (a competent) self, which is constructed through a dynamic and transactional process of *emplotment* (Ricoeur, 1994). Consequently, it argues that teacher self-efficacy should be seen as a domain-specific, task-oriented aspect of a more general narrative self-schema which is in a constant interaction with narrative identity in one narrative process of becoming. In this narrative structure, the past, present and future are “laced together” (Märtsin, 2019, p. 677) in one coherent biography which provides (momentary) closure (Ricoeur, 2008) and which allows individuals to sustain a coherent sense of self who, although changing, remains the same person over time (Smith, 2014). This means that during the process of teacher self-efficacy appraisal teachers cognitively process not only the success of their actions and the significance of these actions, but also the kind of persons they are (with their values, beliefs, resources), the person they used to be (past self, with past experiences, personal and professional journey), as well as the person they aspire to be.

The narrative process of teacher self-efficacy appraisal is initiated by momentary affect stemming from incongruencies or discrepancies arising in the individuals’ ongoing self-narrative (Archer, 2000; Bandura, 1989; Bruner, 1990; Garner & Kaplan, 2019). At the heart of this appraisal stands the meaning-making process, during which individuals make sense of their experiences in light of their ongoing life stories. Although these are most frequently related to the performative sphere, they can in fact relate to the wider context of individuals’ personal lives and circumstances (Archer, 2000). Archer’s (2000) theory of human functioning explains that throughout our lives we are guided by emotions related to our concerns in three distinct spheres: physical wellbeing in the natural order, performative achievement in the practical order, and self-worth in the social order. We need to navigate

these emotions to strike an ongoing liveable balance. She emphasised that, in aiming to strike this balance, attending to these three spheres is not entirely harmonious—attention to one will inevitably jeopardise attention to the other two. This centralised position of affect and emotions in the meaning-making process of teacher self-efficacy development was evident in all four cases of my study. One saw Jacob’s ongoing worries about his weak subject pedagogical knowledge, which made him continuously re-evaluate his capabilities in the classroom. One also saw Katie’s affect related to identity incongruencies (how she visualised her ideal self as a future teacher based on a self-constructed teacher image, and how she saw herself in the present) which paralysed her actions and made her doubt her management and teaching capabilities when interacting with older students. In the case of Nathan, one observed his unshaken and relatively smooth progress throughout the year until the moment he realised that he was not able to deal with an increased workload, a realisation that took him by surprise. Naturally, with his growing teacher self-efficacy, Nathan expected to cope with this new challenge; yet he quickly realised that the increased workload left him physically and mentally exhausted. In the light of this discrepancy between what had been expected and what in fact was taking place, Nathan needed to stop, reflect and redirect his way forward in ways which helped him deal with the challenge. In the case of Laura, whose progress on the course was also relatively straightforward for most of the year, one observed the sudden difficulties she experienced in her personal life which, as she herself explained, left her emotionally exhausted and which affected her judgement about her ability to act effectively in the classroom.

Considering teacher self-efficacy development to be a narrative process of self-schema construction allows us to understand more clearly why this process is so highly individualised and personal. Inextricably connected to the individual’s evolving narrative identity, teacher self-efficacy development forms part of a coherently developing view of self in the profession (Carrin et al., 2012; Kelchtermans, 2005; Smith, 2014), a dynamic view that one holds about oneself as a teacher acting competently in the world (Bandura, 1997). Inevitably, personal factors and personal stories will strongly influence how individuals see themselves and how, based on who they are and where they are, they manage the challenges of their experiences. As this study illustrates, pre-service teachers enter and continue throughout their education with their own baggage of personal journeys, experiences, views, ideals and evolving identities which they continue to navigate and negotiate in the process of becoming a teacher, aiming to fit all these together into one biographical thread of their lives. For some, this negotiation is relatively straightforward—there is little that surprises them or challenges their self-perception. For others, this negotiation can be difficult, especially when one’s self-view is directly challenged and requires a shift.

Based on all the findings, I suggest a general model of the narrative process of teacher self-efficacy appraisal (presented in Figure 15), expanded from the specific case of Jacob (Figure 14) and the previously prominent models of teacher self-efficacy appraisal (of Gist and Mitchell, 1992 and Tschannen-Moran et al., 1998). This model focuses on an iterative process of teacher self-efficacy appraisal (depicted by the subscripts i , $i+1$, etc.), which is part of an individual's evolving ongoing narrative. In this model I depict three ever-changing temporal spaces (past, present and future)—inevitably, what is now the present, will soon become the past, and what is now the future will soon become the present. In this sense, the model presents a snapshot of a current moment in the present, in which individuals consider momentary past and future.

As in the previous models (Gist & Mitchell, 1992 and Tschannen-Moran et al., 1998), the emphasis here is on cognitive processing of information related to individuals' experiences (enactive, vicarious, social, and physiological and affective) and their particular importance—the processing which attends to an assessment of one's performance in the light of task difficulty and an attribution of the level of success of that performance to oneself, in the light of expended effort and utilised resources). In addition to the previously suggested models, however, the newly theorised model also emphasises the important considerations of the overall sense of self in this processing, which not only reflects the aspect of who the individual currently is (including what resources they possess) and where they have come from, but also where they are going (which includes the kind of person the individual aspires to be and the kind of goals they wish to pursue) and how they plan to get there. The model suggests that within their ongoing teacher self-efficacy reappraisal teachers initiate a cognitive processing of information in a moment in which they affectively experience a kind of discrepancy between their previous expectations and the current experience, as well as between the current and aspired-to selves. This processing involves (re)considerations of task difficulty and the aspired-to self, and the planning of experiences which will help the teacher regulate the affective moment and engage in further pursuit of the aspired-to self.

Regarding the nature of the model, although one could argue that *iterative* is no different to *cyclical* as in previously suggested models, I argue that viewing the process of teacher self-efficacy development in this way allows for illustrating not only the repetitive process of refinement and reappraisal but also the everchanging dynamic self along the individual's narrative continuum. As mentioned before, while teacher self-efficacy appraisal draws on the aspects of present, past and future selves, these different selves are not static but also undergo change in the overall process of becoming.

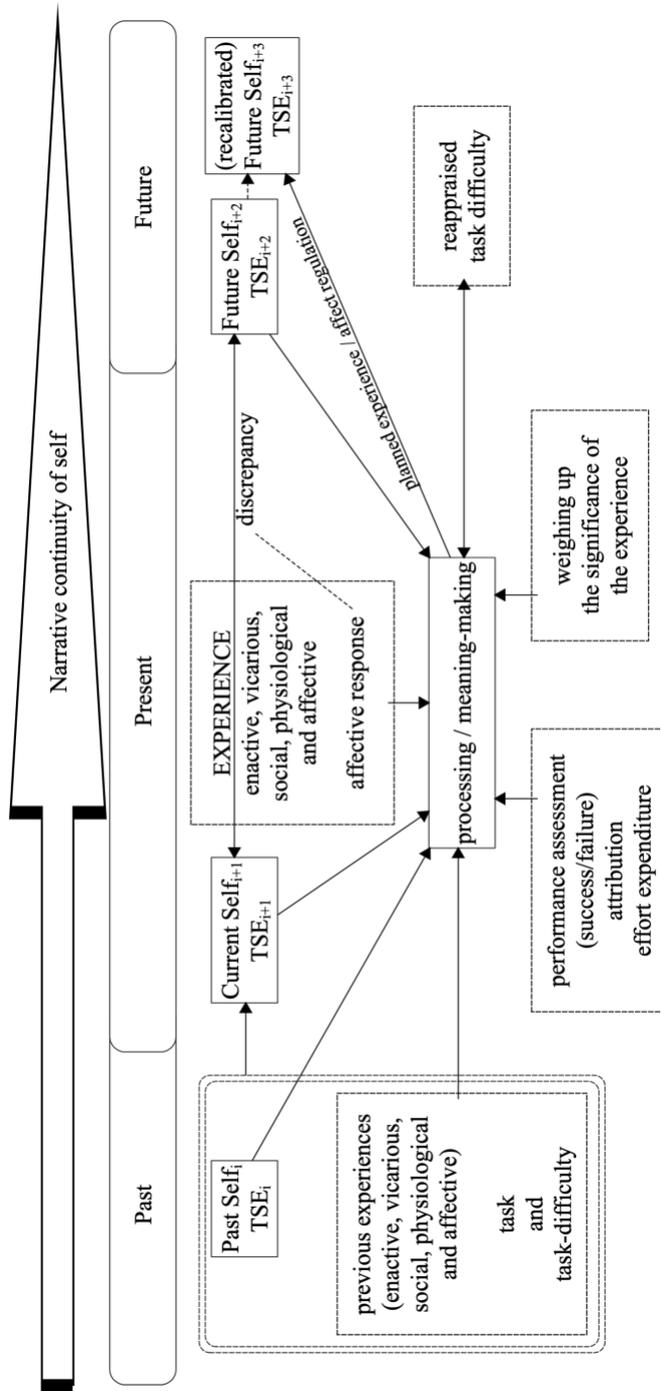


Figure 15: A general theorised model of the narrative process of teacher self-efficacy appraisal

10. Implications

The findings of this phenomenological study of teacher self-efficacy illustrate that teacher development, understood through the reconceptualised lens of SCT and the theory of self-efficacy, can be viewed as a transactional process of cognitive and affective narrative self-schema construction. As such, this process is highly individual, during which teachers develop in different ways, with different starting points, and at different rates (Burn, Hagger, Mutton, & Everton, 2003). It is a process in which teachers source information about their capabilities from enactive, social, affective and vicarious experiences, but they do so in ways which are specific for them and which are affected by their general sense of self. In the context of teacher change which, as the research often suggests is difficult to achieve, Leinhardt (1998) defends teachers, explaining that the “resistance to change on the part of the teacher should not be perceived as a form of stubborn ignorance or authoritarian rigidity but as a response to consistency of the total situation” (Leinhardt, 1998, p. 146). In this study I defend this position by illustrating how in the process of learning, when engaging with a variety of daily activities, the pre-service teachers continuously negotiated different aspects of their personal and professional lives (Sfard & Prusak, 2005). In an ongoing narrative process of becoming, this negotiation goes beyond the development of knowledge, the evolution of beliefs about mathematics teaching and learning, and the accumulation of experiences. It revolves around sustaining a coherent general sense of self which is not limited to professional and performative spheres but encompasses individuals as a whole (Archer, 2000). These claims have numerous implications for the field of teacher self-efficacy and teacher professional learning, which are discussed below.

10.1. Stability of teacher self-efficacy

As described earlier, the stability of teacher self-efficacy is frequently debated in the literature, with contesting claims that teacher self-efficacy is both stable and malleable. Considering routinised behaviour and stability, Markus (1977) pointed out that as individuals accumulate experience within a specific context and as they achieve a level of accomplishment (and confidence in their competence), they develop a relatively established professional identity and

their self-schemata become more resistant to change. In such a state, the teachers' actions become routinised and automated and there is less or no need to reflect on them—there is no imperative to articulate a narrative or examine their biography (Markus, 1977). In other words, a professional teacher in practice does not, on a day-to-day basis, examine who they are and why they do things in particular ways (Markus, 1977). That is of course until something out of the ordinary happens—until some incongruity between one's self-narrative and the expectations of the new occurrence takes place (Archer, 2000; Bandura, 1997; Bruner, 1990). That is why although teachers' narrative self-schemata “become increasingly resistant to inconsistent or contradictory information, ... they are never totally invulnerable to it” (Markus, 1977, p. 64).

This helps explain the somewhat puzzling and seemingly contradictory conclusions that teacher self-efficacy is both stable and malleable. Considering the process of teacher self-efficacy appraisal as a narrative self-schema construction, it seems natural to expect that a relatively established teacher self-efficacy could remain stable over the course of a teacher's career but that it could also return to a state of flux when confronted with unexpected life events and circumstances which disturb the individual's narratives. The world as we know it is full of difficult and unpredictable situations which have a direct effect on our personal, social and professional lives (Archer, 2000). To assume that these will have no bearing on the way we see ourselves and our capabilities to act (including our performance in the profession) seems unreasonable, to say the least.

According to established teacher self-efficacy theory, such disturbing situations could include momentary struggles in enactive experiences, receiving constructive feedback which either does not align with the individual's own judgement or which goes far beyond their capability to act upon it, observing others executing actions which are far beyond one's capabilities, and many more aspects related directly to the performative sphere of teachers' lives. Yet, this study shows that these situations can also include momentarily feelings of tiredness and exhaustion, struggles with a self-view and perceived lack of acceptance as a teacher by students, difficult personal circumstances, cultural clashes, and weak subject pedagogical knowledge; in other words, aspects related to a more general sense of self.

10.2. Reconceptualising Teacher Professional Learning

There is general agreement in the field of education that the quality of education depends on the quality of the teachers (Barber & Mourshed, 2007) who enact the teaching initiatives aligned with frequent reform changes (Guskey, 2002). Yet, what has also been observed is that teachers need support to deal with and effectively teach within the fast-changing reform-oriented

demands of the profession (Bautista & Ortega-Ruiz, 2015; Borko, 2004; Desimone et al., 2002). Despite this recognition, the current educational context (which continues to struggle with competing agendas—political versus those which consider what teachers themselves want or need), has an ongoing tendency to perpetuate one-size-fits-all, traditional models of teacher education which fail to provide teachers with meaningful and appropriate learning opportunities (Hill et al., 2013).

It has been suggested that this might be due to the fact that, in marketing the teaching profession, educational agendas present an increasing focus on “performativity” (Ball, 2003), treating teachers as detached and dispassionate professionals, concerned mainly with and held accountable for providing evidence of classroom work and student achievements. This transposed onto conceptualising TPL in ways which are concerned solely with output results (Day & Sachs, 2004) and which utilise traditional models of teacher professional development (Bautista & Ortega-Ruiz, 2015). Such models, however, are often highly detached from the complex reality of the context that teachers work in (Opfer & Pedder, 2011), treat teachers as passive recipients (Bautista & Ortega-Ruiz, 2015), ignore teachers’ needs (Borko, 2004) and provide teachers with insufficient and short-lived professional support (Bautista & Ortega-Ruiz, 2015). Having no real impact on teachers and their learning (Hill et al., 2013; Hoekstra & Korthagen, 2011), such models have long been considered vastly inadequate (Borko, 2004). It is a system which is in need of change (Bautista & Ortega-Ruiz, 2015).

Having reviewed research on TPL between 2004 and 2014, Mooney Simmie et al. (2017) concluded that TPL programmes are generally considerably a-theoretical and focus mainly on process-product models of “what works, [instead of being] concerned with why an approach might enhance teachers’ professionalism or how teacher professional learning might (...) [be] conceptualised” (ibid, p. 516). This means that even when teacher professional development activities implement so-called best practices, the learning outcomes of teachers in those activities are still unpredictable (Opfer & Pedder, 2011). This situation led to a rejection of the practice-based process-product approaches to teacher education, and advocacy for a focus on theoretical aspects of TPL (Borko, 2004; Opfer & Pedder, 2011). Introducing theoretical perspectives into the field of TPL, however, has not come without its challenges or shortcomings. What we have observed in the field is that, even when theoretical perspectives are present they appear to either conceptualise mathematics TPL either too narrowly focusing on particular situations or research contexts (Adler et al., 2005) or to dichotomise this learning, seeing it as either an *acquisition* of knowledge or a *participatory* activity (Borko, 2004; Prediger et al., 2008). Such approaches not only fail to reflect the complexities of teachers’ learning process (Klassen & Chiu, 2010; Opfer & Pedder, 2011) but also treat teachers from a perspective of a deficit or ‘lacking something’—‘something’ which a particular externally imposed

professional development is set to rectify (da Ponte, 2007). Such approaches also often ignore teacher differences, context and the role of affective factors and teacher needs (Sowder, 2007) in the process of learning. Consequently, these dichotomised, simplistic conceptualisations of TPL (Opfer & Pedder, 2011) can lead to “undesirable practices” (Sfard, 1998, p. 4), failing to address the pressing need for “insights into how induction programmes can work successfully” (Mooney Simmie et al., 2017, p. 517).

It has long been advocated that coherently theorised TPL and development initiatives must take into account not only teacher knowledge acquisition, teacher belief change, and the interactions between teachers and multifaceted context (Hammerness & Matsko, 2013) but also reflective and affective aspects of teachers’ learning (Goldin, 2014). Moe, Pazzaglia and Ronconi (2010) emphasised that if teacher learning activities bring no focus to affective factors and efficacious states, “teachers are at risk of becoming very able to teach, but without feeling satisfied” (Moe et al., 2010, p. 1151). Indeed, emotional, motivational and affective states have been linked to low teacher job satisfaction and burnout (Aloe et al., 2014; Klassen & Chiu, 2010; Skaalvik & Skaalvik, 2007). Further drawbacks of weakly theorised, dichotomised TPL relate to the lack of attention to teachers’ active role in the process and to conceptualising teacher change where teachers are passive and change is something to be imposed on them (Hoekstra & Korthagen, 2011). Yet, as Day (1999) emphasised, teachers cannot be developed but rather develop themselves—they hold the “ownership of change” (Sullivan, 2007, p. 152). This highlights the central role that teacher agency plays in teacher professionalism (Hannula, Lepik, & Kajlas, 2007), where teachers are enabled to continue learning and developing to become confident, motivated, reflective, responsible and intentionally behaving individuals (Soini, Pietarinen, Toom, & Pyhäntö, 2015). As such, teacher agency has been considered the “backbone” of teacher professionalism and learning (Soini et al., 2015, p. 654). Two main contributors to the development of teacher agency are competence and self-efficacy (Wheatley, 2005).

Consequently, professional development initiatives must pay attention to teachers’ active role in the process of learning, where teachers hold the “ownership of change” (Sullivan, 2007, p. 152), and must consider teachers’ professional agency and autonomy to be the core of this professional development (Hannula et al., 2007; Niemi, 2015; Soini et al., 2015). Such initiatives should focus on teachers’ process of becoming (May, 1983) and keep at the heart of their design teachers’ particular wants and needs (Hannula et al., 2007), teacher characteristics (Bruun & Evans, 2020), and the individualistic nature of learning (James & McCormick, 2009). As such, initiatives should not seek to force teacher change but rather provide opportunities for change (Sullivan, 2007).

To summarise, when conceptualising the process of TPL, it is important to recognise a hiatus between the sociological and psychological perspectives

(Bandura, 1997) which consider individuals and their learning in a holistic way (Niemi, 2015), and where all cognitive, experiential, affective, agentic and motivational factors are considered collectively in the process of teacher professional learning and development (Hoekstra & Korthagen, 2011; Neumayer DePiper et al., 2021).

Bandura (1997) argued that such a holistic treatment of learning (both in theoretical and practical terms) can only be achieved by “an integrated causal perspective in which social influences operate through self-processes that produce the actions” (Bandura, 1997, p. 6). Such a conceptualisation of TPL can be achieved by employing SCT and self-efficacy theory which provide a broad, holistic perspective; consider an agentic perspective of human learning; allow for a simultaneous treatment of cognitive, social and affective aspects of learning; and enable the application of TPL principles in practice (see Article 1 for a more detailed elaboration on this issue). More importantly still, these theories provide a framework for understanding the human psychological and adaptive functioning (Woolfolk Hoy & Davis, 2006) at the very core of the teacher learning and change process.

In this respect, three of the most fundamental questions for teacher educators must be: Have we effectively supported teachers in the development of their ongoing narratives? Have we effectively supported teachers in the development of functional skills which will help them deal with the ongoing challenges of the profession, promote self-understanding and help guide self-development? Have we effectively supported the teachers in fostering their autonomy and agency, which will help carry them through their careers? As posits of SCT state, people are not restricted to prescribed responses and reactions to change—they are active orchestrators of this change (Bandura, 2012). Hence, the importance of the focus on teacher self-efficacy development over the course of ITE, which plays an important role in guiding individual action and behaviour by helping individuals develop confidence in their ability to organise and execute specific courses of action which lead to successful outcomes (Bandura, 2006). This relates to the imperative regulatory function of self-efficacy and agency in human behaviour. Consideration of the narrative perspective of teacher self-efficacy appraisal and development provides an even more explicit illustration of this self-regulatory functioning where individuals not only appraise their present capabilities based on past experiences and future aspirations, but also reassess their view of their aspired-to selves and plan experiences which allow them to manage the transition towards these. As such, the study further emphasises the need to consider teacher self-efficacy as one of the most important aspects of teacher learning and development in ITE (Glock & Kleen, 2019). It advocates the importance of supporting pre-service teachers in developing the kind of functioning skills which will help them negotiate the (re)construction of the narratives of their teacher identity and teacher self-efficacy schemata. Considering teacher self-efficacy appraisal and development of their sense of

self in terms of narrative meaning-making of significant and affectively difficult experiences, means that such support should focus on helping pre-service teachers develop the kind of reflective cognitive skills which would help them make sense of and, consequently, mitigate these highly affective experiences which are abundant during the learning process.

10.3. Teacher learning trajectories

The next aspect I consider relates to teacher change, development and growth, and teacher learning trajectories (discussed briefly in Article 2). Current research is saturated with claims based on Fuller and Bown's (1975) model of teachers' learning trajectory, which advocates that teachers' concerns progress outwardly in a linear fashion, starting from concerns about self, through concerns about tasks and towards concerns about student learning. Yet, some claim out that pre-service teachers' preoccupation with behaviour management, task design and effective student learning is not sequential but rather simultaneous or recurring, with different aspects becoming more prominent for different individuals at different stages of their education (Burn, Hagger, & Mutton, 2015). This study concurs with these claims, illustrating how each of the pre-service mathematics teachers' journeys is highly individual and, although many teachers might seem to be preoccupied with the domains of classroom management, student engagement and instructional strategies in this exact order, it is not unreasonable to assume that this might not be true for all teachers. For example, although the case of Katie illustrates her greatest preoccupation with classroom management from the start of the ITE programme, it also shows how this preoccupation continues to be pertinent throughout the year. At the same time, being confident in her subject knowledge, Katie felt capable of responding to contingent situations and keen to experiment with a variety of instructional strategies early in her teaching. In contrast, we saw Jacob who, worrying about his lack of pedagogical knowledge, was more preoccupied with his perceived inability to deal with contingent situations in the classroom than with managing students' behaviour. Although these examples do not describe the overall journeys of Katie and Jacob, they clearly illustrate that pre-service teachers' journeys are highly individual and do not fit specific learning trajectories previously argued for. What is important in this observation is the role that various factors play here—Jacob's lack of specific pedagogical knowledge and Katie's strong subject content knowledge and personal characteristics (being young, shy and disliking confrontations) seem to contribute to different shifts in their learning trajectories.

In short, this study emphasises that the process of professional learning is complex, highly individual and multidimensional. Indeed, Schoenfeld (2011) warned us that any attempt to suggest a simple unidimensional trajectory of

teachers' learning will result in "a gross oversimplification" (p. 194). This study is an additional advocate of this view, emphasising the process of learning as a lengthy and complex process of becoming. Considered in this way, the claims of this study remain at odds with the assumptions of Fuller and Bown (1975), which regard teacher professional learning as unidimensional, and about shifts in teachers' concerns. Undoubtedly, even to an untrained eye, such a view should seem limiting in the way that it skews the picture of teacher development (Conway & Clark, 2003). While it is certainly sensible to assume that one aspect of pre-service teacher education would revolve around addressing their concerns (which can relate to a myriad of issues such as knowledge, emotional wellbeing, ability to enact the teacher role, etc.), this study emphasises that it is equally important to consider teachers' past experiences, current circumstances, goals and aspirations, together with their visions of their future or ideal selves. Considering the example of Jacob, one can clearly see how his development was not only driven by what he feared (his lack of familiarity with the English schooling system) but also by who he hoped he would become (a teacher engaging with a student-centred way of teaching). In other words, what one sees is that Jacob's learning was not driven only by his concerns or deficits but also by his aspirational goals; his learning was not focused only on striving for comfort (Buchmann, 1993) but equally concerned with challenging himself and growing to pursue an ideal self (Conway & Clark, 2003). This provides further support for previous emphasis on teachers' hopes, dreams, aspirations, as well as motivations and goals (which not only drive the learning but also change over time) as important factors in teacher learning (Conway & Clark, 2003; Schoenfeld, 2011).

A similar view was advocated by Schoenfeld (2011). Although discussing teacher professional learning progression through the three learning planes (classroom management, implementing engaging activities, and engaging in diagnostic teaching), he advocated that such a progression does not actually resemble a mere linear passage through those planes. Instead, while focusing on all these three planes simultaneously, teachers shift the weight of focus between planes depending on their circumstances. Importantly, he added, teacher growth in each of the planes is slow and interrelated and any serious study of teachers' actions and learning must necessarily also attend to teachers' orientations (which he defined as a collection of teacher beliefs, dispositions, values, tastes, and preferences), goals, and resources which interact with this learning and which are prone to momentary shifts (i.e., momentary goals are often different from overarching goals). My study aligns with Schoenfeld (2011) regarding the pre-service teachers' simultaneous focus on all three domains throughout the year and the shift of the weight in this focus between the planes, depending on personal goals, orientations and resources (illustrated with the cases of Jacob, Article 5, and Katie, Article 4). Although concerned with all three aspects of their teaching, one can see how

Katie's orientations (Schoenfeld, 2011) magnified her focus on classroom management, and how Jacob's resources (in which Schoenfeld [2011] includes knowledge) amplified his focus on instructional strategies.

In this thesis I suggest that a useful way of looking at teacher self-efficacy development and teacher professional learning is from the perspective of self (Glock & Kleen, 2019)—i.e., how the teachers regard themselves in relation to the different concerns they might have, different domains of the teaching profession, different goals. Conway and Clark (2003), who challenged the unidimensionality of Fuller and Bown's (1975) model, suggested that teacher professional learning not only progresses outwards (from the preoccupation with self towards the tasks and the students) but also inwards towards a more heightened reflexivity and attention to the development of self-as-teacher. They advocated “the centrality of self-as-teacher as a critical component in teacher education and would view its absence in teacher education curricula as problematic” (p. 476). It is this perspective that my study supports—simultaneously considering different concerns, goals and resources (related to self, students and tasks), teachers progress along the continuum of self-development or self-change (Kagan, 1992). Importantly, such a perspective centres around the reflective, agentic and self-regulated individual, an aspect somewhat ignored in the work of Fuller and Bown and their followers.

In addition, we observe differences in how the previously suggested models of TPL conceptualised teacher learning. Although all three models recommend that teacher education programmes should focus on “guiding novices through biographical histories” (Kagan, 1992, p. 163), Kagan, and Fuller and colleagues' models consider a short-lived teacher developmental process, limiting it predominantly to initial teacher education (Conway & Clark, 2003). As Conway and Clark (2003) put it, “they foreclose later reflexive professional development conversations about image of self-as-teacher utilizing discursive, autobiographical and narrative modes of inquiry at all phases of teachers' professional life-cycle” (p. 477). In contrast, Conway and Clark (2003), as well as my study, advocate that such a narrow view on teacher professional learning is hugely problematic and limiting, and point out that teachers continue developing throughout their careers. This is an aspect that I turn to in the subsequent sections.

10.4. Teacher identity and life-long learning

In light of this study, I suggest that our understanding and treatment of identity and the current political educational culture in England must come under scrutiny. I suggest, as many have before me, that the current education context in England, which continues to emphasise ‘performativity’ in the profession, judging teachers by how much they ‘know’ and how they perform against strictly prescribed criteria (Ball, 2003), exacerbates the teachers' need to

portray themselves as experts who have a strongly established teacher identity. This reaffirms the static view of identity (and indeed teacher self-efficacy) as something to be achieved or established, preferably relatively quickly. Consequently, the already highly emotional professional development journey of (pre-service) teachers who focus on chasing the expectation of ‘reaching the final product’ (i.e., becoming experts), will continue to be even more emotionally challenging, especially when continuously exposing incongruencies between who teachers are and who they one day wish to become. This has important implications for the mathematics teaching profession, which continues to be affected by teacher burn-out and high levels of teacher attrition (Weale, 2016). I suggest that accepting the dynamic, narrative nature of identity and teacher self-efficacy, and allowing teachers to fully embrace the highly individual process of their development is essential for moving forward in teacher education.

Importantly, since teacher development is necessarily a long process which requires enactive engagement with the profession, vicarious learning, social support and verification (Stryker, 1984), and reflection, it should go well beyond the moment at which pre-service teachers enter the profession (Alsup, 2006; Cheung, 2008; Woolfolk Hoy & Burke-Spero, 2005). Such a view rests upon the foundational belief that being a life-long learner and a teacher are not mutually exclusive (Burn et al., 2015); allowing teachers to embrace this life-long development should be of highest importance (Niemi, 2015). Teacher development represents an ongoing process of becoming, which does not start on the first day of teacher education and does not conclude with a certificate. In the context of teacher education, this means embracing the person with all their characteristics, personal histories and vulnerabilities (as opposed to seeing raw apprentices who are to simply accumulate and perfect skills), supporting this person on their individual journey by providing a multitude of opportunities, and supporting their agency and the development of reflective skills in the process.

In short, my study emphasises that the process of ‘becoming a teacher’ does not take place or ‘conclude’ overnight but rather reflects the continuous development of a teacher throughout their career. This means that professional development initiatives must conceptualise teacher change as a “process rather than an event” (Sowder, 2007, p. 97), and must consider it in terms of “continuous growth over time” (Sowder, 2007, p. 97). To enable this, the educational context needs to move away from a focus on measuring and assessing the performativity of those in the profession (Ball, 2003) and focus instead on the principle that teachers are professionals who learn continuously (Collinson et al., 2009).

Becoming a competent and confident teacher is a long and continuous process, during which what teachers are expected to do needs to become a part of who they are—part of their ongoing narrative. I suggest that this relates to the process which one often refers to as learning but also links to the big

questions of teacher instructional change and difficulties with achieving it. It is my claim that in the narrative view of a teacher learning or becoming a teacher is no different from having to embrace new challenges such as those related to expectations of instructional change directed by educational reforms. Such instances too require development of knowledge, reconsideration of values and goals, slow skills development and teacher self-efficacy reappraisal. Importantly, they also require the change to become an integral part of who the teachers are within their narrative biography, who they wish to become and how they engage with and interpret new experiences along the developmental continuum.

10.5. Teacher self-efficacy research

Finally, this study and the new perspective on teacher self-efficacy have implications for how research in teacher self-efficacy and its development needs to be conceptualised if it is to prove useful for practical purposes. Previous studies suggested that utilising Bandura's framework and existent models of teacher self-efficacy development might continue to prove insufficient and that professional development activities need to pay attention to wider factors related to this process (Austin, 2013; Kleinsasser, 2014; Olgan et al., 2014; Rupp & Becker, 2021). Glock and Kleen (2019) have also recently advocated that supporting pre-service teachers' in strengthening their associations between teaching self-efficacy and their self-concept should be of highest importance. In the same way, Usher and colleagues emphasised that it is "[k]nowledge, competence, and various forms of self-knowledge and self-belief [that] act in concert to provide adequate judgments and interpretations of efficacy building information" (Usher & Pajares, 2008, p. 790). The findings of this study provide firm support to these statements. In terms of teacher self-efficacy research, this means focusing on rich individual accounts of teachers making meaning of their experiences, not only in the performative sphere but as people generally—who they are, what they are like, their personal and professional circumstances, where they have come from and where they are going.

Consequently, this study advocates what has been previously emphasised by Day—that teacher “professional development must be concerned with the whole teacher as a person, since it is the teachers' whole self that brings significance to the meaning of the teaching act” (Day, 2000, p. 108). Most importantly, this study presents two main arguments. One, that at the core of professional learning and development are reflective processes and meaning-making which enable individuals to make sense of who they are and how they are developing. Two, that longitudinal, qualitative phenomenological studies, by focusing on individual journeys and meaning-making processes, are a

powerful tool for investigating teachers self-efficacy development and the kind of professionals they become.

11. Svensk sammanfattning

Denna studie innefattar en konceptuell undersökning av lärares *self-efficacy*, här översatt till självtillit, och hur den uttrycks genom att fokusera på hur fem blivande gymnasielärare i matematik, i England, skapar mening genom sina erfarenheter i såväl utbildningen som i praktiken. Självtillit handlar om hur man bedömer sin egen förmåga i relation till en särskild uppgift, här undervisning i matematik. Utgående från i tidigare studier identifierade metodologiska begränsningar planerades och genomfördes en ettårig longitudinell studie. I studien används en abduktiv metodologi och en interpretativ fenomenologisk analys görs av kvalitativa data bestående av intervjuer, lektionsobservationer, lärarstudenternas planeringsdokument och skriftliga veckovisa reflektioner.

Studien ökar vår förståelse för komplexiteten i lärarens självtillit och utveckling av densamma. Den bidrar till forskningsresultat inom området för matematiklärares självtillit genom att gå utöver Banduras (1997) väletablerade ramverk med fyra redan kända självtillitskällor: egna erfarenheter, observationer av andra människor, omgivningens respons och affektiva faktorer. Studien visar att lärares självtillit är domänspecifik och utgör en uppgiftsorienterad utvecklingsprocess av ett narrativt självschema. Processen drivs av en agentisk målsökning och baseras på kognitiv bearbetning av information från egna erfarenheter, observationer av andra, omgivningens respons och affektiva faktorer. Lärares självtillitsprocess tar också hänsyn till aspekter av individens förflutna, nutida och framtida jag, som alla ingår i en pågående transformation av sig själv som en kompetent lärare i en narrativ kontinuitet. Detta innebär att lärares självtillit är mycket närmare kopplad till utvecklingen av en professionell identitet än vad som tidigare har visats. Följaktligen föreslår studien en iterativ, narrativ modell för utveckling av lärares självtillit. Den narrativa modellen är centrerad i den meningsskapande processen och utgör en utvidgning av andra modeller som förekommer i den tidigare litteraturen.

Studiens nya sätt att conceptualisera lärares självtillit utvidgar den tidigare mer snäva behandlingen av lärares självtillit. Studien förklarar också tidigare observerade motsättningar i samband med förändringar i matematiklärares självtillit och självtillitens (in)stabilitet. Detta har betydande konsekvenser för att förstå lärares professionella lärande och utveckling.

12. References

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Appendix I

An example of Alison's weekly written reflection with a mentor's response

 **Week 10**
Friday, 16 November 2018, 3:24 PM
by 

I've really enjoyed planning my first two lessons from scratch this week, although the first one took a long time I've definitely got more used to the Activ Inspire software and have been making use of the school and online resources. I've definitely learnt a huge amount of what my class do and don't enjoy - one task on translating about 20 shapes to create a well known logo didn't go down very well; and I now realise that the task was way too long and most students gave up before starting it despite being interested in what the final image would be.

And I felt a lot more confident going in to teach the lessons as I was that more familiar with them, something a lot of people had said would be the case but I didn't realise by how much! Behavior management is still my main problem at the moment, I trialed using a timer on Thursday and Friday and it definitely was working well - I just need to be much more strict with it. I think I might practice using the board and the timer in a free lesson to help increase my confidence.

This week has felt more positive as a whole, I feel like I've made more connections with students; in form time, class and the after school support. I also found out that one of the teachers who strikes me as very confident was the same age as me which helped me realise I am not as young and naive as I keep thinking I am. I guess its strange, as this is the first time I've been part of a team with such a range of ages and myself being right down the bottom as the youngest.

This week has been much more stressful though, with lesson planning on top of the 1a1 assignment and preparing for 1b, but I guess everyone is in the same boat.

 from 
Saturday, 17 November 2018, 12:51 PM
by 

Hi ,

It is so good to read this! You have realised some very useful things this past week.

The issue of 'enjoyment' in maths lessons is an interesting one. On one level it is vital to engage and enthuse pupils. On another, everyone has different things that they are interested in, and finding something that will appeal to absolutely everyone is very difficult. Then there's the issue of what pupils are actually thinking about if they are doing an 'enjoyable' task: are they thinking about the maths or about the context they are working in?

I stress here: I am not advocating 'boring lessons', but want to provoke some thought! From my perspective, the excitement and the enjoyment come from the interest in the mathematics, or from the mathematics that is inherent in a particular object. To give an example:

I have some 'Top Trumps' cards that feature 'Supercars'. The cards give the top speed, the cost, etc of some Ferraris, Bentleys, etc. What is nice is that they have the country of origin on them and it naturally leads to the question; which country makes the best cars?

Pupils can choose a metric, can then find averages for each country (the median is particularly neat here because you literally 'put them in order' by rearranging the cards) and can then write about it. This feels like a sensible use of Top Trumps.

On TES you can download 'Simpsons Top Trumps', where there are fractions and decimals etc assigned to different characters. This is forced and has nothing to do with the Simpsons. I worry that pupils will spend more time thinking about the characters and saying their catchphrases than doing maths.

It's great to hear your confidence in the classroom is increasing!

Have a good week.



Appendix II

An example of MMRS

<p>Weekly review (informed by information in the teaching file)</p> <p>Target One: <i>Develop skill in board work.</i></p> <p>I really feel I've managed to be successful with this target, before each lesson I taught I drew a little picture of how I wanted the board to look like at various stages of the lesson. Although I didn't look at my notes whilst teaching; I remembered what I wanted and I ensured that useful information and examples were visible to the class when doing questions. I also made more of an effort to slow down my explanations and very clearly present them on the board; even if lesson time was tight.</p> <p>From observing other teachers, I noticed that the board that was being projected on was for temporary information whilst the second whiteboard was kept for example problems for reference, as well as names etc for behaviour management. This is something I tried to emulate this week; trying to make a distinction between board work that's temporary or important.</p> <p>Target Two: <i>Consider how to maximise the effect of positive reinforcement.</i></p> <p>I am still struggling with this target which will be continued into next week. I have lined up a couple of observations for next week of teachers to see how they deal with particular classes. I am trying to not talk when students are making a noise or are disruptive – but I need to be more proactive. I tried to tell a couple of year 7 boys off for messing around in a classroom, but they just responded with more silliness which threw me off the script I had planned. And rather than sticking to the script I ended up engaging in their conversation and they basically ignored me and didn't believe the threats of detention I gave them. At which point I should have followed through and given them one; I think I was worried that if I followed through and gave them a detention I would a) ruin any relationship I have with them b) in their minds they have a detention anyway so they might as well continue mucking around. I know this is something I really need to do before they lose respect for me completely; I don't know why I am having such a mental block over this.</p>	<p>Standards met</p> <p>2e), 4a)</p> <p>7</p>
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<p><i>Maintaining a productive working atmosphere within a lesson.</i></p> <p>I attended the school's "Thinking Thursday" staff meeting, which discussed sixth form teaching and the fact students don't suddenly become mature on the progression to A-level and often need support with independent thinking and also independent preparation before and after classes. This is something I hadn't necessarily thought about, though I can remember from when I was in sixth form the huge jump in what was expected of you and I remember this increased demand catching many of my friends out. I guess there also needs to be an emphasis on independent preparation also needs to be encouraged in year 11, which will help the transition not to mention GCSE revision! I know my younger sister would never do anything extra work or revision with her own initiative, the typical response to a suggestion was always 'But Mr X told me I only had to do this'. I guess explicit instruction and advice needs to be given – but then they aren't being independent!</p>	
<p>Write down up to three targets that will be the focus for next week. These can be new (N), on-going (OG), or returning (RET). For each target, outline next week's relevant training activities. These will be informed by information in the teaching file.</p>	
<p>Target One N</p>	<p>Explore different ways of approaching the same mathematical problem with a class.</p>
<p>Training Activities/ Tasks</p>	<ul style="list-style-type: none"> Investigate resources that use examples of different 'student's workings' (see standards unit, maths assessment project) Use/design own examples to use
<p>Relevant standards: 3a), 4a), 4b), 4e),</p>	
<p>Target Two N</p>	<p>Be conscious of voice speed, volume, pitch and control.</p>
<p>Training Activities/ Tasks</p>	<ul style="list-style-type: none"> Ask observing teacher to give me signs about whether I'm talking to fast or need to project more. Try to slow down explanations and let students have processing time. Also focus on projecting my voice and give off more confidence in what I am saying, rather than sounding like I am talking to myself/the board!
<p>Relevant standards: 4a),</p>	
<p>Target Two OG</p>	<p>Maintaining a productive working atmosphere within a lesson. + maintaining and using good relationships with parents of difficult students.</p>
<p>Training Activities/ Tasks</p>	<ul style="list-style-type: none"> Plan what to say to students when having to tell them off. View different teachers deal with difficult classes. Have a clear sanction plan, and give students a prewarning and then follow through.

	<ul style="list-style-type: none"> • Phone a parent of a student I am having difficulties with in class.
Relevant standards: 1a), 7	
Lessons to be taught next week (class and number)	Three year 7 lesson, three year 8 lessons, two year 12 lessons, two year 10 lessons
Subject-Knowledge review/audit discussed? No	
Planning/evaluating work for Subject Studies assignments - issues arising:	
Administrative Tasks/Reminders:	
Copy for Trainee/Mentor/Tutor	

Appendix III

An example of lesson observation field notes

Katie		
Times	Notes	Immediate reflections/digressions/questions
General information collected before the lesson	<p>Teaching Y7 mixed ability This is the first time Katie is teaching the class. She observed them several times and taught 2 starters to the students. This is a first full lesson. Lesson was, once again, preplanned by the department.</p> <p>Lesson objective: To be able to add/subtract Positive and Negative integers</p>	
9:15	Lesson starts, students arrive, a short starter is waiting on the board.	
9:17	Katie uses one student to explain how to approach solving the first of the starter questions. Katie's voice is very quiet.	<p>Quiet voice – Katie seems a little timid, perhaps?</p> <p>Ask about the quiet voice at the beginning – how did you feel in this moment? What was the start like?</p>
9:23	<p>Answers checking; this takes place through the volunteering students, who put their hands up. During this activity she makes numerous mistakes in her simple calculations. When doing so, she stumbles, hesitates, and seems embarrassed.</p> <p>During checking of these answers $37-79 = -58$</p>	<p>(Is Katie nervous? She hesitated for a while and got to an incorrect answer. This is not like Katie at all.</p> <p>Beware: negative vs. minus.</p> <p>(a small error in mixing up the counters' colours) – nerves again?</p> <p>Frequent errors... Why? Were you nervous?</p>
9:26 – 9:31	<p>Make as many numbers as you can, using the counters: 1, -3, 9, -27; Individual task.</p> <p>Katie sets the students the individual task. During the task she walks around the room, checking students' answers, looking at who did most combinations, etc. At the same time she is trying to allocate rewards to the students with 'credits' (a school's reward system) but she cannot be heard very well doing so and she mentions these almost in passing.</p>	<p>Was this an embarrassing moment for Katie? She seemed incapable of confidently reward the students and speaking to them in a confident manner? How do you feel addressing the students in the class? What is your relationship with the students and how, would you say, does it affect your actions in the class and confidence in general?</p>
9:32	<p>Exposition, using an example: work out: $5 + (-3) - (-4)$ Katie explains an approach to working with operations on directed numbers, using two methods: number line method (walking backwards when subtracting) and 'the signs' method (deciding on + or - when having + and - etc.).</p> <p>This is done very quickly and narrated mostly by Katie. The students are mainly listening and observing. Katie engages in some collection of students' suggestions but this is done only on a</p>	<p>What happens with the rest of the class? (especially as this is a mixed ability class.) Did you deliberately limit</p>

Appendix IV

Teacher self-efficacy survey

TEACHER SELF-EFFICACY SURVEY

This questionnaire is designed to help us understand your teacher self-efficacy, its development and contributing sources. Please indicate your opinion about each of the statement below.

For the purpose of subsequent interviews, we ask that you provide your name on the questionnaire. However, as in all previous parts of the data collection process, your details will be kept confidential.

Name: Date:

1. Teacher self-efficacy

Efficacy for Instructional Strategies

(0 – no efficacy through
8 – very high)

How highly would you rate your ability to:

1.1	explain central themes in your subject so that even low achieving students understand?	0	1	2	3	4	5	6	7	8
1.2	use a variety of assessment strategies?	0	1	2	3	4	5	6	7	8
1.3	provide an alternative explanation or example when students are confused?	0	1	2	3	4	5	6	7	8
1.4	craft good questions for your students?	0	1	2	3	4	5	6	7	8
1.5	implement alternative strategies in your classroom?	0	1	2	3	4	5	6	7	8
1.6	respond to difficult questions from your students?	0	1	2	3	4	5	6	7	8
1.7	adapt teaching to meet pupils' needs?	0	1	2	3	4	5	6	7	8
1.8	respond to contingencies and adjust your lessons to the proper level of individual students?	0	1	2	3	4	5	6	7	8
1.9	gauge student comprehension of what you have taught?	0	1	2	3	4	5	6	7	8
1.10	provide challenges for very capable students?	0	1	2	3	4	5	6	7	8
1.11	assess students' progress	0	1	2	3	4	5	6	7	8
1.12	communicate working progress?	0	1	2	3	4	5	6	7	8

Efficacy for Classroom Management

(0 – no efficacy through
8 – very high)

How highly would you rate your ability to:

1.13	control disruptive behaviour in the classroom?	0	1	2	3	4	5	6	7	8
1.14	get children to follow classroom rules?	0	1	2	3	4	5	6	7	8
1.15	calm a student who is disruptive and noisy?	0	1	2	3	4	5	6	7	8
1.16	establish a classroom management system with every group of students?	0	1	2	3	4	5	6	7	8
1.17	keep a few problem students from ruining an entire lesson?	0	1	2	3	4	5	6	7	8
1.18	respond to defiant students?	0	1	2	3	4	5	6	7	8
1.19	establish routines to keep activities running smoothly?	0	1	2	3	4	5	6	7	8
1.20	make your expectations clear about student behaviour?	0	1	2	3	4	5	6	7	8

Efficacy for Student Engagement

(0 – no efficacy through
8 – very high)

How highly would you rate your ability to:

1.21	foster student creativity?	0	1	2	3	4	5	6	7	8
1.22	get through to the most difficult students?	0	1	2	3	4	5	6	7	8
1.23	help students think critically?	0	1	2	3	4	5	6	7	8
1.24	help improve the understanding of the student who is failing?	0	1	2	3	4	5	6	7	8

1.25	motivate students who show low interest in school work?	0	1	2	3	4	5	6	7	8
1.26	help students value learning?	0	1	2	3	4	5	6	7	8
1.27	get the students to enjoy learning?	0	1	2	3	4	5	6	7	8
1.28	get the students to trust you?	0	1	2	3	4	5	6	7	8
1.29	get the students to believe that they can do well in schoolwork?	0	1	2	3	4	5	6	7	8
1.30	get students work collaboratively?	0	1	2	3	4	5	6	7	8
1.31	get students to persevere when working with difficult problems?	0	1	2	3	4	5	6	7	8

Outcome Expectancy

Rate how much you agree with the following statements:

(0 – completely disagree
8 – completely agree)

1.32	When a student does better than usual in mathematics, it is because the teacher exerted a little extra effort.	0	1	2	3	4	5	6	7	8
1.33	When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.	0	1	2	3	4	5	6	7	8
1.34	If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching.	0	1	2	3	4	5	6	7	8
1.35	The inadequacy of a student's mathematics background can be overcome by good teaching.	0	1	2	3	4	5	6	7	8
1.36	When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.	0	1	2	3	4	5	6	7	8
1.37	The teacher is generally responsible for the achievement of students in mathematics.	0	1	2	3	4	5	6	7	8
1.38	Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.	0	1	2	3	4	5	6	7	8
1.39	If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.	0	1	2	3	4	5	6	7	8
1.40	If teachers try hard enough, they can get through to <u>all</u> students.	0	1	2	3	4	5	6	7	8
1.41	Even increased effort in mathematics teaching produces little change in some students' mathematics achievement.	0	1	2	3	4	5	6	7	8

2. Sources of teacher self-efficacy

Physiological and affective states

Rate the effect of the following factors on your teaching efficacy:

(0 – no effect through
8 – very high effect)

2.1	feelings of stress or anxiety during your teaching session	0	1	2	3	4	5	6	7	8
2.2	feelings of getting anxious after getting something wrong in the class	0	1	2	3	4	5	6	7	8
2.3	information you obtain from your body that might include nervousness, tension, or calm while teaching	0	1	2	3	4	5	6	7	8
2.4	feelings of accomplishment and happiness following a teaching experience	0	1	2	3	4	5	6	7	8
2.5	feelings of tiredness and stress associated with general workload	0	1	2	3	4	5	6	7	8
2.6	feelings of lack of acceptance and intimidation from the students	0	1	2	3	4	5	6	7	8
2.7	feeling anxious or uncomfortable about the small age difference between the students and myself	0	1	2	3	4	5	6	7	8

Open questions

Identify some of the most prominent feelings and emotions that you experienced when you were teaching and when you were preparing to teach. Which of these feelings or emotions would you say have raised/decreased your confidence for teaching?

Verbal Persuasion

Rate the effect of the following factors on your teaching efficacy:

(0 – no effect through to 8 – very high effect)

2.8	interpersonal support provided by colleagues in the school	0	1	2	3	4	5	6	7	8
2.9	clerical support provided by the school	0	1	2	3	4	5	6	7	8
2.10	cooperating with other teachers	0	1	2	3	4	5	6	7	8
2.11	other colleagues persuading you about your skilfulness as a teacher	0	1	2	3	4	5	6	7	8
2.12	significant people in your life persuading you about your skilfulness as a teacher	0	1	2	3	4	5	6	7	8
2.13	your mentor persuading you about your skilfulness as a teacher	0	1	2	3	4	5	6	7	8
2.14	feedback from the mentor or other colleagues about your teaching ability	0	1	2	3	4	5	6	7	8
2.15	your mentor's encouragement to look at a problem from many different angles	0	1	2	3	4	5	6	7	8
2.16	encouragement and strategies from others for overcoming obstacles	0	1	2	3	4	5	6	7	8
2.17	compliments and verbal rewards from others for what you have done	0	1	2	3	4	5	6	7	8

Open questions

How did others around you help build your sense of efficacy for teaching?

What sort of messages did others convey that influenced the development (or lack thereof) of your teaching efficacy?

What type of feedback from others did you find influenced the development (or lack thereof) of your teaching efficacy?

Vicarious Experiences

Rate the effect of the following factors on your teaching efficacy: (0 – no effect through to 8 – very high effect)

2.18	classroom observations of other colleagues	0	1	2	3	4	5	6	7	8
2.19	classroom observations of my mentor	0	1	2	3	4	5	6	7	8
2.20	watching skilful teachers	0	1	2	3	4	5	6	7	8
2.21	observing modelling at university	0	1	2	3	4	5	6	7	8
2.22	watching people similar to you succeed at teaching	0	1	2	3	4	5	6	7	8
2.23	watching others struggle to teach	0	1	2	3	4	5	6	7	8
2.24	sharing experiences with other trainee teachers	0	1	2	3	4	5	6	7	8
2.25	sharing experiences with other colleagues (other than trainee teachers)	0	1	2	3	4	5	6	7	8
2.26	comparing your teaching with that of your experienced colleagues	0	1	2	3	4	5	6	7	8
2.27	comparing your teaching with other trainee teachers	0	1	2	3	4	5	6	7	8

Open questions

Vicarious experiences affecting confidence are things that we have seen, we have observed or have read. Can you describe some of the most powerful vicarious experiences that influenced your teaching self-efficacy? If so, can you describe what they were and how they exerted that influence?

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Enacted Mastery experiences

Rate the effect of the following factors on your teaching efficacy:

(0 – no effect through to 8 – very high effect)

2.28	experience of teaching in general	0	1	2	3	4	5	6	7	8
2.29	experience of teaching particularly difficult to manage classes	0	1	2	3	4	5	6	7	8
2.30	experience of teaching high attaining students	0	1	2	3	4	5	6	7	8
2.31	experience of teaching students with special educational needs	0	1	2	3	4	5	6	7	8
2.31	number of hours/days spent teaching	0	1	2	3	4	5	6	7	8
2.32	experiencing teaching a successful lesson	0	1	2	3	4	5	6	7	8
2.33	experiencing teaching a lesson which did not go as well as expected	0	1	2	3	4	5	6	7	8
2.34	trying things out (experience taking risks in the classroom)	0	1	2	3	4	5	6	7	8

Open questions

What enacted teaching experiences affected changes in your teaching efficacy?

What personal enacted experiences affected changes in your teaching efficacy?

OTHER SOURCES OF TSE

List (and discuss very briefly) any other factors contributing to changes in your teacher efficacy (other than the ones already mentioned above). (One per box)

3. Final Reflection of the Year

In the box below, please reflect on the year of your teacher training – e.g. your development, the development of your confidence, the development of your skills, your work with the placement schools, your work with faculty members, your participation in the university course, etc.

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Appendix V

Participant consent form



Consent to participate in a research study.

1. Title of project: The Development of Teacher Self-Efficacy of a trainee Secondary Mathematics teacher during a one-year programme of initial teacher education (ITE).

2. Investigator:

Gosia Marschall
Doctoral Student at Stockholm University <gosia.marschall@mnd.su.se>

3. Purpose of the study: This study aims to develop a rich understanding of how teacher self-efficacy develops during the prospective teacher training year.

4. Study design: The study employs a qualitative approach to data collection and analysis. It consists of lesson observations (captured with field notes), interviews (video or audio-recorded and transcribed) and use of documentation (participants' weekly reflections and MMRS documents completed by the trainee teachers as a compulsory part of the training programme).

5. Mode of participation: I understand that:

- 5.1 interviews will be informally structured and last around 45 minutes
- 5.2 interviews will be electronically recorded for later transcription and analysis
- 5.3 lessons will form part of my regular teaching on the course and will not require from me any special preparation or planning
- 5.4 lessons will be observed by Gosia Marschall
- 5.5 during the lesson observations field notes will be completed by Gosia Marschall

5. Research ethics and risks: I understand that:

- 5.1 my participation is voluntary
- 5.2 I may withdraw from the process at any time and for no reason
- 5.3 my schools, mentors and I are guaranteed anonymity
- 5.4 all data will be stored on secure electronic media
- 5.5 all due care will be taken with respect to my physical and emotional health
- 5.6 I am free to ask of any member of the project team any question that will enable me to understand the project and the nature of my participation
- 5.7 I will be given a copy of my consent form

6. I have read the above and agree to be a participant in this study.

Participant's name (printed)

Participant's signature

Date:

Researcher's name (printed)

Researcher's signature

Date:

Doctoral Theses from the Department of Mathematics and Science Education, Stockholm University

1. Britt Jakobsson (2008). Learning science through aesthetic experience in elementary school: Aesthetic judgement, metaphor and art.
2. Karim Mikael Hamza (2010). Contingency in high-school students' reasoning about electrochemical cells: Opportunities for learning and teaching in school science.
3. Jakob Gyllenpalm (2010). Teachers' language of inquiry: The conflation between methods of teaching and scientific inquiry in science education.
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7. Annie-Maj Johansson. (2012). Undersökande arbetssätt i NO- undervisningen i grundskolans tidigare årskurser.
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10. Cecilia Caiman (2015). Naturvetenskap i tillblivelse. Barns menings-
skapande kring biologisk mångfald och en hållbar utveckling.
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25. Helena Eriksson (2021). Att utveckla algebraiskt tänkande genom lärandeverksamhet. En undervisningsutvecklande studie i flerspråkiga klasser i grundskolans tidigaste årskurser.
26. Gosia Marschall (2021). Reconceptualising teacher self-efficacy in relation to teacher identity. A longitudinal phenomenological study of pre-service secondary mathematics teachers during initial teacher education.