Developing Pre-service Maths Teachers' Resilience Using the Growth Zone Model

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Abstract

This paper reports on action research aimed at developing teacher resilience. Relationships between teacher resilience and teacher retention have been well established; however, less is known about effective strategies for building resilience. Teacher resilience is known to be the outcome of dynamic interactions between everyday challenges and protective resources in a process involving teachers employing practical strategies through harnessing their personal and contextual resources. This research focused on using an intervention programme to develop five aspects of resilience amongst 25 pre-service maths teachers. For a period of one academic year, various approaches for developing motivational, professional, emotional, social and physical aspects of resilience were identified and evaluated. The results of questionnaires and interviews confirm that increasing participants' personal and professional networks, along with their use of the growth zone model, can improve resilience. Adapting the interventions for use within both pre and in-service teachers is a route for future research.

Keywords: Teacher resilience, pre-service maths teachers, five aspects of resilience, growth zone model

1. Introduction

Teaching has one of the highest turnover rates amongst the professions (Harris and Adams, 2007; Worth, De Lazzari and Hillary, 2017). In England, rates of leaving the profession of early-career teachers in some STEM subjects including maths has been particularly high over the last few years (Worth and De Lazzari, 2017). A vast amount of teacher attrition research has focused on reasons and causes for high rates of teacher attrition; nonetheless, one approach to addressing teacher attrition involves developing teacher resilience (Tait, 2008; Scheopner, 2010). Resilient teachers are more likely to persevere, persist and self-safeguard in the face of the daily challenges of the profession and, hence, they may be less inclined to consider leaving the profession (Day and Gu, 2014). It is also suggested that teacher resilience is important for

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enhancing teacher effectiveness and teacher well-being (Le-Cornu, 2013). Additionally, resilience is of importance in teaching for another reason: while resilience in students forms an important part of the current educational agenda, it is only realistic to expect students to develop resilience if their teachers exhibit resilience themselves (Henderson and Milstein, 2002).

Research on teacher resilience is particularly worthy of attention at this time given the current social and political context that surrounds the teaching profession, as most educational researchers agree that teachers' work has arguably become more complex, challenging and demanding than at any other time (Johnson et al., 2015). This is in part due to changes in the social setting and the influences of globalisation and diverse communities on teachers' work (Clandinin, Downey and Huber, 2009). Moreover, Gu (2018) highlights the negative impact of the shift in education policies from provisions and processes to outcomes on teachers' wellbeing, which can potentially lead to difficulties recruiting new teachers and retaining them once they are in the profession.

Even though research offers recommendations for pre-service programmes, to date, there remains limited examples of how such recommendations may be implemented through interventions to determine the relative impact of the identified factors and how to further enhance that impact (Beltman et al., 2018). The research on which this paper is based adopted a new lens to examine strategies for developing resilience amongst pre-service maths teachers: teachers were encouraged to use their agency for building resilience by using strategies relevant for the context they work at.

The purpose of this research was to operationalise the process of resilience development by using interventions to support pre-service maths teachers to employ practical strategies to develop the five aspects of resilience. It; therefore, builds on previous studies (Mansfield et al., 2012; Beltman et al., 2018), and may serve to reduce attrition rates through influencing practice that can potentially increase quality retention and teachers' well-being. This will allow discussion of the implications for teacher education programmes, schools and teachers themselves.

2. Literature review

The first year of teaching can be highly challenging. Considerable research has explored a range of personal and contextual challenges teachers experience early in the teaching profession and various factors have been included. The challenges comprise a wide range from lack of self-efficacy (Day, 2008) to reluctance to seek help (Fantilli and McDougall, 2009), mismatch between personal beliefs and practices (Day and Gu, 2014), behaviour management

(Hudson, 2013), unsupportive leadership and staff (Le-Cornu, 2013) and heavy workloads (Hudson, 2013).

On the one hand, continued exposure to these challenges can lead to depletion of teachers' personal resources along with extra stress and burnout (Beltman, 2015), which are threats to well-being. On the other hand, the exposure to challenges can potentially strengthen resilience through building three resilient capacities of: (1) coping resources, (2) usage of coping and emotional regulation, and (3) resilient beliefs (Crane et al., 2019). The resilience process begins with an initiating stimulus (stressor or challenge) and ends with an outcome, hopefully one that demonstrates or builds resilience. The initiating stressors can activate the resilience process by creating a disruption to the individual's internal and external sense of balance (Sammons et al., 2007); however, the degree of challenge differs between individuals based on their lived experiences (Fleer, 2016), cognitive appraisal (Kumpfer, 2002), perception and interpretation of the challenge as manageable or threatening (Jepson and Forrest, 2006).

The literature explores the complexity of resilience and the range of personal and contextual factors contributing to resilience (Kumpfer, 2002; Beltman, Mansfield and Price, 2011; Galea, 2018). The notion of the complexity of resilience supports the view that resilience needs to be examined in the context of a particular domain, encouraging researchers to study many types of resilience, including resilience in educational settings.

Kumpfer (2002), in his seminal study of resilient children, discusses several issues that can potentially make research on resilience a daunting task. These include a lack of agreement on the conceptualisation of resilience due to its complex nature (Beltman, Mansfield and Price, 2011), biased definitions of the successful outcomes indicative of a resilient individual, definitions of environmental risk protection, and the characteristics of a resilient individual.

To develop resilience; however, the promising key point arising from extensive literature is that resilience can be learnt in a process involving individuals as active agents, instead of resilience being regarded as an innate ability or a set of individual's attributes (Castro, Kelly and Shih, 2009; Mansfield and Price, 2011; Day and Gu, 2014; Beltman et al., 2018).

2.1 Conceptualisation of teacher resilience

The research in the field of teacher resilience is growing (Beltman et al., 2018); however, a review of the literature reveals a range of conceptualisations of teacher resilience due to the complex and multi-faceted nature of this construct (Gu, 2018).

Rather than being considered as a capacity to survive and thrive in extremely adverse circumstances, teacher resilience is now more portrayed as relative, developmental and dynamic, manifesting itself as a fluctuating construct which is a result of a dynamic process

within a given context (Gu and Day, 2013). Based on this view, resilience is more perceived as being closely related to the everyday capacity of teachers to sustain their well-being as well as their professional purposes to successfully manage the everyday challenges that are ingrained in the teaching profession. Additionally, teachers' capacity to be resilient changes as a result of the influences of the personal and professional settings in which they work (Day and Gu, 2014).

The role of human agency in developing resilience is increasingly recognised in literature and that the resilient individuals are actively participating in modifying their context as a part of their interaction with the environment (Kumpfer, 2002; Gu and Day, 2013). In this view, individuals are not only shaped by their context and social factors, but they can also shape the context and control their situations through assessing and controlling their own thoughts, motivations and actions (Bandura, 1989). For teachers, to be an agent is to influence, intentionally, own functioning and school circumstances; that said, human agency is often exercised through collaboration and collective experiences; however, this can be a challenge for novice teachers who generally lack self-efficacy compare to more experienced teachers and particularly beginning maths teachers who are more likely to be the introvert personality type (Per and Beyoğlu, 2011; Göncz, Göncz and Pekic, 2014).

Kumpfer (2002) suggests that resilience needs to be understood in terms of context, process and outcome rather than just identifying static factors or personal attributes. His framework organises the findings of many resilience studies through specifying six areas influencing resilience, namely: the setback or challenge, environmental risk and protective mechanisms (environmental context), individual- environmental interaction processes, individuals' five aspects of resilience (spiritual, cognitive, behavioural, emotional, and physical), resilience processes, and the positive outcome (Kumpfer, 2002).

The current piece of research aims to develop teacher resilience by addressing the five aspects of resilience. Each of the five aspects and related coping skills will be explored briefly in the following sections.

2.1.1 Individuals' five aspects of resilience

Notwithstanding the diverse approaches in the literature about operational definitions of resilience and its conceptual framework, which have been the subject of considerable debate and controversy over the years, there is little dispute that there are individuals whom most people would consider 'resilient' by almost any definition. Resilient individuals demonstrate competencies in five major aspects: spiritual/motivational, cognitive (professional and academic for teachers), behavioural/social, emotional and physical (Kumpfer, 2002; Mansfield

et al., 2012). Using a term such as 'competence' can imply resilience is an innate quality, so to avoid confusion, this term is replaced by 'aspects' of resilience (Mansfield et al., 2012).

To develop a categorical framework for improving understanding of factors influencing resilience, it is crucial to note that these five major aspects involve overlapping categories, for example a teacher demonstrating a sense of humour portrays both emotional and social aspects. Additionally, it should be mentioned that individuals do not necessarily demonstrate all the resilience aspects simultaneously.

2.1.1.1 Spiritual/motivational aspects

The spiritual or motivational aspect of resilience primarily includes teachers' personal and professional values and beliefs as well as their personal and professional identity, which serve to motivate them and create a direction for their efforts. While research suggests that intrinsic and altruistic motivations, such as love of teaching and doing good, are the most important reasons teachers enter the profession (Heinz, 2015), much educational literature recognises that the teachers' motivations as well as their identities are context and role-specific and therefore not stable. Teachers' motivations and their identities depend on both teachers' capacities to manage several influences within their work and lives as well as the nature of support provided in their workplace (Day and Gu, 2014). These in turn will have an impact on teachers' own professional and organisational identities re-shaping their contextual identities.

The success of motivational aspects depends on factors such as aims and goals (Bandura, 1989), strong intrinsic motivation (Gu and Day, 2007), optimism (Le-Cornu, 2013), internal locus of control (Werner and Smith, 1982), perseverance and persistence (Sinclair, McInerney and Liem, 2008).

2.1.1.2 Professional and academic aspects

The professional aspect of resilience involves cognitive (professional and academic) abilities such as using a range of teaching practices (Bobek, 2002), the ability to accept failure, learn and move on (Howard and Johnson, 2004), self-awareness and critical reflection (Le-Cornu, 2013), interpersonal awareness (Luthar, 1991), high levels of efficacy for teaching (Brunetti, 2006) and creativity (Metzl and Morrell, 2008).

Many studies have found more resilient individuals generally have higher professional mastery and academic abilities than less resilient ones (Kumpfer, 2002). Professional mastery is a major protective factor (Garmezy and Masten, 1991) that is influenced by academic and professional achievements as well as learning experiences. Professional mastery can increase self-efficacy, a strong predictor of resilience (Bandura, 1997).

2.1.1.3 Social/behavioural aspects

Hernandez-Martinez and Williams (2011) discuss how the definitions of resilience have been refined over time. Similarly to Beltman, Mansfield, and Price (2011), they describe how the early definitions of resilience were based around the internal traits of resilience before moving towards a definition that expanded to include external social factors such as conditions and environment. They define resilience as 'a dynamic process of interaction between socio-cultural contexts and the agency of developing individuals' (Hernandez-Martinez and Williams, 2011, p.3). The socio-cultural context can include the schools and the school cultures that teachers are working within.

Whilst very similar to professional and academic aspects, social aspects require behavioural action, not just thoughts; individuals may know what they need to do to succeed but lack the necessary social skills to accomplish this aim. Aspects of social competencies include social skills such as strong interpersonal skills that enable the development of social support networks (Tait, 2008), problem solving and help-seeking skills (Castro, Kelly and Shih, 2009), flexibility (Le-Cornu, 2013) and willingness to take risks (Sumsion, 2003).

2.1.1.4 Emotional aspects

An increasing number of scholars are recognising the profoundly emotional experience of novice teaching (McNally and Blake, 2010) and the overwhelming, conflicting, dynamic and nebulous journey that new teachers can experience. It is precisely because of this that the novice teachers' ability to manage and regulate emotions plays a significant role in developing resilience.

Skills of resilient individuals that could be considered within the domain of emotional aspects include relationships with other professionals, recognition of feelings, emotional management and emotion regulation and the ability to restore self-esteem and sense of humour (Bobek, 2002).

2.1.1.5 Physical aspects

Variables have been included in resilience studies that correlate with physical well-being; this aspect includes good health and health maintenance skills such as exercise, good diet and sleep (Werner and Smith, 1982).

Strategies for developing physical resilience involve either the use of direct action to change the situation that is causing stress or attempts to control the stress through relaxation techniques, trying new hobbies or participating in sports activities. These strategies can also lead to developing emotional resilience through an increase in individuals' ability to manage and regulate their emotions (Kumpfer, 2002).

Studies have demonstrated that good physical status is predictive of resilience (Kumpfer, 2002). Individuals with few physical problems, good sleep patterns, and physical strength may internalise this physical strength and interpret themselves as "strong" psychologically as well. In addition, maintaining good health can increase self-efficacy and therefore resilience (Bandura, 1997).

2.1.2 Intervention Programme

The intervention programme for the current research focused on selecting and justifying strategies to operationalise resilience. However, the process of designing and implementing the interventions was challenging owing to the complex, dynamic and distinctive nature of resilience. On the one hand, individuals faced different daily challenges in the context of their schools and classroom; on the other hand, personal and contextual resources available to teachers varied from one school to another. Therefore, a prescribed programme of intervention would not work for all because any intervention had to take into account the differences in teachers' personal and contextual challenges and resources. However, such a programme could serve as a starting point to make teachers aware of the importance of agency in increasing their capacity to be resilient.

To address challenges with prescribed interventions, the current research used an intervention programme that explicitly encouraged a cohort of pre-service maths teachers to utilise their sense of agency; for example, teachers used their agency to decide when they need to recruit support, or which practical strategies may help them overcome their daily challenges. Such an approach to interventions can be a particularly useful way to assist beginning teachers who may have a lower self-efficacy or may be reluctant to seek help.

While the intervention programme aimed at identifying and developing practical strategies that participants could use to harness their unique personal and contextual resources in their various contexts, a theoretical framework was developed to inform the interventions around five aspects of resilience. To achieve this, the programme focused on the following themes:

- What teacher resilience is and why teachers need to develop more resilience
- Practical strategies teachers could use to develop the five aspects of resilience.
- Developing a support network inside and outside school through assigning participants to relational links (teachers, friends and family members).
- Managing and regulating emotions by help-seeking and recruiting support using the growth zone model.

- Collaborative reflective practice sessions to propose changes and modify interventions.
- Collaborative problem-based learning by using a design thinking approach.

Being resilient involves the teacher coping outside their comfort zone, managing emotions successfully and recruiting support when needed, aspects which the growth zone model (Figure 1) supports (Johnston-Wilder et al., 2013). The model draws from a lesser-known development of Vygotsky's zone of proximal development (Zaretskii, 2009).
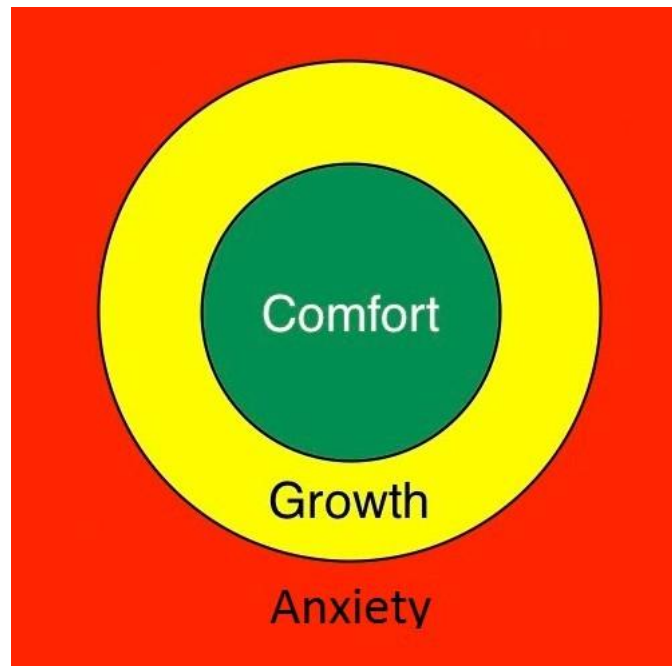

Figure 1. The Growth Zone Model (Johnston-Wilder et al., 2013)

In the growth zone model, the comfort zone (green zone) in the centre of the diagram represents the area where individuals can perform tasks independently and without support. This is often referred to as teachers undertaking accustomed routine practice. However, due to the unchallenging nature of this zone, minimum growth takes place within this zone. The growth zone (yellow zone) is where most growth can happen; in the context of teaching, examples can include: taking on a new challenge, trying a new teaching approach or adapting to a new classroom or school culture, something that pre-service teachers experience during their second school practice. In this zone, teachers need support, collaboration, persistence, perseverance and a sense of agency(Johnston-Wilder et al., 2013). Whilst in the growth zone, the individual needs to be encouraged to take risks, make mistakes and recruit support when needed; this is to avoid the experience of harmful anxiety. The anxiety zone (red zone) refers to the outer zone in which individuals perceive the challenge to be beyond their capabilities, even with support. This can lead to emotional anxiety and may affect individuals' capabilities to successfully carry

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out their normal, routine tasks. Little or no effective growth takes place within this zone, and repeated exposure to this zone can result in the development of persistent anxiety and lack of coping, and avoidance. Agency is the key for keeping a task challenging (yellow) rather than threatening (red).

3. Methodology

De Lisle (2011) argues that mixed methodologies are most useful when researchers are confronted by complex phenomena that cannot easily be understood through a single form of probing. Thus, a mixed method approach was adopted for the current action research to generate a more comprehensive picture of resilience.

The project took place over two key phases; the first phase involved using a qualitative questionnaire to explore teachers' perception of resilience. The second phase included quantitative and qualitative fieldwork to explore changes in the teachers' resilience after the interventions. During phase two the quantitative questionnaire was conducted at three points to provide a snapshot of the change and trends in the resilience score of teachers. Additionally, the semi-structured interviews allowed for data triangulation, tracing change over time and reasons behind the questionnaire results.

The action research involved participation of 13 female pre-service maths teachers and 12 males; the teachers were predominantly between 20 to 30 years of age (20-30, n=19; 31-40, n=4; 41-50, n=2; >50, n=0). In line with BERA's ethical guidelines, prior to conducting the research, teachers provided voluntary informed consent with the right to withdraw; pseudonyms were used to ensure confidentiality and anonymity of the teachers. Throughout the remainder of the report, the members of the cohort of pre-service maths teachers are referred to as 'participants'.

3.1 Phase one

Phase one of the research involved conducting a qualitative paper survey with the participants at the start of the action research.

This phase was used to explore participants' perception of resilience to plan for interventions and to compare the findings with those in the literature to explore emerging findings specific to maths teachers. This was particularly important as, at the time of this research, we could not find evidence of any previous research in the field of teacher resilience specific to maths teachers. For this reason, the open-ended question, *"How would you describe a resilient maths teacher?"* was included in the initial qualitative survey and the resulting data were used in designing the interventions and interpreting the data.

To address the multi-faceted nature of resilience and to obtain a broad set of responses, participants were asked to note down range of attributes, factors and strategies which describes a resilient maths teacher, a system was used to score the importance of factors and strategies attributed to resilient maths teachers.

In total, 25 qualitative paper surveys were completed in phase one. The data was analysed thematically, using NVivo 12, based on theoretical relevance to common themes as well as definitions specific to maths.

3.2 Phase two

The purpose of this phase was to explore the impact of the interventions by conducting 3 quantitative surveys (n=25), one prior to the interventions and two after implementing them to identify the impact of the interventions and to identify new areas for intervention.

Whilst different instruments have been used over the years for studying resilience, two of the most popular and validated instruments are the Connor-Davidson Resilience Scale (CD-Risc) by Connor and Davidson (2003) and the Resilience Scale for Adults (RSA) by Friborg et al. (2003, 2005) both presenting satisfactory psychometric properties for measuring resilience in adults. Contrary to the CD-Risc, which evaluates mainly the internal factors related to resilience including personal competencies and persistence, spiritual influences, positive coping strategies, and stress management, the RSA assesses both the external and the internal factors such as family cohesion, social skills, peer support, personal strength, and personal style (Friborg et al., 2003).

In a recent study carried out by Daniilidou and Platsidou (2018), the researchers combined both RSA and CD-Risc instruments to identify a single scale that could measure the teacher resilience. This led to the design of a new scale: the 26 items Teachers Resilience Scale (TRS). Overall, the TRS assesses the most common protective internal and external factors of resilience in teachers and the psychometric properties of the TRS have been found to be satisfactory (Daniilidou and Platsidou, 2018).

The new teacher resilience scale (TRS) comprises of personal and emotional competencies (9 items), spiritual influences (3 items), family cohesion (6 items) and social skills and peer support (8 items): factors that are all reflected in the five-aspects of resilience aside from the physical aspect. To address this missing aspect in the questionnaire, four questions were added to capture participants' engagement with the physical aspect as a process of resilience building. A 5-point Likert scale was used for responding to the questions on the TRS scale.

In addition to the TRS scale, one-to-one semi-structured interviews (n=10) were conducted to assess the effectiveness of the interventions along with descriptions of the type of challenges and strategies to overcome the challenges. Since a semi-structured interview guide was used flexibly, not all participants were asked questions in the same way. Additional information was gathered on the type of actions taken to overcome the challenge and to explore common themes, factors and strategies contributing to teachers' resilience. Using NVivo 12, themes common to all teachers were identified and noted, as were differences. Responses were then categorised based on theoretical relevance to the five aspects of resilience. Data were analysed, and emergent themes noted during analysis. There was a constant tension between remaining true to the data (inductive approach) and using the five-aspect framework to inform the coding process (deductive approach); where a trade-off was necessary, remaining true to the data was prioritised.

Key interview topic areas included:

- Participants' main challenges and threats during the pre-service year;
- Participants' main strategies to overcome the challenges and threats;
- The effectiveness of the interventions;
- Thought processes and time taken to implement the intervention strategies to develop resilience;
- Other possible strategies and possible changes to the interventions that could have helped participants to further develop resilience;
- How likely participants were to stay in teaching and reasons for this.

3. Results/ Findings

3.1 Phase one

Although it was apparent from the responses that participants interpreted our questions to focus on personal aspects of teacher resilience, the data were also examined for references to the process, context and the outcome.

To begin, participants' data from the qualitative surveys were coded using an iterative and deductive process to find categories relevant to the theoretical framework. Initially, each response was coded in more than one category as participants had mentioned multiple aspects of resilience in their responses. The next step involved individually coding the remaining data inductively by identifying unique ideas and text phrases relevant to maths in each response. In this process, it was important to remain true to the data by retaining participants' words and phrases to avoid bias and misinterpretation of data; different words and phrases with the same

meaning were coded identically. We then used the coded data to identify new categories. Coding continued until 10 categories were identified to reflect the data (Table 1).

The multi-faceted nature of resilience was evident in the data as many participants provided data that referred to more than one aspect. The participants described a 'resilient maths teacher' using aspects that could be further coded into four of the five aspects but not the physical one. The results indicated that participants had less or no focus on the social and physical aspects as dimensions related to the resilience; therefore, we decided to further focus on the development of these two aspects through interventions.

Table 1. Definition of a Resilient Maths Teacher

Definition	Number of Responses
A resilient maths teacher is prepared to explain a concept more than once and in different ways until students understand the work- **professional aspect**	18
Someone who can enable even the most negative students to develop and enjoy the subject they are studying through determination to succeed, even when feeling beaten- **professional and emotional aspects**	8
Continues to help and care about their students' development even if their students no longer seem to care- **emotional and social aspects**	8
Remains positive, motivated and perseveres- **motivational and emotional aspects**	8
Is easy to talk to, approachable and shows empathy when students struggle with maths- **social and emotional aspects**	4
Has the ability to achieve development amongst their students despite an array of challenges- **professional, motivational and emotional aspects**	4
Can bounce back and adapt to different situations- **professional, motivational and emotional aspects**	3
Helps students enjoy and learn maths through making connections and applying it to the real world- **professional aspect**	2
Is committed to students and patient when students struggle with maths- **professional and emotional aspects**	2
Asks for help when needed- **social aspect**	1

3.2 Phase two

The results of TRS scale were analysed to calculate the group's mean score and the standard deviation at three points: the start, the middle and the end of the research (Table 2).

The post-test results indicate a slight, non-significant improvement in professional, spiritual and emotional aspects of resilience ($p > 0.05$), whereas the motivational, social and family cohesion aspects of resilience improved with a significance ($p < 0.05$). Additionally, the mean score of overall resilience improved significantly ($p < 0.05$).

Table 2. Results of Teacher Resilience Scale

Aspects of Resilience	Mean pre-test	Mean mid-test	Mean post-test	Standard Deviation post-test
Professional Resilience	3.520	3.700	3.800	0.6495
Spiritual Resilience	2.880	3.067	3.372	1.145
Motivational Resilience	3.587	3.960	3.920	0.7020
Emotional Resilience	3.480	3.660	3.620	0.7943
Social Resilience	3.230	3.995	4.302	1.401
Family Cohesion	3.633	3.927	4.148	0.7072
Overall Resilience	3.451	3.797	3.986	0.7066

The results of the additional questions assessing participants' physical resilience shows improvement in this aspect of resilience (Table 3).

Table 3. Results of Teacher Resilience Scale- Physical Aspects

The statement which describes participants' sleeping, eating and exercise pattern.			
	Percent pre-test	Percent mid-test	Percent post-test
Sleeping Well	52.0	70.1	64.0
Lack of Sleep	48.0	29.9	36.0
Good Sleep Patterns	40.0	58.6	56.0
Disturbed Pattern	60.0	41.4	44.0
Good Diet	36.0	47.6	64.0
Eating Less Healthy	64.0	52.4	36.0
Regular Exercise	32.0	44.0	40.0
Little or No Time for Exercise	68.0	56.0	60.0

Thematic analysis of interview data, carried out at the end of the research, led to identification of the following personal and contextual challenges (Figure 2).

In the semi-structured interviews, the professional-related challenges in the participants' responses included behaviour management and aspects concerning the practice of teaching, particularly enabling lower-attaining students to engage with maths. Participants felt that teaching lower-attaining groups had a negative impact on their self-efficacy and their motivation; this was in addition to the challenges of being a novice teacher, as James stated:

> *I'd say one of the main challenges is dealing with trickier students. I think, coming into a new setting, especially where there's one- When there's a set routine in there, particularly with the class teacher, I think walking into that and taking over, can be quite tricky. I think a lot of students these days know when a student teacher walks in.*

Despite regular reflective practice to develop their teaching strategies with lower-attaining students, participants felt they had not yet been able to overcome this challenge successfully.

Challenges related to motivation included maintaining professional values, sustaining motivation to stay in the profession despite challenges, and perfectionism: the setting of unrealistically demanding goals accompanied by a disposition that regards failure to achieve them as unacceptable.

The social challenges consisted of lack of support from mentors and family and being isolated in the school along with reluctance to seek help. The emotional challenges were mainly mentor's lack of positive feedback and emotional responses to the negative feedback; this is best exemplified in the words of Naomi:

> *I think, with the training, the challenge is just having someone observe and then giving you feedback. Sometimes, when they're criticising- I think I went through a period where it was just negative after negative, and it was demoralising, you don't have any motive, you feel like you're doing everything wrong.*

Finally, the challenges related to physical aspects concerned lack of time to engage with physical activities, lack of lunch break and/or sleep due to either stress or work demands. Results show that the type of challenges that the participants encountered changed from time to time and the major challenge concerning all participants involved issues with heavy workload and work/life balance, as Stacey explained:

> *The main challenge for me is having enough time to get everything done. So, having time to plan all my lessons, make sure I've got answers to everything, and also having*

time to do all the assignments that we've got to do. I feel like I haven't had time to have

a work/life balance, because I, kind of, get home, eat, chill for, like, an hour, and then

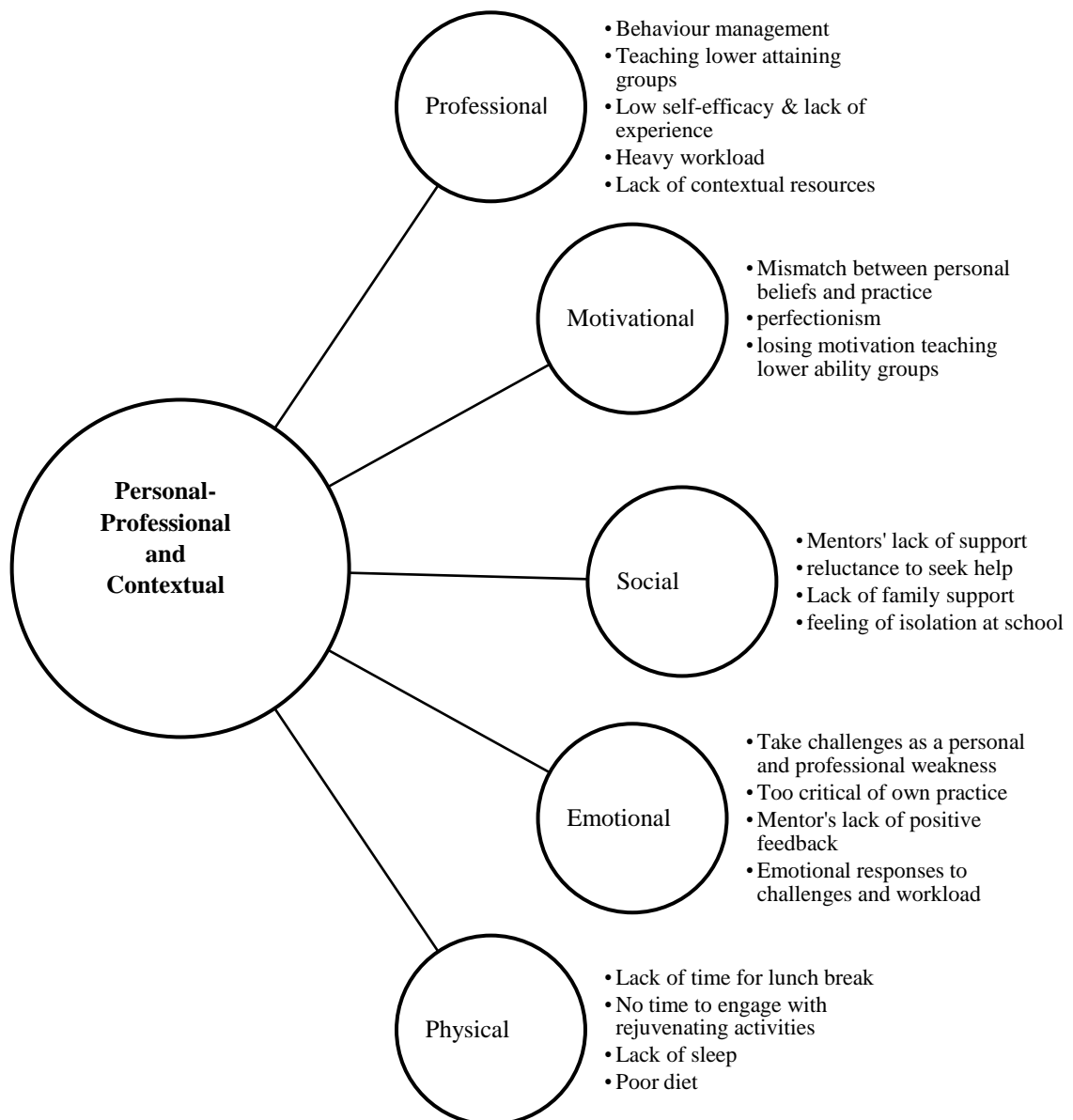*the rest of the time is planning lessons.*

Figure 2. Personal- Professional and Contextual Challenges

The interview results suggest that, for participants, strategies to overcome challenges changed depending on the context, type and the degree of the challenges (Figure 3). This is consistent with the notion that the participants had to employ *everyday resilience,* which involved their participation in a flexible and regular process of resilience building.

Participants felt that interventions made them aware of the importance of recognising and regulating their emotions while facing challenges along with various strategies they could use to overcome challenges with support of others. Moreover, repeated exposure to daily

challenges gave them adequate experience to reach a stage when they could recognise and regulate their emotions more effectively.

Underlying the success of developing teacher resilience in this study is the notion that the resilience stemmed from participants' collaborations with their personal and professional network (relational links) to discuss their options for addressing the challenges in a process involving collaborative problem solving. The support of their relational links and their empathetic relationships was captured in the interviews for instance:

> *The connectedness and how teachers can build resilience through developing personal and professional networks, I definitely found that useful. As I said, I implemented it with my professional mentor at school and I found the department that I worked within was really good at just- if I had a problem, I'd go to them and two or three people would be more than happy to help me.* (Levi)

At the time, when participants were finding themselves in the anxiety zone due to the nature of the challenge or facing multiple challenges, the relational links were found helpful in supporting participants overcome challenges. The relational links were used by the participants as 'direct actions' to change the situation and overcome the daily challenges of the job as Sarah noted: *I've spoken to the teachers about my problems with behaviour management, and I've asked them what they've done in previous cases, and I've tried to replicate that'.* In contrast, the physical activities were used as 'palliative action' to develop coping skills and to control stress through relaxation techniques; for example:

> *I took up karate as just exercise to try and reduce stress, and also just a hobby-type thing, and that helped when I found the time to do it. Often, I found myself knowing I need to plan these lessons, so I can't go to karate.* (Stephen)

The findings from interviews conducted at the end of the pre-service programme suggest that most participants were either too busy or too tired to engage with any kind of physical activities after school.
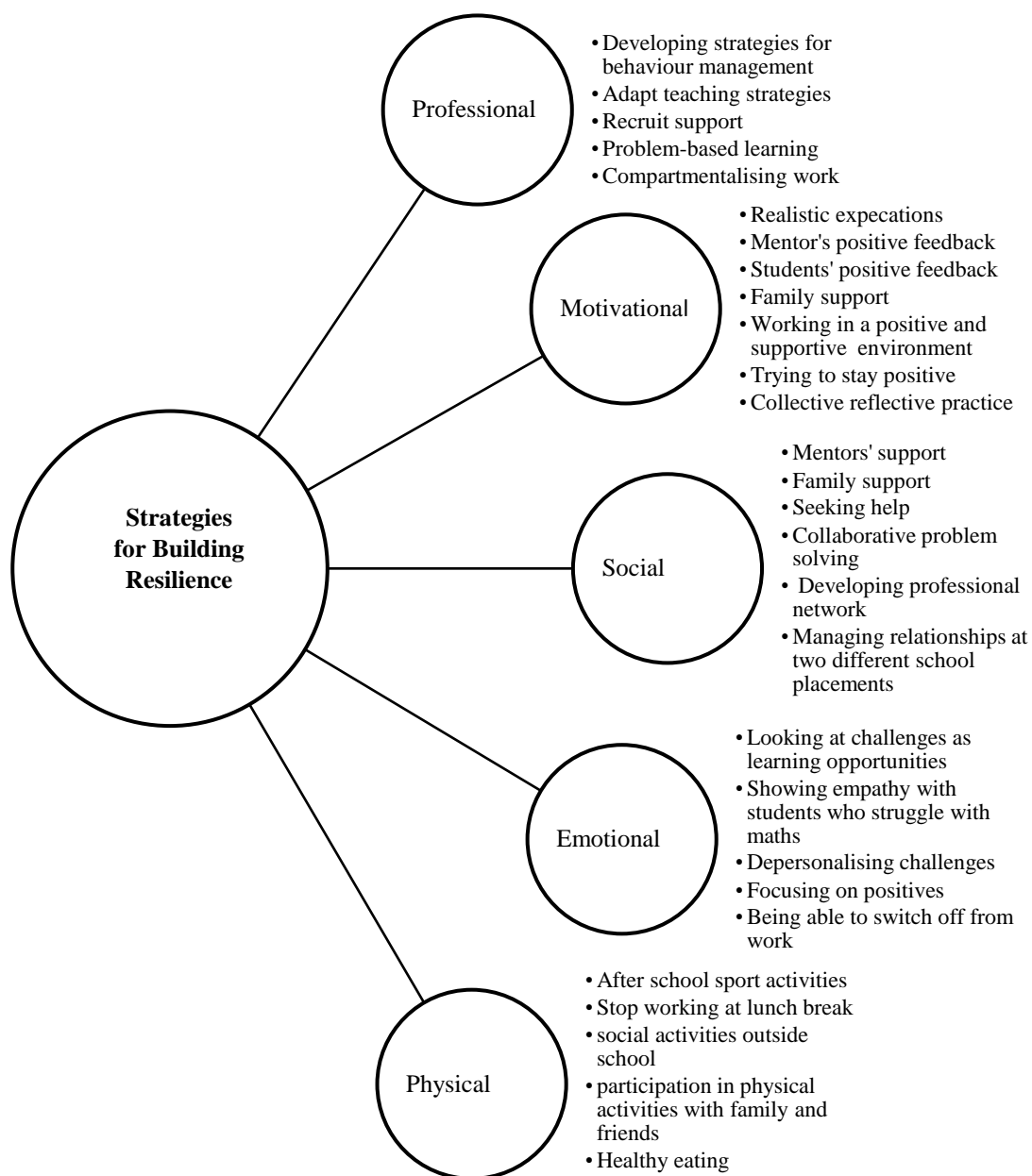
Figure 3. Strategies used by the participants for Building Resilience

4. Discussion

4.1 Phase one

Understanding the factors and processes that contribute to developing resilience amongst pre-service maths teachers involves engagement with a complex and challenging process.

Whilst phase one was used to explore participants' perception of resilience; it therefore seemed very unlikely that participants' perceptions of resilience could be described by a single aspect,

but rather it is likely to be characterised by multiple, possibly inter-connected aspects that teachers can draw upon in their everyday practice. Furthermore, what are deemed the most important aspects of resilience can be seen to differ amongst participants depending on their particular environmental context and type of challenge, or their perceptions of the challenges. One possible advantage in using the five-aspect framework to investigate and conceptualise teacher resilience lies in the overlapping nature of the aspects and the underlying recognition that, from the perspective of participants, teacher resilience is a multi-faceted construct. This framework is congruent with the resilience process identified by larger-scale studies noted in the literature review (Mansfield et al., 2012). Organising the participants' perception of resilience into a five-aspect framework was useful for capturing a holistic and authentic view of teacher resilience and for planning the intervention programme.

During the first phase of the research, the most common aspects reflecting participants' understandings of resilience were the professional aspects. Given that many participants described a resilient maths teacher as one who is prepared to explain a concept more than once and in different ways, it seems that the description of a resilient maths teacher involved a specific set of professional aspects unique to maths due to the more abstract and complex nature of the subject along with the way maths is taught in schools (Nardi and Steward, 2003).

The other most common aspects highlighted in the responses of participants concerned emotional and motivational resilience respectively. This is consistent with research highlighting the role of emotions and motivations in teaching and their relationship to factors associated with high rates of teacher turnover (Sinclair, McInerney and Liem, 2008; Schutz and Zembylas, 2009).

Another distinctive feature of a resilient maths teacher described by the participants was their ability to be empathetic to students who struggle with maths. This feature was further explored through the semi-structured interviews and it was noted that a group of participants had previously experienced issues with their maths teachers' lack of empathy in their time as a student. This perezhivanie and lived experience (Fleer, 2016) had made these participants aware of the importance of teachers' empathetic relationship with students; Werner (1985) suggests that resilient individuals demonstrate responsibility and empathy towards the needs of others.

Finally, the least frequent aspects of resilient maths teachers, as suggested by the participants, comprised social and physical resilience. Given that teachers' work involves interaction and relationship with students and colleagues, it was surprising that the social aspects of teaching were least frequently mentioned. Social support from colleagues and family has been thought

important in teacher resilience (Day, 2008) yet building support and help-seeking was only mentioned by a small number of our participants. These findings are similar to other empirical research which suggests that novice teachers are less likely to seek help as they fear this may be interpreted as their weakness in professional competence (Doney, 2013). Additionally, this could be an aspect specific to maths teachers who tend to have an introvert personality type (Per and Beyoğlu, 2011).

The comments from participants also suggested that there may well be additional aspects of resilience that are unique to novice teachers or maths specialists. For example, aspects such as being critically reflective may be considered more appropriate to novice teacher or the ability to regulate emotions so as to 'not take pupils' mathematical disengagement personally' or 'being able to pick yourself up after teaching a lower ability group' could be specific to maths teachers. It may be that these are aspects particularly important to the teachers in our sample in the English context; it does suggest, however, that more research would be beneficial.

4.2 Phase two

The results from the TRS scale shows that the intervention programme had more success in developing participants' social and motivational aspects of resilience. This success could be related to the nature of the interventions which had more focus on developing resilience using relationship building strategies. The data from the TRS scale indicate that the interventions had less success in developing participants' professional, emotional and physical resilience. On reflection, while modifying the interventions to equally focus on these aspects can be a way to move forward, the final TRS scale was completed when participants experienced various professional and academic challenges including external lesson observations and university assignments during their final weeks of the pre-service programme. Crane et al. (2019) argues that exposure to multiple challenges can result in individuals' depletion of resilience; hence, perhaps it would reasonable to suggest that the participants' lower score in the final TRS scale could be associated with the temporal factors and their experience of simultaneous multiple challenges during the final weeks of the pre-service programme.

The findings from the interviews illustrate that participants used various strategies to overcome challenging situations; these include:

- Developing professional mastery through gaining experience and with the support of their relational links.

- Retaining a positive teacher identity through an ongoing discussion involving successful negotiation of the teacher identity as a part of reflective practice sessions at university.
- Emotional management and regulation of emotions using the growth zone model.
- Social competence through building relationships and seeking help.
- Taking up physical activities as a coping strategy.
- Managing workload and maintaining work/life balance by compartmentalisation.

Our study found that resilience was enhanced when the participants were able to retain a strong sense of their personal agency (Bandura, 2000) while at the same time working through the uncertainties of their new teaching roles. At the start of the intervention, not all participants felt comfortable or confident enough to seek help whilst in the anxiety zone. As the participants' autonomy grew, they became increasingly aware of the importance of engaging in secure and empathetic relationships, at both personal and professional levels.

Additionally, at the beginning of the programme, not all participants were comfortable or confident with the use of the strategies introduced during the intervention sessions, but the more experience they gained with employing them, the more the strategies became natural and habitual to them, to a point that a group of participants even found themselves using them regularly for solving problems outside of the work context.

Our findings confirm that developing resilience takes place in social practice (Sammons et al., 2007). The relationships that the participants developed with their relational links and other participants appeared to promote their resilience by increasing their self-efficacy, skills of critical and empathetic reflection, problem solving and coping skills. Moreover, these relationships meant that the participants were able to maintain positive feelings such as interest, enthusiasm and trust through engagement in supportive non-judgmental relationships.

The collaborative reflective practice taking place at university fostered the participants' resilience by building their self-efficacy (Bandura, 1997) through their vicarious experience (comparing their performance with peers and the realisation that others experience the same types of challenges). Discussions with the other participants provided opportunities for a reality check in that the participants were able to confirm many of the same feelings and similar experiences and this resulted in developing the participants' capacity to cope with new challenges (Gu and Day, 2007).

Our study confirmed that the participants' engagement in the problem solving with the relational links assisted them in developing their teaching resources and also their ability to

adapt their teaching practice. Nonetheless, there remained challenges with teaching lower-attaining groups as participants felt it was extremely challenging to sustain their motivations despite their lower attaining students making little or no progress in maths. In the words of Fran: '*The real problem is that the mentors want to see quantified progress; my students enjoy their maths lessons but apparently this is not enough*'.

Additionally, our study has provided insights about the nature of the professional support received from the relational links. Participants particularly appreciated their autonomy and sense of agency as they were actively engaged in the problem solving rather than passively being advised or guided by their relational links. They were viewed as active participants in their own learning as well as being able to contribute to others' learning through sharing ideas and resources.

Participants mentioned the importance of learning about compartmentalisation in the interventions to manage their heavy workload. Whilst in psychology compartmentalisation is considered as a coping strategy that allows individuals to deal with internal conflicts simultaneously by inhibiting direct or explicit interaction between separate compartmentalised challenges (McWilliams, 2011), for the participants, this meant isolating each challenge or task from all the other challenges or tasks they were dealing with. The process of compartmentalisation required participants to apply extreme focus on each compartment, but only for a short period of time. Once they made progress, they closed the compartment and focused on the next one. This process helped participants to avoid thinking about work once they left school, so they could focus on the compartments related to their life outside school. The importance of an effective work–life balance has already been highlighted in a study of resilient practitioners in the field of social work (Kinman and Grant, 2011; Grant and Kinman, 2012).

The responses from participants in this study show that participants experienced different types of challenges at different levels. This highlights the difficulties in investigating resilience, especially as it may only be evidenced in contexts where challenges are present.

Using the five- aspect framework to examine the development of teacher resilience and their inter-connectedness has potential implications for initial teacher education (ITE) programmes. Emotional management (Meyer, 2009) and physical activities, for example, receive minimal attention in ITE programmes in England. If initial teacher education programmes aim to support the development of teachers' resilience, all aspects of resilience should be addressed at appropriate times of their programme. Although ad hoc professional development sessions for building teacher resilience are available, currently many ITE programmes offer limited

sessions or will only focus on a limited number of skills, such as offering students' support to cope with work-related stress. This was captured in the interview transcripts in which participants demanded the implementation of a teacher resilience module into the ITE programme. While participants thought the intervention programme was effective in empowering them to build capacity for resilience, they would have liked more collaboration between the ITE programme and the schools to plan for individualised interventions based on different participants' needs.

The findings from this research demonstrate strong connections between teacher resilience and the context as participants consistently made reference to context when describing a resilient maths teacher. This highlights an area for further investigation; perhaps, a useful next step would be to explore how maths teachers interact with challenges or setbacks in a given context. Finally, the results of the interviews show that all participants expressed their willingness to remain in the profession despite the everyday challenges and setbacks of teaching. Although at the time of this research all participants are still working as teachers, it is too soon to hypothesise any direct link between the interventions and the retention rate which has been around 85-90% in the previous years.

5. Limitations of the study

While the validity of this study stems from the multiple sources of data and length of the study, this study is limited by data collection of a relatively small sample size through both quantitative and qualitative methods.

Since the participants were selected from the same ITE programme; they had experienced the same pre-service course and they had been systematically targeted for the research. Given the importance of context, examining the views of participants from a wider range of pre-service contexts and outside of one university would provide a study where findings could be reported with more certainty.

Another limitation to this study is the context in which the participants were situated. Grammar schools were not a part of this study, and only comprehensive and independent schools were included. Research can further explore resilience in different contexts including Grammar school settings too.

6. Conclusion

Although resilience amongst learners has been well studied by researchers from multiple disciplines, there remains limited empirical research on developing resilience in teachers.

Whilst much can be captured from the resilience literature, the complex and challenging nature of the teaching profession demands that research focus on the factors that contribute to teachers' development of resilience. This paper highlights the operationalisation of teacher resilience through interventions using the five-aspect framework and the strategies for building the resilience of pre-service maths teachers.

The findings from phase one illustrate how pre-service teachers of maths described resilience mainly as a professional competence. Phase two was then conducted to examine the process of resilience development through implementing interventions to investigate how resilience can be developed in action.

Our study has highlighted the crucial role of growth-enhancing social resilience and increased awareness of the role of recruiting support and agency in development of maths teacher resilience. Developing and nurturing personal and professional relationships with the personal and professional network enabled the pre-service teachers, participating in this research, to develop their self-efficacy, problem solving and their coping skills.

Additionally, the self-care activities and the compartmentalisation of tasks to manage the workload and to maintain the work/life balance enhanced the participants' somatic and emotional states leading to increase in the physical, professional, motivational and emotional resilience. The critical message from this research is that everyone surrounding pre-service teachers, and the pre-service teachers themselves, can have an active role in development of teacher resilience.

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