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Exploring Teachers' Perspectives About Executive Functions
in the Primary School Context in New Zealand

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Abstract

Cognitive psychology research has suggested that executive functions (EFs), a set of cognitive skills that facilitate goal-directed behaviour, play an important role in learning and academic success. EFs, comprised of the three core cognitive components of inhibitory skills, working memory, and cognitive flexibility, are also associated with social-emotional learning and competency. Research has also shown that targeted teaching and practice can improve EFs, with far reaching benefits. However, there is currently little evidence about whether teachers are aware of these skills, or of their importance. This study, therefore, explored New Zealand primary teachers' perspectives about EFs as a necessary first step to understanding teachers' knowledge, values and practice in New Zealand.

The study used a mixed methods design to obtain quantitative and qualitative data through an online survey. Results indicated that teachers were generally aware that there is a set of non subject-specific skills that are important to learning, but their knowledge and understanding of EFs themselves, prior to completion of the survey, was limited. Teachers rated all EFs as very important to learning and the majority of teachers were already attempting to support development of EFs within their classroom practice. Knowledge of and use of specific activities or teaching strategies to target development of specific EFs was limited, however many teachers were providing learning environments conducive to using and practicing EFs.

This research highlights the need for professional development and support for teachers to develop their understanding of EFs. It also demonstrated a need to provide teachers with a range of teaching strategies and activities to integrate within their current learning environments in order to better support development of EFs within their students.

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Chapter One

Introduction

Overview

This study focuses on teacher perspectives about an area of cognitive psychology called executive functions (EFs). This introductory chapter presents the context of the study and introduces some of the key terms used in the research. This is followed by the rationale for the study, and finally by a summary of how the structure of the thesis is presented.

Background to the Study

Cognitive psychology research is important to education because it enables the processes and mechanisms behind successful learning to be revealed. In the past two decades, a significant amount of attention has been given to the domain of executive functions (EFs), a set of cognitive skills that facilitate goal-directed behaviour and that include suppressing distracting information and unwanted responses (i.e., inhibitory skills), monitoring and manipulating information in mind (i.e., working memory skills), and flexible thinking (i.e., cognitive flexibility skills) (Gilmore & Cragg, 2014). EFs are considered to regulate the basic cognitive processes that underpin all domains of academic learning and achievement (Best, Miller, & Jones, 2009; Bierman & Torres, 2016). EFs are also associated with social-emotional learning and competency (Rabhari & Vaillancourt, 2015). Longitudinal research has suggested that the EFs skills of young children are a better predictor of future performance on many measures of social and academic success than IQ or socio-economic status are, even after controlling for almost every other variable possible (Diamond, 2014; Moffitt et al., 2011; Samuels, Tournaki, Blackman, & Zilinski, 2016). Just as well-developed EFs predict positive outcomes for students, the reverse is also true, in that students experiencing delays or difficulties with EFs will have a less positive experience with academic and social-emotional learning (Blasco, Saxton, & Gerrie, 2014; O'Toole, Monks, & Tsermentseli, 2017). Fortunately, research has also shown that there are strategies that can be learned and practiced from an early age that can improve EFs, with far reaching benefits (Diamond, 2014; Samuels et al., 2016). What is less clear from the literature is how well known the research findings are to teachers.

To date, much of the research into the role EFs play in learning, has been carried out in controlled, experimental studies away from classrooms (Gilmore & Cragg, 2014). It is therefore difficult to determine if the role EFs play in learning is evident within the

classroom environment, and whether teachers know about it and know how to recognize it. For example, with young children, the ability to sit quietly and not interrupt the teacher is widely accepted as a necessary behaviour that a child must master in order to be able to effectively learn academic content (Willis, Dinehart, & Bliss, 2014). But are teachers aware that this skill is actually an early developmental manifestation of EFs, specifically inhibition? The ability to suppress the impulse to call out to the teacher relies on the same inhibitory skills that in older children might be displayed by the ability to suppress distracting information in a word problem in order to attend to just the relevant information. However, success in the latter scenario depends on mastery of the earlier developmental manifestation of inhibition. In other words, teaching strategies that focus on developing EFs might predictably make more of a difference to future academic success than teaching strategies that focus solely on academic content.

Rationale for the Study

Given the strong association between EFs and academic success, it is important to understand the extent to which the theory, backed by research, translates into educational practice. This is particularly salient for primary schools, since younger children are the optimal age for rapid development of EFs (Diamond, 2013). The overall objective of this study therefore is to better understand if primary classroom teachers are well informed as to the nature of and importance of EFs, and furthermore, do they know how to develop EFs in their students. The study aims to understand what the current level of understanding and practice for EFs is in New Zealand since there is currently no research on this topic in New Zealand.

In order to gather information about teachers' perspectives the study utilized an online survey. To keep the study size manageable, the survey targeted a random sample of New Zealand primary school teachers. The survey was designed to explore teachers' level of knowledge about EFs and their current pedagogical practice including strategies, activities or explicit teaching to help students develop their EFs. A third element to explore was teachers' views about the value of EFs. This was explored because the success of any future professional development or intervention regarding EFs may depend on whether teachers value EFs and are motivated to help develop them in students (Deci, Olafsen, & Ryan, 2017).

It is hoped that the results of this study will help to build a picture of the current level of knowledge, understanding, value and practice of EFs amongst a sample of New Zealand primary school teachers. The information gained about teachers' current

perspectives and practice can help inform appropriate next steps, such as professional development and inclusion of information about EFs into teacher training, so as to be able to capitalize on the cognitive research findings within New Zealand primary classrooms.

Organization of the Thesis

This research thesis is presented across five chapters. The present chapter introduces the research context, the key terminology associated with the study, and the rationale for the study. Chapter Two provides a review of the literature related to executive functions (EFs), states the research questions guiding the study, and gives the definition of EFs that is used throughout this study. The nature of each of the three EFs (inhibitory control, working memory, and cognitive flexibility) and how they manifest in children is evaluated, along with a review of their importance for learning and life in general. The chapter concludes by examining the significance of EFs to schools and teachers, the relevance of teacher perspectives to pedagogical practices, and the need to examine the New Zealand context.

Chapter Three details the mixed methods research approach, based on a constructivist paradigm, which utilised a survey to explore teachers' perspectives about EFs. Details of the research design are described, including ethical considerations, sample randomization processes, participant recruitment, questionnaire construction, and data analysis.

The results of the qualitative and quantitative data are presented in Chapter Four. The results are presented in four sections; teacher demographic data in the first section, followed by the three research questions and the key themes and trends relating to each of them.

Chapter Five discusses the significance of the findings provided in the results chapter. Trends and themes are compared to the literature, and critically examined in relation to the three research questions. Interpretations of the results are summarized, followed by an explanation of the limitations of the study. The chapter concludes with implications and suggestions for further research. The thesis uses a five-chapter structure and concluding statements are within the fifth chapter.

Chapter Two

Literature Review

The term executive functions (EFs) refers to a set of high-order cognitive skills that enable individuals to stay focused, think before acting, control impulses, delay gratification, behave rationally and reflectively, solve problems, shift mindset as demands change, and undertake strategic goal-orientated planning (Diamond & Ling, 2016). These skills are developed and undergo great changes throughout childhood, adolescence and into adulthood (Bagby, Barnard-Brak, Sulak, Jones, & Walter, 2012). Strategies for enabling EFs such as self-control can be learned and practiced from an early age, with far reaching benefits (Murray, Theakston, & Wells, 2016). EFs are considered critical for success in many aspects of life, and recent research suggests they might be a better predictor of future success than IQ or socioeconomic status (Diamond, 2014; Samuels et al., 2016). Despite the robust links between EFs and academic success, much of the research still derives from a cognitive psychology perspective rather than an educational perspective, and it is unclear how well the gap between the empirical, cognitive data and teacher knowledge and practice has been bridged.

In the literature review that follows, a definition of EFs will be derived from a synthesis of prominent studies in the field of cognitive psychology. A description of how EFs are expressed in children will then be given. The importance of EFs to children within the educational context and life in general will be ascertained. This will be followed by an exploration of the relevance of EFs to teachers and schools. Finally, the significance of teacher knowledge will be examined, and current beliefs and understanding within the New Zealand school context reviewed.

Reaching a Definition of Executive Functions (EFs)

Over the past few decades the definition of EFs has undergone many iterations and there has been a shift in conceptualization from being a unitary construct of frontal lobe function (Baddeley, 1990) to a set of collaborative, hypothetical cognitive processes (Anderson, 2001; Gibb, Piquette, Harker, Raza, & Rathwell, 2015). At the most basic level, EF refers to domain-general psychological processes that are associated with the cognitive abilities required for conscious control of attention and behaviour in order to achieve a goal. This is in contrast to domain-specific skills, which are more commonly associated with academic functioning, such as knowing the letters of the alphabet or multiplication facts.

Research into EFs has historically emanated from cognitive psychology, using neuropsychological perspectives, and involved the study of patients with frontal lobe damage who demonstrated intact IQ performance but who displayed impaired performance on executive (frontal lobe) tasks, including the regulation of emotion and attention (Blair, 2016). More recently research has shifted to a focus on individual variance within normally developing populations from a variety of perspectives, including developmental psychology, developmental psychopathology, and educational psychology (Zelazo & Müller, 2011). Subsequently, a number of models have been devised to try and capture the processes central to EFs (Miyake et al., 2000), with some researchers opting to narrow the definition of EFs to just two core skills (Bell & Cuevas, 2016; Gilmore, Keeble, Richardson, & Cragg, 2015). However, most researchers currently associated with studies of EFs draw on the results of neuroimaging studies to support a definition that there are three core neurocognitive skills that are dealt with by the prefrontal cortex, and which sub serve further, more complex EFs such as self-regulation (Best et al., 2009; Blasco et al., 2014; Hui-Chun & Gray, 2017; Miyake et al., 2000; Monette, Bigras, & Guay, 2011). The three core skills most commonly referred to in definitions of EFs throughout the literature are *inhibitory control*, *cognitive flexibility*, and *working memory*, and this, therefore, is the definition used for this study.

Inhibitory control. Inhibitory control (also referred to as inhibition, or impulse control) involves the ability to consciously override an impulse or habit to act in one way (Hui-Chun & Gray, 2017), whether due to external stimuli or internal predisposition, in order to act in a different and more appropriate way (Diamond & Ling, 2016). This ability to actively choose how to react and behave ensures that we thrive in a civilized society governed by rules and norms, giving measured responses rather than impulsive ones, waiting our turn, and resisting temptations that do not serve us well. Inhibitory control is also the process that enables irrelevant or distracting information to be screened out so that it does not distract us and interfere with our performance on the task at hand (Diamond, 2014; Molfese et al., 2010).

Inhibitory control is the one element of EFs most commonly linked with another commonly cited developmental construct, self-regulation, partly due to overlaps with terms such as self-control and impulse suppression (Willis et al., 2014). Some studies define inhibition as a specific, measureable cognitive skill separate from, but a contributor to, the larger construct of self-regulation (Anderson, 2001; Diamond, 2014;

Diamond & Ling, 2016; Molfese et al., 2010). Others question if temperament-based inhibition of emotional reactivity, a commonly used description of self-regulation, is significantly dissimilar to the cognitive-based inhibitory control of EFs (McClelland & Cameron, 2012), and some use the terms interchangeably (Blair, 2016; Cuevas, Calkins, & Bell, 2016; C. J. Holmes, Kim-Spoon, & Deater-Deckard, 2016). For the purpose of this study, self-regulation will be considered to be a separate construct, defined as the conscious control of thoughts, feelings and behaviours (McClelland & Tominey, 2014), but at the heart of which lie the three core EFs.

Working memory. Alan Baddeley is the most prominent name associated with studies in working memory and in 1974, along with Graham Hitch, he devised the original working memory model (Baddeley & Hitch, 1974) from which numerous revisions have subsequently been made. A simplified description of working memory describes it as a process involving holding information in mind whilst mentally working with it. Thus working memory involves both remembering information in the short term, and incorporating new information to synthesize with the original information. Working memory is a critical component in reasoning and problem-solving tasks, completing multi-step instructions, and completing mental calculations (Blasco et al., 2014; Hui-Chun & Gray, 2017). It is also critical for any other activity that unfolds over time (Diamond, 2014), such as reading for example, where the words read at the start of a sentence or passage need to be held in working memory until the last words have been read, in order to make sense of the whole (Diamond & Ling, 2016).

Cognitive flexibility. Cognitive flexibility, also referred to in some literature as shift (Bagby et al., 2012; Blasco et al., 2014), or attentional flexibility (McClelland & Tominey, 2014), is the ability to focus attention on one task, then change attention and focus on another, different task, in response to changed priorities or demands. It also involves the ability to think creatively, beyond the obvious, in order to problem solve or be able to see things from another perspective. Cognitive flexibility also works in conjunction with the other two core EFs, for example when faced with a need to change perspective, the previous perspective needs to be inhibited in order to allow the working memory to introduce and consider a new one (Diamond, 2014). Such flexibility is crucial when facing new, unexpected challenges and for being able to seize new and unanticipated opportunities should they arise (Diamond & Ling, 2016), and is the opposite of a rigid, inflexible, averse-to -change mindset.

How Executive Functions are Expressed in Children

Executive functions (EFs) first emerge in infants around the end of the first year of life, with particularly rapid development taking place in the subsequent years, up to around age 5 (Zelazo & Müller, 2011), and with further development right into adulthood (Cuevas et al., 2016). Research suggests that EFs can be conceptualized as being skills that are both correlated with one another and also separable (Hui-Chun & Gray, 2017), that they overlap and build upon one another to help develop management of thoughts and behaviour (McClelland & Tominey, 2014), and that the organization of them changes over time, becoming more modular with age (De Franchis, Usai, Viterbori, & Traverso, 2017). However, the exact developmental course over time of each component, and the difference between children in terms of how they coordinate the components, remains unclear (Best et al., 2009).

Within the school environment, EFs manifest in both domain-general skills and domain-specific skills. They can also manifest in a range of observable temperaments, personalities, and goal-directed behaviours. Zelazo, Blair, and Willoughby (2016) devised a semantic map to illustrate the behaviours, temperaments and personalities associated with EFs, and which is summarized in Figure 1.

Temperament and Personality	Goal-Directed Behaviour
<p>Strong EFs are more often displayed by individuals with the following temperamental or personality characteristics:</p> <ul style="list-style-type: none"> • Effortful control • Conscientiousness • Openness • Grit 	<p>Strong EFs are needed for the following examples of goal-directed behaviour:</p> <ul style="list-style-type: none"> • Self-control • Reflective learning • Deliberate problem solving • Emotion regulation • Persistence • Planning

Figure 1. Temperaments, personalities and behaviours associated with EFs (Zelazo et al., 2016).

Therefore EFs can be summarized as the cognitive processes that enable a child to consciously control or regulate their learning and behaviour, to follow school rules, to work in the presence of distractions, to sustain attention and attend to classroom activities, to work and play well with others, and to persist with challenging tasks.

Inhibitory control in children – domain-general skills. Diamond (2014) uses the term self-control when referring to inhibition in children, and describes it as the

ability to resist temptation and not act impulsively. Example behaviours include being able to sit still for appropriate periods of time, not calling out or interrupting, waiting one's turn, and resisting taking or eating something desirable. Inhibition is what stops a child from saying something rude or hurtful, hitting or hurting another child who has done something or taken something and caused upset, and grabbing or stealing what they want (Diamond, 2013). It is also what allows a child to stop in games such as musical statues, traffic lights, or any other game involving stopping and starting (Gibb et al., 2015). Other aspects of inhibition include discipline and perseverance; to stay on task and complete that task when it is frustrating, boring or challenging; resisting temptations to switch to a preferable activity; inhibiting distractions; and delaying gratification (Diamond, 2014). Inhibitory control is far more challenging for younger children than older ones, but even at an early age, studies such as Walter Mischel's famous study of delayed gratification, referred to as 'The Marshmallow Test' (Mischel, 2014), demonstrate how some children develop good strategies early on to suppress attention to powerful and distracting stimuli (Diamond, 2013).

McClelland and Tominey (2014) prefer to describe inhibitory control in children as being intrinsically linked with the other two EFs. For example, to inhibit an unwanted, aggressive behavioural response when faced with having a favourite toy taken by someone else, a child must also draw upon two other EFs. Working memory permits the child to recall the appropriate alternate response, and cognitive flexibility allows the child to have previously attended to instruction from a teacher explaining what the appropriate response is. In the context of role-play, inhibitory skills are crucial to suppress the impulse to act *out* of character (Bierman & Torres, 2016), however it is working memory that allows the child to remain *in* character, and cognitive flexibility that allows him or her to adapt that character's role within the changing demands of the game (Dias & Seabra, 2017).

Working memory in children - domain-general skills. Probably the most easily recognized example of working memory is the ability to remember and follow instructions, directions or rules, especially where there are multiple steps (Diamond, 2014). Being able to participate successfully in classroom, playground or group games requires working memory to hold the game's rules and objectives in mind whilst simultaneously updating that information (mental reordering) and for the new information to be applied to thinking or plans as the game progresses (McClelland & Tominey, 2014). Being able to hold a question or comment in memory until you are

able to ask or share it also draws on working memory, as does the ability to consider a variety of alternatives to solve a problem or to consider which apparatus you will need to complete a task (McClelland & Tominey, 2014). Reasoning, problem solving and creative thinking all require the ability to store and manipulate information mentally to come up with new connections or combinations (Diamond, 2014).

Cognitive flexibility in children - domain-general skills. A child that can stop what they are currently doing, and successfully go and engage with another task is demonstrating cognitive or attentional flexibility. If one way of approaching a problem is not working, being able to come up with a different approach or to re-conceptualize the problem is also showing cognitive flexibility (Diamond, 2014). Within games and thematic play, the ever-changing situation requires rapid adjustments and adaptations, through cognitive flexibility, to meet the new demands (Dias & Seabra, 2017). Cognitive flexibility also underlies the ability to admit you were wrong when presented with additional or updated information, and to empathize with someone and see things from their perspective (Diamond, 2014). It also enables a child to change perspective spatially, and consider, for example, how an object would look from a 'bird's eye' view.

Executive functions in children – domain-specific skills. Many years of research into language learning has demonstrated that it is a complex process (Kamhi & Catts, 2012). All three of the EFs are involved collaboratively in managing the process of language learning, with the literature offering a variety of viewpoints as to the degree of involvement of each of the individual EFs (Berninger, Abbott, Cook, & Nagy, 2017).

The contribution of each of the EFs to language learning processes is described in great detail in a number of studies. For example, reading has been reported to require: inhibition to allow the suppression of misleading or irrelevant information (Chiappe & Hasher, 2000; De Franchis et al., 2017), working memory to facilitate word decoding and reading comprehension (Booth, Boyle, & Kelly, 2014; Diamond, 2014), and cognitive flexibility to sustain focus and derive meaning (Berninger et al., 2017; Cartwright, 2012).

Writing places the greatest strain on cognitive resources, even more so than for reading, and all of the EFs are involved in the whole process, from initial planning through to final editing (Best et al., 2009; Drijbooms, Groen, & Verhoeven, 2015). Difficulties arise in ascertaining the degree to which each of the EFs are recruited in the writing process. A popular model adopted by researchers called the Simple View of Writing, suggests EFs are less involved in the early writing efforts of young children

(Drijbooms et al., 2015), but that as a writer matures and develops, they increasingly use EFs to allow planning, revisions, and attention to the global structure and coherence of text (Altemeier, Jones, Abbott, & Berninger, 2006; Graham, Harris, & Olinghouse, 2007). Other researchers prefer to describe the recruitment process of EFs in writing as being less of a developmental trajectory, and instead reflecting individual differences in children as regards development, personal interest, learning history, ability, context, and access to resources and technology (Bazerman et al., 2017; Berninger, 2015).

Evidence for the importance EFs play in mathematics learning has come from cognitive psychology research of an experimental nature, where test scores are correlated to current or future mathematics achievement (Cragg, Keeble, Richardson, Roome, & Gilmore, 2017; Gilmore & Cragg, 2014).

All three EFs, and in particular working memory (Diamond, 2013; van der Sluis, de Jong, & van der Leij, 2007) are considered to be the core skills at work when accurately and efficiently selecting and performing arithmetic procedures and reaching a solution to a problem (Cragg et al., 2017; Friso-van den Bos, van der Ven, Kroesbergen, & van Luit, 2013). Inhibition skills such as suppressing impulsive responses, filtering irrelevant numbers or information, and self-monitoring are considered to be important skills involved in successful mathematical problem solving (Blair, Ursache, Greenberg, & Vernon-Feagans, 2015). Similarly, the cognitive flexibility skill of attention shifting is considered to be important, as it allows switching between number functions, in order to tackle multi-step numeracy problems (Friso-van den Bos et al., 2013; van der Sluis et al., 2007).

When faced with word problems in mathematics, all of the EFs associated with reading and writing are also added to the EFs required. Furthermore, the application of math's skills to novel problems or real-world situations greatly increases the recruitment of EFs (Gilmore et al., 2013).

The literature therefore highlights the many ways in which EFs are expressed in both domain-general contexts, and domain-specific contexts, and demonstrates how critical they are to success in the respective domains.

Why Executive Functions are Considered so Important

Research has shown that well-developed EFs are associated with a variety of positive outcomes including “better social cognition, social understanding, prosocial behaviour, social-emotional learning, and academic ability” (Rabhari & Vaillancourt, 2015, p. 257). EFs are involved in the regulation of more basic cognitive processes and

are associated with and predictive of different domains of school achievement (Best et al., 2009; Bierman & Torres, 2016; Blasco et al., 2014; Samuels et al., 2016). They are understood to be an important predictor of physical and mental health (Vuontela et al., 2013), criminality, and general success in life (Moffitt et al., 2011). They have been shown to predict mathematical ability (Blair et al., 2015; Clark, Pritchard, & Woodward, 2010; Shah et al., 2017) and to be significantly associated with different domains of literacy, in particular decoding and comprehension (Best et al., 2009; Booth et al., 2014; Cartwright, 2012; Chiappe & Hasher, 2000; De Franchis et al., 2017).

Longitudinal research has shown the relevance of executive functions throughout development on many social and academic measures, even after controlling for almost every other variable possible (Best et al., 2009; Diamond, 2014). For example, Moffitt et al. (2011) found that a child displaying good inhibitory control at an early age, was less likely to succumb to substance abuse or drop out of school as an adolescent, and 30 years later had a better job, higher income, better health, fewer criminal offenses, and overall better quality of life than someone who as a child had displayed inferior inhibitory control.

Social-emotional competence. A reciprocal relationship is suggested to exist between EFs and peer relationships from early childhood through to adolescence (C. J. Holmes et al., 2016), with peer problems earlier in life contributing to poorer EFs later in childhood, and better EFs reducing the likelihood of peer problems later in childhood. Similarly, childhood aggression is understood to correlate strongly with weaker EFs, specifically inhibition (O'Toole et al., 2017; Poland, Monks, & Tsermentseli, 2016).

Learning disabilities and disorders. Difficulties with EFs are a prominent feature of many learning disabilities and disorders (Blasco et al., 2014). Children diagnosed as having Autistic Spectrum Disorder (ASD) tend to display deficits across all measures of EFs, and with particularly significant deficits in cognitive flexibility (Blijd-Hoogewys, Bezemer, & van Geert, 2014). Poor EFs are also linked with persistent Attention Deficit Hyperactivity Disorder (ADHD) (Antonini, Becker, Tamm, & Epstein, 2015; Best et al., 2009; Robinson & Tripp, 2013), conduct disorder (Fairchild et al., 2009), obsessive compulsive disorder, (Hybel, Højgaard, Hove Thomsen, Lykke Mortensen, & Lambek, 2017), schizophrenia (Wiguna et al., 2014), depression (Hulvershorn, Cullen, & Anand, 2011), and addictions (Moreno-López et al., 2012).

Lower socio economic status. Higher levels of EFs are believed to enhance the resilience of children who experience early adversity (Bierman & Torres, 2016), but are often delayed amongst children growing up in poverty who commonly display low levels of classroom engagement, and elevated attention problems (McClelland & Tominey, 2014; Shah et al., 2017). The literature indicates that it is those children with the poorest EFs who consistently gain the most from interventions targeting EFs (Diamond & Ling, 2016), irrespective of whether their poorer EFs are associated with lower socio-economic status (Blair & Raver, 2014), or ADHD (J. Holmes et al., 2010). Developing EFs might therefore act as a preventative measure against the academic risks associated with poverty (Pears et al., 2014).

To this end, there are a great number of researchers who hypothesize that even small improvements in children's EFs can produce great impact on a child's life (Diamond, 2014; Diamond & Lee, 2011; Fay-Stammach, Hawes, & Meredith, 2014; Moffitt et al., 2011; Molfese et al., 2010; Monette et al., 2011; Shanmugan & Satterthwaite, 2016), and may even play a key role in narrowing the gap between disadvantaged children, such as those growing up in poverty (Blair, 2016) and their more advantaged peers (Bierman & Torres, 2016).

Academic achievement. In their recent meta-analysis of studies exploring the potential of executive function interventions on academic achievement, Jacob and Parkinson (2015) sought to examine the strength of the correlation between EFs and achievement. Their analysis documented strong associations between EFs and academic achievement, for both single point in time and predictive studies, across ages (3 - 18 years), and irrespective of specific construct studied (inhibition, attention control, attention shifting, and working memory) or measurement type used (naturalistic vs. laboratory based) (Jacob & Parkinson, 2015).

In summary, at the most general and basic level, EFs play a pivotal role in a powerful, self-fulfilling prophecy, where those with good EFs are able to capitalize on their strengths, and those with weak EFs will slip further and further behind. Children with weak EFs will struggle to pay attention in class, complete tasks, inhibit impulsive behaviours, and will generally experience less enjoyment at school. Teachers tend to get frustrated or annoyed at them so that feelings of negativity about their own self-worth are perpetuated, thus heightening the risk of resistance to school and schoolwork, and ultimately to dropping out of school completely (Blair & Diamond, 2008). Conversely, children with good EFs are pleasant to teach, find schoolwork easier, receive praise

more often, and generally enjoy the school experience. They hold a positive perception of their self worth and are motivated to learn and behave well (Blair & Diamond, 2008). The research therefore paints a clear picture of the importance of having good EFs, and of the crucial role schools could play in supporting children in developing EFs.

Relevance of Executive Functions to Schools and Teachers

Teachable skills. The general consensus is that EFs, as a set of definable cognitive skills that affect the pace and quality of children's learning capabilities, can be taught (Bierman & Torres, 2016; Blair, 2016; Cartwright, 2012; Diamond, 2013; Molfese et al., 2010; Zelazo et al., 2016). There is however, debate as to the extent to which they can be taught, and the transferability of improvements (Diamond & Ling, 2016; Shah et al., 2017). Diamond and Ling (2016) conducted a meta analysis of 84 studies that focused on the relative successes of interventions, programs and approaches for improving EFs. Results of their review indicated that training of narrow and specific EFs, such as working memory, improve that particular skill, and transfers to similar skills such as attention, but does not transfer to dissimilar ones such as flexibility. However, training that covers a wider range of skills and is embedded in real world contexts, such as martial arts training or classroom curricula like Tools of the Mind (Bodrova & Leong, 2007) predictably shows more widespread cognitive benefits (Bagby et al., 2012; Blair & Raver, 2014). For example, in a Brazilian experimental study, a classroom intervention for Grade 1 students produced improvements in not only EFs, but also reading and maths in the experimental group compared to the control group, the benefits of which endured at the one year follow-up and showed transfer effect for behavioural measures (Dias & Seabra, 2017).

Classroom and curriculum interventions. One of the most well established curriculums that promote self-regulatory skills, and in which inhibition skills feature prominently, is the Montessori Method. Developed by Maria Montessori in the early 1900s to develop 'inner discipline', the pedagogy aligns with constructivism and aims to instill independence, autonomy, self-direction and self-efficacy within the child. Ervin, Wash, and Mecca (2010) compared 127 Montessori-schooled children with 129 non-Montessori schooled children over a period of three years. They found the Montessori schooled children exhibited significantly superior self-regulation skills and subsequent academic performance compared to the non-Montessori schooled children. However, Bagby et al. (2012) caution against drawing any conclusions about a *causal*

relationship between school environment and the development of EFs in the absence of an experimental design.

A more recent intervention used within early childhood education is Tools of the Mind (Bodrova & Leong, 2007), a curriculum grounded in Vygotskian Theory of development and designed to enhance EFs within an instructional context. The curricula is largely based upon purposeful play that is planned collaboratively by the children and their teachers, and recorded in play plans (Willis et al., 2014). Structured play offers an opportunity to engage in purposeful, goal directed activity in a fun and engaging way, to hold information in mind either with or without the aid of concrete prompts (Diamond, 2014), and to sustain attention, all classic components of EFs (Blair, 2016). However, although some studies have found evidence of efficacy for the program on measures of EFs, social and behaviour competencies, and academic achievement (Barnett et al., 2008; Diamond, Barnett, Thomas, & Munro, 2007; Dias & Seabra, 2017), others found no significant effect (Farran & Wilson, 2014; Wilson & Farran, 2012), or a lack of empirical evidence to support intervention effect (What Works Clearinghouse, 2008). Hypotheses offered by the study authors as to why the program might not achieve widespread success include complexity of the program, lack of teacher training for confident implementation, better outcomes for children from poorer backgrounds, and difficulty fitting the program into a school day.

The Incredible Years Teacher Classroom Management (IY TCM) Program in New Zealand, known as the Incredible Years Teacher Training Program (IY TTP) in the U.S., focuses on improving the quality of teacher–student interactions and the promotion of positive classroom management strategies. Although IY TTP is not an intervention specifically designed for EFs, the program has been used in the U.S. as part of the Chicago School Readiness Project (CSR) in a 2008 study that included direct measures of EFs (Raver et al., 2008). The cluster-randomized trial included 35 Head Start classrooms (government funded early childhood centres for low-income families) and 543 children aged 3-4 years. Significant intervention effects were recorded on two measures of EFs, namely attention and inhibitory control, with examiners also rating the experimental group as being more focused and less distractible during testing sessions relative to the control group (Raver et al., 2011). The intervention also correlated with superior academic scores and classroom behaviour (Raver et al., 2011).

The studies mentioned above have indicated that there are a number of interventions that have been shown to improve EFs, but similarly there have also been

interventions with little or no reported improvement to EFs, with lack of teacher confidence or lack of time being posited as possible reasons why. Given that the success of an intervention will rely in part on the expertise and commitment of the teacher delivering it, it would be useful to ascertain what teachers currently know about EFs and whether they value them as a set of skills for learning.

Teachers' Knowledge and Beliefs about Executive Functions

Teaching beliefs and their relevance to pedagogical practices. Teachers hold a variety of beliefs about learning, shaped not only by their training, but also by variables such as age, experience, and culture (Snider & Roehl, 2007; Stohlmann, Cramer, Moore, & Maiorca, 2014). Gilmore and Cragg (2014) suggest that teachers with training or interest in cognitive psychology or neuroscience may be aware of the importance of EFs and therefore adapt their teaching style to reduce the demands placed on students' EFs. However, teacher-training courses do not tend to include neuroscience in the curriculum, and for those teachers that are interested, only limited resources are available that are intended for use by teachers, such as books by Dawson and Guare (2003, 2009b), Kaufman (2010) and Meltzer (2010). Furthermore EFs may be considered a hidden curriculum in schools since many teachers know that students need them, but typically don't realize that they can teach the skills explicitly (Dawson & Guare, 2009a).

The importance of teacher beliefs is significant. Any curriculum reform or change in practices can only be achieved if teachers' attitudes and beliefs are first addressed (Wallace & Priestley, 2011). Additionally, teachers' beliefs are not always indicative of actual classroom pedagogy. For example in a study exploring teacher knowledge of self-regulation skills, Willis et al. (2014) found discrepancies between teacher beliefs that children had the ability to exert internal control, and their classroom management which encouraged external control.

Teachers' beliefs about executive functions. Studies investigating teachers' beliefs and practices with regard to the role EFs play in academic achievement are limited. One study conducted in Israel sought to explore whether the well-established link in scientific literature between EFs and academic achievement was expressed in the pedagogical beliefs and practices of elementary teachers (S. Rapoport, Rubinsten, & Katzir, 2016). Results indicated that most teachers recognized the effect that EFs have on reading and arithmetic, and that their beliefs about this effect were related to their reported teaching practices (S. Rapoport et al., 2016). However, they also found that

most teachers' knowledge about EFs was intuitive rather than derived from explicit training, and that contrary to their hypotheses, the experienced teachers held more traditional views which rated subject-specific skills above domain-general skills.

Gilmore and Cragg (2014) carried out a study in the U.K. to explore teachers' knowledge of EFs and their understanding of the importance of EFs to mathematics. Their online survey, which had 96 respondents from across all school stages, found that although only 18% of teachers had heard of the term *executive functions*, 72% were aware that the skills described were important to learning. Contrary to the Israeli study, their study found that knowledge about the importance of EFs increased with number of years of teaching experience. Specifically, 63% reported that they had learned about EFs from their own teaching experience, whereas only 16% had learned from either initial teacher training or later professional development (Gilmore & Cragg, 2014).

Only a small number of studies reporting New Zealand teachers' beliefs or perspectives about pedagogical issues could be located, and of those, none were concerned with EFs.

Statement of the Research Questions

Despite a critical mass of studies examining EFs and academic achievement across many countries and educational settings (Mulder & Cragg, 2014), a search of the literature reveals a scarcity of studies exploring teachers' knowledge, perspectives or beliefs of EFs, and no studies within New Zealand. Therefore, before it is possible to consider ways in which to capitalize on the many benefits associated with good EFs, it is first necessary to establish what level of understanding New Zealand teachers have of EFs, how much value they believe EFs add to learning, and what their current pedagogy entails as regards supporting the development of EFs. The research questions to guide the study were therefore as follows:

- What are New Zealand primary school teachers' knowledge and understanding of executive functions?
- What value do New Zealand primary school teachers place on executive functions?
- How do New Zealand primary school teachers support the development of executive functions in their classroom practice?

Chapter Three

Methodology

Introduction

This chapter describes the mixed methods research approach utilized to explore teachers' perspectives about executive functions (EFs) in the classroom context in New Zealand. Based on a constructivist paradigm, both quantitative and qualitative data were collected through an online, anonymous survey. The survey was distributed to a sample of primary schools in Auckland, New Zealand, selected via a randomization process of a publically available database. Prior to embarking on the study, approval was gained from the Massey University Human Ethics Committee (MUHEC), the details of which are outlined in this chapter. The processes of analysis and interpretation of survey responses is discussed at the conclusion of this chapter.

Methodological Approach

This mixed methods study aimed to explore and describe teachers' perspectives on EFs. The study was positioned in a constructivist perspective. Constructivist theory suggests that knowledge is constructed rather than discovered, subject to social, cultural and historical context, and moulded by experience. As a researcher I was guided by this theory as I captured, described and interpreted the individual views, values and practices of primary teachers to construct a larger understanding of teachers' perspectives of EFs in the New Zealand context within the current educational climate.

Design

The aim of this study was to capture and analyse the knowledge, perspectives and practices of individual primary school teachers, to gain a larger understanding of teachers' perspectives of EFs in the New Zealand context. A mixed methods design was chosen as it integrates both quantitative and qualitative data within one single study, and permits a more complete and synergistic use of data (Creswell, 2014). Quantitative data was obtained through close-ended or response scale questions which can help identify current opinion or patterns of behaviour, and can provide good breadth of coverage on a range of topics (Coolican, 2013). Qualitative data was obtained through open-ended questions that allow the participants to use their own terms and descriptions of concepts, and which can offer greater depth and detail (Coolican, 2013). There are a variety of ways to approach mixed method research, and a convergent design was chosen for this study. Convergent design allows for side by side comparison of findings from both data sources, a means for either corroborating or contradicting findings, and a

useful way to understand contradictions between results (Guetterman, Feters, & Creswell, 2015). In the context of this study, the convergent mixed method design sought to explore teachers' knowledge of, value held, and practice of EFs in the classroom context.

Method Selection

The research questions of the present study required primary school teachers to indicate what they know already about EFs, what value they place on EFs, and what they currently do in their classrooms to support the development of EFs. A platform was therefore required that could allow both response scale measures or close-ended questions, and also opportunities to share their views and experiences within open-ended questions easily and efficiently. The web-based survey tool Survey Monkey was selected as it could combine quantitative and qualitative questions, and afford fast access to the target population.

Questionnaire Design

An online questionnaire was designed that comprised 21 questions, presented through a variety of multiple choice, Likert response scale, and open-ended questions. A higher number of multiple choice or Likert scale questions involving radio buttons (single click response) were used as it is reported that these make questionnaire completion faster and more appealing (De Bruijne & Wijnant, 2014). Eight open-ended questions were strategically placed within the questionnaire to probe teachers' existing knowledge, experience and opinions or to allow them to expand on their responses. The questionnaire items were selected by drawing on research literature of EFs and similar studies probing teachers' knowledge of EFs (Gilmore & Cragg, 2014; Shirley Rapoport, Rubinsten, Katzir, Reimer, & Colzato, 2016). Consideration was taken to avoid any leading questions, loaded questions, questions that might provoke a feeling of discomfort, double-barrelled questions, or double negatives (Harvard University, 2017). The full survey is included as Appendix B.

The first section comprised a series of demographic questions aimed at capturing teacher experience, qualification, year level taught and decile¹ rating of school in order to describe the response sample. No identifying information was requested so that anonymity was maintained.

¹ New Zealand schools have decile ratings of 1 to 10, that help determine how much funding they get from the government. A school's decile measures the proportion of students living in low socio-economic or poorer communities. The lower a school's decile rating, the more funding it gets.

The second section sought to ascertain teachers' current knowledge and beliefs about EFs by asking them to explain EFs in their own words, and to indicate to what extent they had come across the construct prior to completing the questionnaire. The respondents were subsequently asked to rate the importance of a set of 10 skills for learning at primary school on a 5-point Likert scale (from *not important* = 0 through to *extremely important* = 4). Three items referred to EFs, two items referred to social/emotional skills, two items referred to subject-specific skills, and three items referred to general skills. The non-EFs skills are skills commonly associated with school success in research literature. The items were intermixed.

In section three, EFs were separated into three components, working memory, cognitive flexibility and inhibition. A brief description was provided for each, and the respondents asked to share an example of how a child in their class would behave if they demonstrated good skills for each component.

Section four targeted teachers' personal perspectives about the value of EFs, and stated that there were no right or wrong answers. Respondents were asked to rate the importance of a set of 18 skills (6 within each of the three components) for learning at primary school on a 5-point Likert scale (from *not important* = 0 through to *extremely important* = 4).

The last section tapped into teachers' current practices. Items probed whether teachers were trying to support development of EFs, and what supports or hinders them. A list of 22 classroom strategies for the promotion of EFs was provided and respondents were asked to indicate which, if any, they use. They were given an opportunity to comment if there is anything else they do in their classroom to promote EFs and if they had any other relevant comments to share.

Ahead of distribution, a pilot study of the survey was conducted to ensure credibility and validity of the survey. The questionnaire was reviewed for relevance and clarity by two academics and revisions were made. The survey was then completed by a group of representatives of a relevant population (early years education university Masterate research group) and further feedback was provided. Final revisions to the survey were completed.

Survey Participants and Survey Distribution

The participants for this study were Auckland-based primary school teachers currently teaching Years 1 to 6, from across the complete socioeconomic public school decile range. To access this population, the New Zealand Government schools database

from the Education Counts website was used to access a list of primary schools (Education Counts, 2017). From within the Auckland Region, a random-stratified sample distribution method was applied. The database was filtered to select full primary and primary schools from the Auckland Education Region. The Auckland schools were then sorted into 10 groups by decile rating, and a computer randomization function applied to each group. Sorting by decile grouping was to stratify the sample and attempt to reach a sample of respondents working in a diverse range of settings. There was no intention to run sub-analyses by decile.

Email invitations to participate in the study were sent to the school principals of the first 10 randomized schools from each decile group for whom an email address was provided on the Ministry of Education database. This resulted in 100 school principals receiving an email inviting them to forward the invitation to their staff. The voluntary, anonymous nature of participation in the study, along with information about the research and the compulsory ethics statement was included in the email invitation (see Appendix A).

Follow up emails were sent after two weeks, and again after three weeks, reminding principals that the survey was nearing its closure date and requesting participation. The survey was open initially for four weeks. Due to low response rates, (6 after four weeks), a second tier of email invites to the next 10 schools on the randomized lists, (or all remaining schools if less than 10), were sent out, with the survey remaining open for a further 3 weeks. Follow up emails were sent to the second tier of schools on each subsequent Monday. Due to the nature of the sampling method used, it is not possible to report the number of potential participants, only the number of schools approached, which was 151, and from which 38 teachers chose to participate.

Data Analysis

The web-based survey tool Survey Monkey collected survey responses automatically. Once the survey was closed, data was exported to the researcher's personal database. The data was then analysed, depending on whether it was quantitative or qualitative, as described below.

Quantitative data analysis. An Excel raw data grid was created to count occurrences of selected variables from lists and ranking matrices in the questionnaire responses. The percentage of respondents answering each question was stated in order to address the issue of skip responses. A coding system then determined which data

went into which category. Descriptive statistics were then calculated to highlight any trends, patterns or contradictions within the population sample (see Table 1).

Qualitative data analysis. The raw response data from the open-ended questions was first compiled onto an Excel spreadsheet. A first screening of the responses was carried out for familiarization with the content. Thematic analysis was subsequently applied to the text content using a 7-step comparison method (LeCompte & Preissle, 1993) to identify emerging patterns and themes, and which is outlined in Table 1. In the event of comments relating to more than one category, the comments were separated and the appropriate parts placed in the respective category. The number of comments in each category was therefore potentially greater than the total number of responses. Salient quotes that illustrated key themes were noted, as were comments that conflicted with key themes or the majority view.

Table 1. *Summary of LeCompte and Preissle’s 7-step thematic analysis framework*

Step		Description of analytical process
Step 1	Perceiving	Noting your first impressions and what captures your attention.
Step 2	Comparing	Looking for any similarities, seeing if there are things that go together, and whether certain themes carry through different parts.
Step 3	Contrasting	Looking for things that differ from other things, things that don’t go together, and things that don’t fit your emerging categories.
Step 4	Aggregating	Looking for emerging groupings, and questioning why they go together and what labels they could be ascribed.
Step 5	Ordering	Looking for any pattern or order within the group. Assessing if any themes are stronger more important than others, and if there are categories and sub-categories.
Step 6	Establishing linkages and relationships	Establishing how the categories relate to one another, relate to the literature, and relate to everyday practices.
Step 7	Speculating	Proposing a tentative explanation or theory, explaining its significance, and suggesting what other research needs to be done.

Data Interpretation

The researcher and supervision team discussed the research data from the survey. The questionnaire was designed to specifically address the three research

questions. Therefore the response data were carefully considered in terms of what information it provided to address the research questions. Quantitative data was used to track trends and patterns, and qualitative data used to substantiate or contradict them. The qualitative data also provided richer information and further insight into the subject. Taken together, the quantitative and qualitative data provided an indication of teachers' knowledge, value and current practice as regards EFs in NZ primary schools.

Ethics

Prior to conducting the research, a MUHEC screening questionnaire was completed and as a result, a low risk ethics application was submitted and approved. The guiding principle of informed consent was addressed by providing all participants with written information detailing data collection processes, the voluntary nature of participation, and their right to withdraw at any stage. Participation in the survey was therefore deemed to be giving informed consent. Anonymity and confidentiality of the participants and their schools was preserved at all times as no identifying information was requested. Ethical guidelines for the storage and disposal of data were followed.

Risk of harm to participants was viewed as minimal but was nonetheless considered and addressed through keeping the survey brief, and using sensitively phrased questions that had been piloted prior to use. Furthermore, there were no covert or deceptive elements within the survey. Cultural and social sensitivity was addressed through inviting teachers to describe their own perspectives, and by emphasizing that there were no right or wrong answers.

Conclusion

The methodology used in this mixed methods study has been described in full and allows for replication of the study. An online questionnaire developed by the researcher, comprising 21 questions across five sections, was distributed to a random-stratified sample of Year 1-6 primary school teachers in the Auckland Educational Region. Procedures to ensure credibility and validity of the survey were completed and ethical approval was granted. Data were analysed in relation to the three research questions.

Chapter Four

Results

Survey responses were received from 38 respondents, however, 14 of these were incomplete surveys that had no information other than demographic information.

Participants who only responded to demographic questions were removed from the data set, as they did not provide information to address the research questions. The data from the remaining 24 complete surveys were analysed and the findings are discussed below.

Demographic Information

Table 2 presents demographic information about the teachers who participated in the survey.

Table 2. *Demographic data of teachers*

Demographic item	% of sample
Highest qualification held by teacher	
Doctorate degree	0
Masters degree	17
Bachelors degree	57
Post graduate diploma	22
Diploma	3
Teaching qualification held by teacher	
Diploma	13
Bachelors degree	50
Post graduate certificate in education	13
Post graduate diploma in education	25
Teacher's experience with studying psychology	
No experience of studying psychology	42
Holds a degree in psychology	0
Studied psychology through initial teaching training	35
Studied psychology through short courses or professional development	12
Studied psychology informally or through personal interest	12
Years of teaching experience	
1 to 3 years	5
4 to 10 years	23
11 years or more	73
Year group taught by teacher	
Year 1	17
Year 2	4
Year 3	4
Year 4	8
Year 5	0
Year 6	17
Other	50

Decile rating of teacher's school	
Decile 1-3	0
Decile 4	16
Decile 5	5
Decile 6	5
Decile 7	26
Decile 8	11
Decile 9	5
Decile 10	32

Note. N=24. Percentage might not sum to 100 because of rounding.

Analysis of the demographic data indicated that the majority of participants were experienced teachers with either 4 to 10 years teaching experience (23%) or more than 11 years teaching experience (73%). A bachelor's degree in teaching was held by 50% of teachers, and a postgraduate qualification held by 38% of teachers. None of the teachers had a formal qualification in psychology, and 42% responded that they had never studied psychology. Of the teachers that had undertaken some form of study of psychology, 35% had done so as part of their initial teacher training, 12% had attended short courses or professional development, and 12% had studied informally due to personal interest.

The distribution of teachers across year levels was not uniform, with Year 1 (17%) and Year 6 (17%) the most commonly taught year levels. Half of the teachers (50%) indicated that they did not specifically teach one of the 6 year-group options. The reasons given included: teaching across all year groups, teaching composite classes, or not currently engaging in classroom teaching due to holding a specialist or management role. The majority of teacher responses (74%) came from teachers from schools in the upper decile ranges (7-10). There were 5 responses from teachers in schools in the decile ranges 4-6, and no responses from teachers in schools in decile ranges 1-3.

Research Question One: What are New Zealand Primary School Teachers' Knowledge and Understanding of Executive Functions?

To explore what teachers know about EFs, participants were asked to describe their knowledge and understanding of EFs in their own words. Out of 24 respondents, 21 respondents provided a description and three chose to skip the question. Overall, many of the themes and keywords that emerged related directly to EFs, although no respondents gave a description that accurately covered all three of the core skills that comprise EFs (inhibitory control, working memory, cognitive flexibility). One respondent indicated a degree of knowledge and understanding of the three facets of

EFs but included other non-EFs skills in their description too. The majority of respondents cited terms related to one or two of the core skills of EFs. Terms falling into the category of inhibition, such as staying on-task, persistence, ignoring distractions, self-regulation, and managing self, were the most frequently cited terms. Many respondents used terms relating to cognitive flexibility, such as reflective learning, ability to focus, and flexible thinking. Terms related to working memory, such as planning, self-guidance, and organization, were less frequently cited in the responses, although three respondents cited the actual term ‘working memory’ as part of their description of EFs. Other categories to emerge from analysis of the responses were student agency, learning style, non-EF cognitive skills (such as processing speed), growth mindset, independence, learning goals, social-emotional maturity, and positive behaviour.

In order to examine the depth of teachers’ knowledge and understanding of each of the specific core EFs, the teachers were subsequently provided with a brief description of each EF, then asked to share examples of skills students with well-developed EFs would exhibit, in their own words. Table 3 shows key skills that the literature describes as being indicative of students demonstrating successful executive functions, separated into each of the three core components of working memory, cognitive flexibility, and inhibition. The frequency of responses from the teachers that aligned with these skills is indicated alongside the skills.

For working memory, teachers were provided with the information that working memory is generally ‘the ability to hold and manipulate information in your mind’. The kind of specific examples the literature gives that demonstrate working memory skills include reasoning and problem solving, completing multi-step instructions, mental calculation, reading comprehension, writing composition, following game rules, and creative thinking (Diamond, 2014; McClelland & Tominey, 2014). As seen in Table 3, reasoning and problem solving, the application of retained information, and reading comprehension were the most commonly cited examples of working memory by teachers. Conversely, teachers gave skills such as maths and creative thinking as an example only once. The responses from the teachers also included a number of examples of non-working memory skills such as confidence, assessment success, inference, processing speed, risk taking, listening skills, and references to long term memory.

Table 3. *Examples of skills demonstrated by students with successful executive functions*

Skills	Frequency mentioned (n)
Working memory:	
Reasoning & problem solving	8
Applying retained information	6
Reading comprehension	6
Remembering instructions/procedures	4
Writing skills	2
Maths skills	2
Creative thinking	1
Mental reordering	1
Cognitive flexibility:	
Flexible thinking	9
Task switching	8
Attentional flexibility	8
Multi-step problem solving	6
Empathy	3
Attention	2
Games, thematic play	0
Inhibition:	
Task completion, staying on-task, sustained application	9
Screening out distractions	8
Overriding impulses or habits	2
Choosing how to behave or react	2
Self-control	2
Suppressing irrelevant information	1
Waiting your turn	0
Resisting temptation	0

Note. N= 24.

For cognitive flexibility, teachers were provided with the information that cognitive flexibility is generally ‘the ability to switch attention between tasks and to flexibly switch perspectives’. Further examples from the literature about cognitive flexibility skills include attention, task switching, attentional flexibility, reconceptualization of problems, engagement in games and thematic play, problem solving, and empathy (Diamond, 2014; Dias & Seabra, 2017). Just under half of the respondents included a few of the aforementioned skills, as seen in Table 3. A large selection of other skills that do not align with the literature definition of cognitive flexibility were also mentioned and included confidence, persistence, calm temperament, applying prior knowledge, peer tutoring, time management, sociability, comprehension, active listening, disregarding extraneous inputs, ignoring distractions, group work, and reflective learning.

Inhibition was described to the teachers as ‘the ability to sustain focus and ignore distraction’. The kinds of skills demonstrated by students with good inhibition

include choosing how to react or behave, waiting for their turn, resisting temptation, overriding impulses or habits, screening out distractions or irrelevant information, and self control (Diamond, 2014; Diamond & Ling, 2016; Gibb et al., 2015). The range of examples of skills provided by the teachers was wide and included both a number of inhibition skills that align with the literature, as shown in Table 3, and a range of other, non-inhibition skills. One respondent encapsulated the construct of inhibition particularly accurately with the description that the student ‘may choose to work alone to assure their own quality control’, indicating awareness of goal-directed, controlled behaviour and an ability to ignore distractions and remain on-task. Other skills cited by teachers that do not relate directly to inhibition included meeting targets, ability to share thinking, self-management, thinking at a deeper level, relating prior knowledge to new ideas, taking risks with their learning, and challenging themselves. Several temperaments were also described including calm, confident, positive, and determined.

Overall, the results indicated that approximately half of respondents mentioned examples of skills directly related to EFs, but that there were many examples of non-related skills given too. There was an absence of examples given about certain specific skills across all three EFs.

Having elicited teachers’ existing knowledge and understanding of EFs, the survey then explored whether teachers had come across information about EFs prior to participation in the survey, and if so, where. Overall, the *skills* associated with EFs were reported to be familiar to many of the teachers (76%), with only 23% of the teachers responding that they hadn’t encountered information about EFs before. Of the teachers that had encountered information about EFs, responses indicated that teachers were exposed to information through both informal and formal means. Informal means, such as professional conversations or personal reading and research were more common than formal means such as through undergraduate or postgraduate study, training, or professional development, as shown in Figure 2.

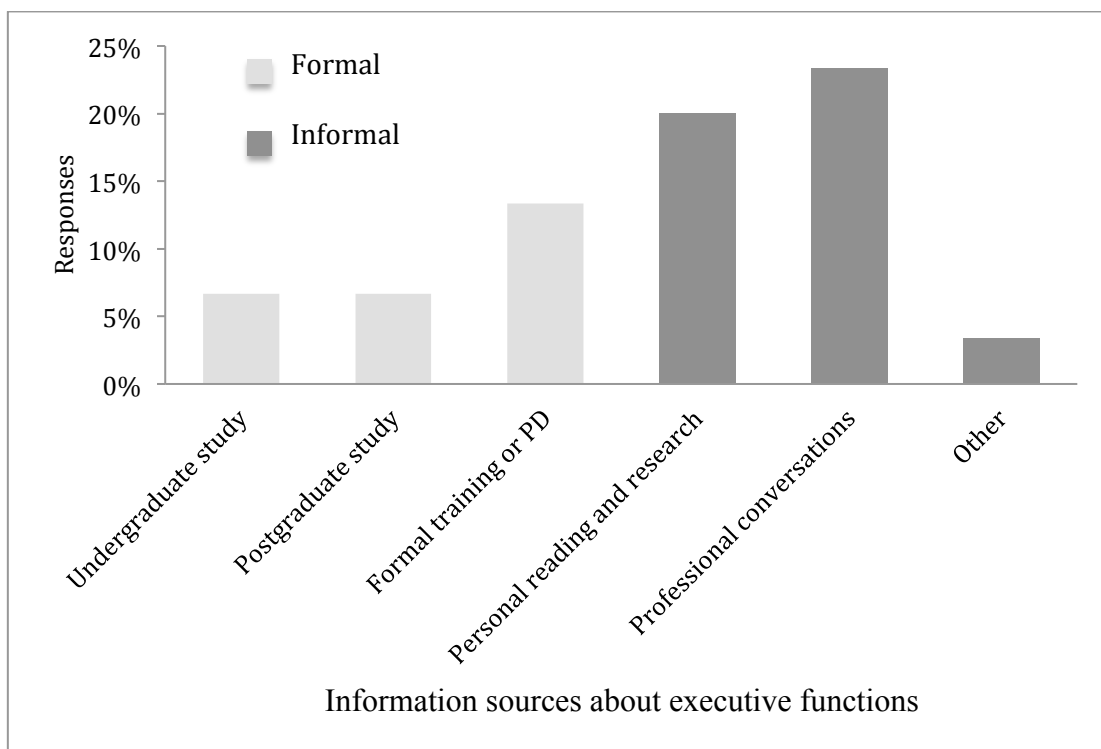


Figure 2. Description of where teachers have previously encountered information about executive functions.

The term ‘executive functions’ was reported to be less familiar to many of the teachers than the set of skills themselves, with only 27% of the teachers responding that they use the term ‘executive functions’. Some teachers indicated that they did not have a term for this set of skills (27%). Of the remaining teachers, 45% reported that they used an alternative term, such as student agency, life-long learning skills, independent learning, and one teacher elaborated that ‘this terminology is not widely used in our pedagogical language, it’s more a psychology term....’.

Research Question Two: What Value do New Zealand Primary School Teachers Place on Executive Functions?

To examine the value teachers’ ascribe to EFs, the survey sought to compare teachers’ ratings of the importance of EF skills compared with other learning skills prevalent in the primary school context. Teachers were asked to rate a set of learning skills by how important they consider them to be on a 5-point Likert scale (ranging from not important through to extremely important). The learning skills in the list belonged to one of four categories of skills: ‘executive functions’, ‘social-emotional skills’ ‘domain specific skills’, and ‘other skills’. The categories were not defined to the teachers and the skills were randomized within the list.

Mean importance ratings of the range of learning skills are given in Figure 3, and grouped into their sub-categories.

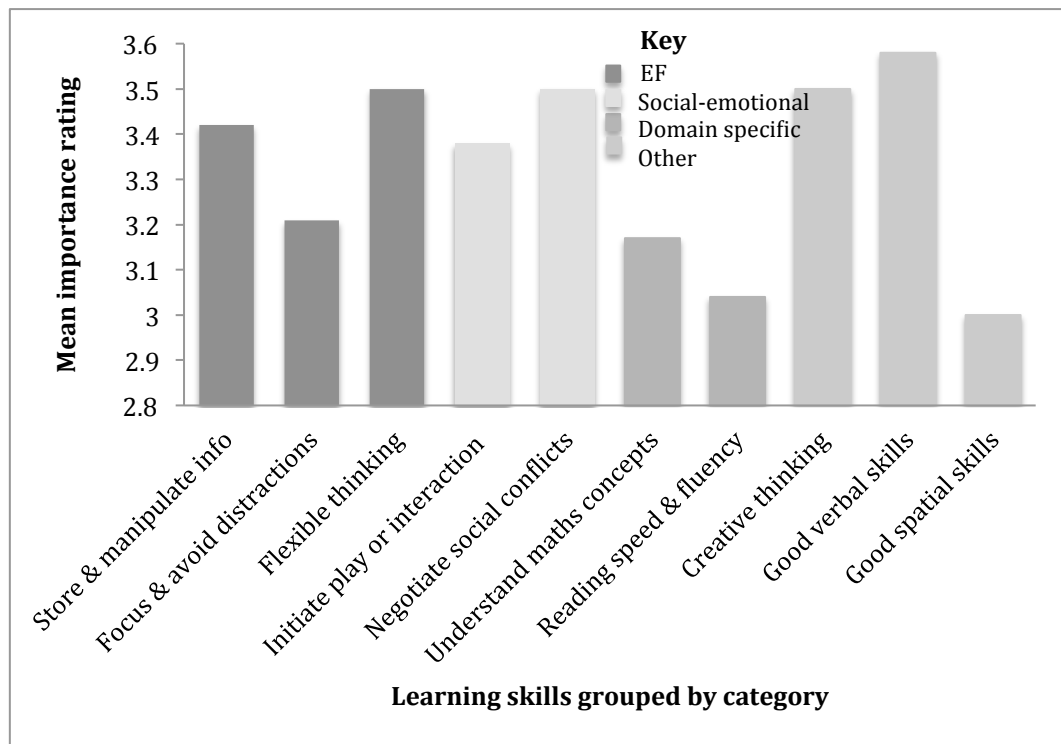


Figure 3. Mean importance ratings of learning skills from teacher questionnaire.

Note. Rating scale: 0 = 'not important', 1 = 'somewhat important', 2 = 'important', 3 = 'very important', 4 = 'extremely important'.

All teachers' responses on the rating scale fell between 'important', and 'extremely important'. There were no responses indicating a skill was 'not important' or 'somewhat important'. Therefore the teachers' rated all skills as important for learning, with just 0.58 mean difference between the highest and lowest rated skills. The results also indicated that teachers ascribe relatively equal importance to skills from across all of the four categories (executive functions, socio-emotional skills, domain specific skills, and 'other' skills), with domain specific skills and spatial skills rated slightly less important overall. The individual skill rated as most important overall was having good verbal skills, which belonged in the 'social-emotional skills' category.

Having explored the value teachers place on a range of both EF and non-EF skills, the survey next sought to explore the value teachers place on a range of 18 specific EF skills. The skills were divided into the three categories of working memory, inhibition, and cognitive flexibility and a 5-point Likert rating scale was again used.

Overall, teachers' valued each of the EF skills categories as equally important, with a difference in mean importance rating between the highest and lowest scoring skills categories of just 0.16, as illustrated in Figure 4. Working memory skills scored highest with an overall mean importance rating of 3.22, followed by cognitive flexibility skills with a rating of 3.17, and thirdly inhibition skills with a rating of 3.06.

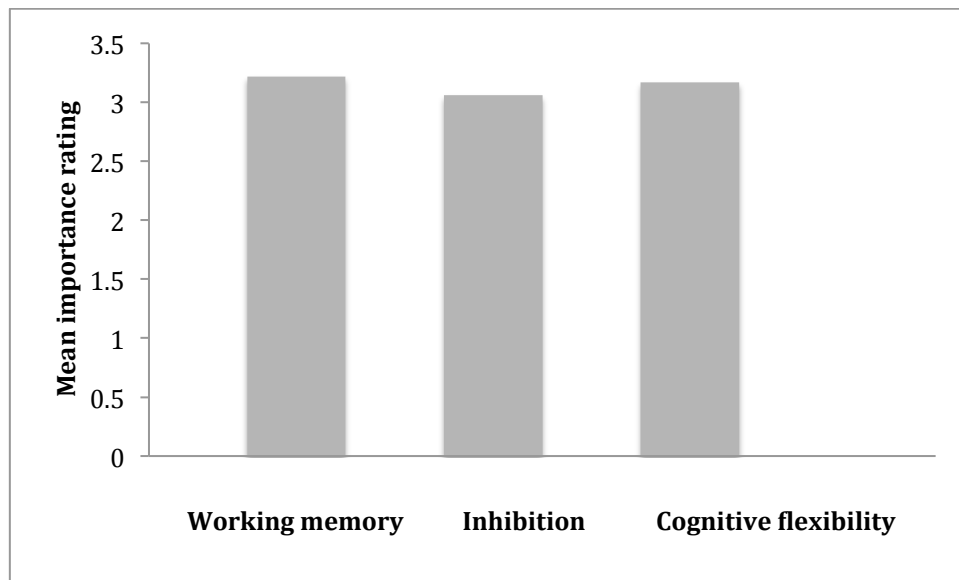


Figure 4. The importance teachers assigned a series of 6 skills in each of the three categories: working memory, inhibition, and cognitive flexibility.

Note. Rating scale: 0 = 'not important', 1 = 'somewhat important', 2 = 'important', 3 = 'very important', 4 = 'extremely important'.

Of the individual skills across the three skills categories, 'considering alternatives in a problem' (working memory) and 'seeing things from a different perspective or angle' (cognitive flexibility) both received the highest rating of importance of the 18 skills, as can be seen in Table 4. 'Delay gratification' (inhibition) was rated as the least important skill overall.

Table 4. *Teachers' mean importance ratings of 18 executive function skills*

Executive function skill	Mean importance rating	Executive function category
Consider alternatives in a problem	3.57	working memory
See things from a different perspective or angle	3.57	cognitive flexibility
Update stored information with newly acquired information (mental reordering)	3.48	working memory
Store and manipulate information mentally to come up with new connections or combinations	3.43	working memory
Come up with novel ways of attacking a problem	3.43	cognitive flexibility
Persist on difficult tasks	3.43	inhibition
Sustain attention (stay on task)	3.19	inhibition
Inhibit inappropriate behaviour, and choose another response	3.14	inhibition
Remember and follow multistep instructions or directions	3.10	working memory
Adjust to changing demands or priorities	3.10	cognitive flexibility
Control impulsive behaviour	3.00	inhibition
Return to a previously unfinished task and continue working on it	3.00	cognitive flexibility
Continue with a game or task when the rules or objectives change	3.00	cognitive flexibility
Filter out irrelevant stimuli	2.95	inhibition
Transition between tasks and activities	2.90	cognitive flexibility
Hold a question or comment in memory until you are able to ask or share it	2.90	working memory
Remember and follow rules	2.86	working memory
Delay gratification	2.65	inhibition

Note. Rating scale: 0 = 'not important', 1 = 'somewhat important', 2 = 'important', 3 = 'very important', 4 = 'extremely important'.

Research Question Three: How do New Zealand Primary School Teachers Support the Development of Executive Functions in their Classroom Practice?

To explore how New Zealand teachers support the development of executive functions, the survey first ascertained the frequency with which teachers were supporting development in their regular classroom practice, followed by examining the nature of the support.

The majority of teachers reported that they were currently either regularly (45%) or constantly (45%) trying to support development of students' EFs. Only one respondent reported that they were not supporting EFs at all. Analysis of the information teachers gave to describe in their own words how they support the development of EFs in their classroom practice indicated that the support fell into three broad categories. The first category of support was at the environmental or systemic level, and included examples such as 'provide an environment of collaborative goals and learning', 'supportive colleagues in a collaborative environment', 'an inclusive, supportive environment', and 'consistent school language and professional development in this area'.

The next category was classroom level support and included general teaching approaches such as 'promoting opportunities for self-management', 'encouraging ownership of their work', 'catering for diversity of needs', 'reinforcing behaviour expectations', and 'teaching as inquiry'. More specific teaching approaches included use of 'success criteria in formative assessment', 'reflections', 'challenging higher thinking', 'meta cognitive talk', and 'talk moves or talk buddies'.

The third category reflected the teachers' own personal knowledge base and ability to support the development of EFs. Comments shared in the questionnaire included a need to know how to identify students areas of difficulty, to 'understand what EFs means and its impact on learning', and to 'know what works well for students'. Teachers also expressed how useful highly skilled staff members could be for sharing knowledge and expertise with them, and the utility of 'collegial conversations'. Being an experienced teacher and reading articles about EFs were also described as factors that help build a teachers' own knowledge base and thus ability to support EFs with their students.

The teachers who either were not supporting the development of EFs, or were only occasionally supporting them, gave lack of time, lack of resources, and lack of understanding as the main factors that were inhibiting them.

To further explore the extent to which teachers were incorporating strategies and activities in their current classroom practice, the questionnaire provided the teachers with a list of 22 examples, all of which help to promote development of EFs, and asked them to indicate which ones they currently use. Overall, there was a high self-reported usage rate, with 14 of the 22 list items practiced by either 80% or more of the teachers. The most frequently used item was brainstorming (mind mapping), which 100% of the

teachers reported to use. Re-telling of stories or information to summarize main points was the next most commonly used item at 95%. The use of visual prompts, and the breaking down of tasks into smaller chunks, both of which help develop working memory, were used by 90% of teachers. The use of games requiring sharing or turn taking, and which help develop inhibition skills, were also used by 90% of teachers, as was the promotion of critical thinking (cognitive flexibility). The least used strategies were the ones involving direct teaching of skills. Teaching ‘shifting’ strategies to adapt content and presentation for different audiences and contexts was the least used overall at 29%. Regular practice of specific skills such as thinking skills, and memory skills, was the second lowest scoring item used by 57% of teachers, followed by memory techniques (mnemonics), which were used by 66% of teachers.

To find out if there are any other strategies or activities currently used by teachers to help develop EFs, they were invited to share any more examples from their classroom practice. Eight of the respondents offered examples and the range of strategies and activities described was broad, comprising many examples that do relate to EFs, and some with less of a link. Teaching style or strategy was described most frequently with examples such as ‘allowing children to lead their own learning...to develop independence and social skills’, ‘cooperative learning’, ‘mixed ability strategy groups focusing on mathematical discourse’ and ‘allowing children to verbalize thought process to correct response’. Teaching activities were also described and included ‘inquiry based activities’, ‘scaffolding learning steps through repetition’, ‘widening rather than extending inquiries’, and ‘finding online activities’ to practice certain skills. Some of the respondents described personal strategies or approaches, such as ‘I speak with the student... about what works for them’, and ‘I try to keep a balance of all sensory inputs’. One respondent elaborated ‘my current practice is embedded in this – but has come to it through experience and many years of reflection’.

Examples of activities shared that have a less direct relation to developing EFs were meditation, and celebrating ‘novel or fun stuff’.

At the end of the questionnaire teachers were given the opportunity to share any further comments. Eight respondents chose to respond, all of who indicated that either they believed EFs to be important, ‘an area for immense growth’, or that they would be keen to learn more ‘I hope it (the study) will be published so that we can learn more about this’. One respondent highlighted that EFs are ‘not widely recognized in schools’

and another commented that more funding needs to go into schools ‘for direct training and PD for staff on current research’.

In summary, the majority of respondents taking part in the survey were experienced teachers with 11 or more years teaching experience. The higher decile schools were strongly represented and the lower decile schools (1 to 3) were not represented at all. None of the respondents had a formal psychology qualification and 42% had never studied psychology. A significant number of the respondents indicated that they were not currently a classroom teacher of a year 1 to 6 class, due to being in senior leadership, an across-years role, or having a composite class.

Overall, 76% of the teachers reported that they were familiar with the set of skills that comprise EFs, 27% of who used the term ‘executive functions’, and a further 24% did not use any term to refer to EFs. Descriptions given by the teachers in their own words indicated some knowledge of the skills associated with EFs. Recurrent themes described were staying on task, self-management, and self-regulation, which relate to inhibition, and focus, flexible thinking, and reflective learning, which relate to cognitive flexibility. The results of teacher ratings of a series of 22 EFs indicated that teachers value all EFs, and in particular skills related to working memory.

As regards current classroom practice, 90% of teachers reported that they were using strategies and activities to support the development of EFs. Of the strategies and activities listed in the questionnaire, mind mapping, and re-telling of stories or information were the most commonly used. Of the strategies and activities that teachers described in their own words, collaboration, reflection, and opportunities to self-manage were the most commonly cited. Approximately one third of the teachers reported that they believed EFs to be an important topic, and that they would welcome more information or more training.

Chapter Five

Discussion

This study set out to examine what New Zealand primary school teachers know and understand about executive functions (EFs), the value they place on EFs, and the level to which they support the development of EFs in their practice. In this chapter, key findings from the study focusing on the three research questions will be discussed. An examination of teacher knowledge and understanding about EF will be reported first. Next, the importance teachers' place on the skills associated with EFs for learning will be examined, followed by a discussion of the current pedagogical practice of the respondents and their views about the topic of EFs. The chapter concludes with a summary, limitations of the study, implications, and finally recommendations.

Research Question One: What are New Zealand Primary School Teachers' Knowledge and Understanding of Executive Functions?

Overall, the information provided by respondents indicated that the majority had encountered some kind of information about EFs before, that they were familiar with the types of skills associated with EFs, and that they were all aware that EFs are domain-general skills as opposed to domain-specific skills. The high level of self-reported engagement with information about EFs is somewhat contradictory given that the terms inhibition and cognitive flexibility were never cited by the teachers, and working memory was only referenced three times. This may relate to the smaller subset of respondents that reported they specifically used the term EFs when referring to key EF skills. These terms associated with EF skills are the most commonly used terms in literature about EFs, so teachers who had not previously encountered the term EF would be unlikely to encounter the terms associated with the three core skills. It would be useful to conduct further research about the nature of the information the teachers' engaged with to learn about EF skills in order to understand where teachers are accessing their information. Notably, the survey results showed that none of the teachers gave a comprehensive description of what constitutes EFs as regards the core skills, even allowing for alternative terminology.

Nonetheless, goal-directed behaviours, temperaments and personalities related to well-developed EFs, as described in the literature and which are shown in Figure 1, such as self-regulation, managing self, staying on task, reflective learning, flexible thinking, and persistence were commonly cited in the teachers' own descriptions of

EFs, with the terms student agency and growth mindset also referenced. Student agency is a concept that is embedded within the New Zealand curriculum Key Competencies and which aims to promote the empowerment of students within the education context, making them active participants in their own learning (The New Zealand Curriculum, 2007). The five Key Competencies are: thinking; relating to others; using language, symbols and texts; managing self; and participating and contributing. Examples given in the curriculum of the kinds of characteristics and behaviours teachers are to develop in their students in order to address the Key Competencies include perseverance in problem solving, resilience in adversity, and collaboration towards common goals. Figure 5 shows key skills and attributes associated with EFs, New Zealand curriculum key competencies and Dweck's (2012) growth mindset. As seen in the figure, it is clear that within the New Zealand curriculum Key Competencies, and especially thinking, and managing self, there are some clear overlaps with the temperaments and behaviours associated with students with well-developed EFs.

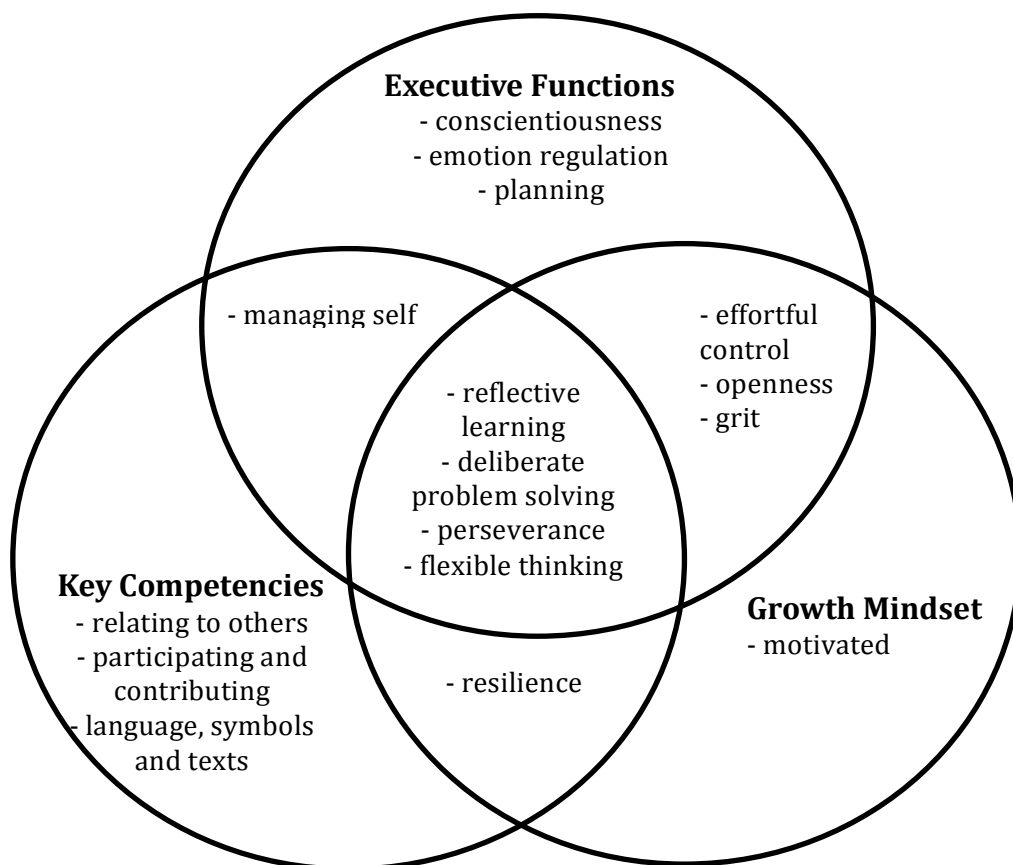


Figure 5. Venn diagram illustrating attributes and skills associated with executive functions, New Zealand curriculum key competencies and Dweck's (2012) growth mindset.

Having a growth mindset was also referenced in a number of teachers' responses. Dr Carol Dweck's (2012) work on the construct of fixed mindsets (fixed traits or ability) versus growth mindsets (malleable traits or ability) explored the underlying beliefs about learning and intelligence, and is well known within the education community. She found that students who believe they can get smarter, and understand that effort can make them stronger, are more inclined to take on challenges and to persevere, even when faced with initial failure. Such attributes of perseverance, reflective learning, and learning from mistakes align with some of the temperaments, personalities and behaviours associated with well-developed EFs, as seen in Figure 5., and adopting a growth mindset would certainly enhance the development of EFs.

It can be seen from the previous two examples, that New Zealand teachers are aware of the importance of some of the skills related to EFs, and that the context in which they may have been exposed to them presents them as part of larger concepts (student agency and growth mindset), but not as cognitive constructs with specific terminology and skills.

The survey also explored the depth of teacher knowledge and understanding of each of the three specific core EFs, working memory, inhibition, and cognitive flexibility. After being given a brief description of each of the EFs, approximately half of the teachers were able to provide examples of student skills or behaviours related to that description. Additional, perhaps less obvious skills that also directly related to the three EFs were far less commonly mentioned, with some not referenced at all. For example, problem solving, reasoning, and reading comprehension were the most commonly mentioned skills for working memory, but surprisingly mental calculations or maths skills, which rely on working memory the most out of all three of the EFs (Gilmore & Cragg, 2014), were scarcely referenced. Long-term memory, or the ability to recall prior learning and knowledge, and to apply it to new learning, was another commonly mentioned skill required to be a successful learner, and given as an example of working memory in teachers' own words. However, long-term memory is not one of the core EFs. Working memory, which may be *served* by long-term memory, is quite distinct in that it is a unique skill that involves holding information in mind in the short term only, whilst simultaneously doing something with that information in order to reach a solution (Diamond & Ling, 2016). Writing skills and creative thinking were also barely mentioned. A possible explanation for this is that whereas it is well known that success at school requires mastery of a number of subject-specific skills, such as

knowing how to read, spell and such, it is far less known that working memory is also vitally important for mastery of these same skills. The apparent lack of knowledge and understanding of the importance of working memory may be because it is domain-general, comes from a cognitive psychology perspective, and as is the case with psychological constructs, is discreet (not visible) in nature and consequently hard to isolate and identify (Miyake et al., 2000).

When asked to describe examples of good inhibition, ignoring distractions and staying on-task were commonly cited, however no teachers described being able to wait your turn, play games such as traffic lights, inhibit calling out, engage in role play, delay gratification, or resist temptation, skills which are important in the primary years (Bierman & Torres, 2016; Diamond, 2013; McClelland & Tominey, 2014), but which perhaps are not thought of as being linked to EFs. Furthermore, some of the other example skills given, such as confidence to tackle something that is hard, feeling free to think and take charge of their learning, take risks with their learning, and challenge themselves, seem to reflect a literal translation of the term ‘inhibition’, a sense of freedom and uninhibited learning, rather than the psychological definition of the word.

As with the previous two EFs, examples of skills of cognitive flexibility that closely aligned with the description provided in the questionnaire were most common, with understanding of the construct perhaps helped because ‘cognitive’ and ‘flexibility’ are readily understood terms that allude to skills related to thinking and adaptability. Once again, the less obvious skills associated with cognitive flexibility, namely thematic play, attention (Dias & Seabra, 2017), and empathy (Diamond, 2014) were not identified by respondents, indicating that they do not associate those skills with cognitive flexibility.

In summary, NZ teachers appear to be familiar with the bigger conceptual picture. They are aware that there are a set of domain-general skills that allow students to manage their own learning and behaviour. They were able to describe what some of the well-developed EFs look like, in terms of temperaments, personalities and goal-directed behaviours. Their descriptions echo common themes emerging from the New Zealand Curriculum Key Competencies and from popular psychological theory in education such as Dweck’s growth mindset. However, teachers are not familiar with the cognitive psychology terminology associated with EFs, which is not surprising given the limited experience the respondents have had with formal psychology study. Furthermore, much of the research into EFs has traditionally been conducted in

laboratories using abstract cognitive tasks that do not necessarily translate to how EFs manifest in the classroom (Cragg et al., 2017). Deeper and more specific knowledge of the three distinct core skills, inhibition, working memory and cognitive flexibility was low, especially for the more discreet, hard to measure skills. This is not surprising, given that the constructs are non-visible and underlie many better-known, larger scale constructs such as self-regulation, and student agency. Teachers commonly gave examples very closely related to the brief description they were provided in the questionnaire, and it would be interesting to explore how they would have responded without this prompt, to see if it perhaps steered them in answering in one particular way, and if it dissuaded them from sharing other, credible examples.

Findings from the study suggest that respondents have part of the picture, and in particular in the area of attributes and skills that are reinforced by the New Zealand curriculum Key Competencies, or enhanced through personal research, but they don't have the full picture in terms of knowledge and understanding of the full set of core EFs. The implications of this gap in teachers' knowledge and understanding will be addressed later in the chapter.

Research Question Two: What Value do New Zealand Primary School Teachers Place on Executive Functions?

The questionnaire provided respondents with a randomized range of skills covering four categories (EFs, social-emotional skills, domain-specific skills, and other skills), which they were asked to assign an importance rating to. The categories were not provided to the respondents, and it was interesting that they rated all skills as 'very important', with domain-specific skills rated as slightly less important overall out of all four. This is encouraging as it suggests that the importance of EFs is apparent in the classroom, not just the laboratory, and even in the absence of formal training about EFs. Similarly, within the domain of EFs, when provided with six examples of each of the three core EFs, and again asked to rate their importance, there was very little difference in mean importance rating between categories, with all EFs rated as 'very important'.

Analysing teacher importance ratings of EFs from this study, and comparing them to Gilmore and Cragg's study (2014) that looked specifically at mathematics learning, interesting similarities are found. In both studies, teachers' assigned more importance to inhibition and shifting skills (cognitive flexibility), with regards to mathematics learning, than working memory. This finding is interesting as it differs

from recent research evidence situated within the area of cognition that has tended to focus on the important role that working memory plays in mathematics learning (Cragg et al., 2017). The difference between teachers' perspectives about the importance of working memory to mathematics learning and what the current research evidence has found may be due to the environmental contexts. In the laboratory, cognitive psychologists are able to carry out experiments that accurately test and measure single, definable constructs such as working memory (mental manipulation of abstract information), in isolation. However, within the classroom, it would be harder to know how to accurately identify those same skills, whereas other skills such as 'focusing on relevant information and avoiding distractions' (inhibition), and 'being able to think flexibly' may be easier for teachers to recognize. More research about real-life, classroom based executive function tasks may help to shed light on how to recognize EFs, and how EFs can support learning.

Looking briefly at the demographics of this study, the majority of respondents were experienced teachers. All teachers reported that they valued EFs as 'very important'. This could possibly reflect the findings of the Gilmore and Cragg (2014) study where awareness of the importance of EFs, as opposed to domain-specific skills, for learning, only increased with 10 years or more of teaching experience. Certainly a number of respondents in this study referred to their own experience as being their primary source of knowledge and understanding of EFs, and very few had any formal engagement with information about EFs.

Reflection on the personal comments and importance ratings of EFs given by the respondents is important when considering implications for the future success, or not, of promoting the development of EFs in primary classrooms. The majority of teachers rated EFs as 'very important' or higher, and many personal comments indicated an intent to support development of them in the classroom and a desire to learn more about EFs. According to Deci et al. (2017), participating in an activity by choice, by one's own volition, is a demonstration of autonomous motivation. A specific type of autonomous motivation is intrinsic motivation, described as being motivation that is driven by internal interest and enjoyment and for which the activity itself supplies the 'reward', rather than any external reward system (Deci et al., 2017). Adults in employment, who are intrinsically motivated for at least some parts of their job, generally tend to display high-quality performance (Deci et al., 2017). In the context of this study, that would suggest that the teachers who are interested in learning about EFs,

would deliver high-quality instruction, without need for external reward. Furthermore, when people can identify the value and importance of their work, they will show enhanced levels of work motivation. In other words, if teachers are interested in EFs, and believe EFs are valuable to learning, then they have the necessary intrinsic motivation to engage in learning more about EFs and applying that knowledge in their own practice. Data from this study showed that teachers, more often, accessed information about EFs through informal routes such as personal reading and research, and professional conversations. Voluntary comments from a number of the teachers emphasized the value they place on EFs and their desire to learn more. Example comments included ‘the more research done the better’, ‘I feel this is such an important area for schools and education to develop’, and ‘I think it is very important for students to develop this at school’. It would appear that the sample of teachers from this study is open and motivated to developing their knowledge and understanding further.

Overall, the findings of this study about the value teachers place on EFs provide only limited data for interpretation purposes, since teachers rated all skills categories (domain-specific, executive functions, social-emotional, and other) as equally important to learning, and all of the core EFs as equally important overall. Belief about the value of EFs together with a desire to learn more indicate a propensity for intrinsic motivation, and that bodes well for supporting the development of EFs within classroom practice.

Research Question Three: How do New Zealand Primary School Teachers Support the Development of Executive Functions in their Classroom Practice?

To gauge the level of support for the development of EFs in teachers’ current classroom practice, teachers were invited to both share examples in their own words, and to select activities from a list of 22. The self-reported rate of engagement in supporting EFs in their current practice was high, with just under half the sample regularly supporting them and just under half constantly supporting them. Although encouraging, this result should be considered with caution, as teachers’ beliefs about what they practice are not always an accurate representation of actual practice, as found in the study about self-regulation skills by Willis et al. (2014).

As regards what it is that teachers are doing to support the development of EFs, the most common examples given by teachers in their own words reflected provision of suitable learning environments and learning styles, and which again echo the New

Zealand curriculum Key Competencies. The examples of collaborative learning, allowing students to lead their own learning, inquiry based activities, and allowing opportunities to self-manage highlight an understanding of the bigger picture in the sense that these kinds of environments and styles do foster using and developing EFs. However, caution must again be used, as teachers' self-reporting of their practice may be more indicative of their pedagogical beliefs rather than their actual practice, as found in the study by Willis et al. (2014), and may be subject to social desirability bias whereby the most socially acceptable response is given in preference to the true response (Brenner & DeLamater, 2016). Furthermore, teachers are more likely to base day to day instructional decisions on student characteristics and behaviour, classroom constraints, time constraints, and their own experience and intuition, as found in the study by Snider and Roehl (2007). Certainly a lack of time and a lack of resources were given as reasons for why some teachers felt inhibited in their ability to support the development of EFs.

Respondent examples of specific teaching practices to directly teach EFs were limited in number, and comprised meta-cognitive talk, engaging students in reflection, and focusing on mathematical discourse. These results align with those of Gilmore and Cragg (2014) and seem to indicate that teachers appreciate that there are a set of skills that serve to support student learning, and that these skills can be developed through manipulation of the learning environment. However, just as Dawson and Guare (2009a) suggest, knowledge and understanding of the specific core components of EFs, and more specifically how to teach and develop them through targeted activities appears to be less well known. This was also reflected in the self-reported use of the 22 listed activities and strategies, where teaching of 'shifting' strategies and regular practice of thinking skills and memory skills were reported as the least used.

The rationale given by teachers for why they feel that they could support development of EFs highlighted the potential importance of teacher experience and age. Informal contexts such as collegial conversations, rather than formal training, were also emphasised for shaping their attitude about the importance of EFs. Although teaching experience and intuition is no doubt useful, as Snider and Roehl (2007) caution, whilst beliefs and practices guided by knowledge create professional expertise, if sound research and empirical evidence is lacking, then those beliefs become personal, ideological and lacking a scientific base. In other words, whilst experiential learning and personal discovery are a welcome sign of intrinsic motivation and desire to learn, an

over reliance on these in lieu of formal training is undesirable due to the risk of misguided education. It is therefore encouraging that numerous comments were made in the survey that teachers wanted to know more about EFs, wanted to know how to identify difficulties with EFs in students, and generally felt the topic was important for student learning.

In summary, although self-reported support for the development of EFs in teachers' current practice was high, the results are approached with caution since they cannot be validated through observation data, and may be susceptible to pedagogical ideology rather than reality. Notwithstanding, many credible examples were given for learning environments, implemented by teachers, which facilitate the development of EFs in the broader sense, a number of which derive from the New Zealand curriculum Key Competencies. Collegial and school-wide support, together with personal research and experience show an encouraging level of engagement with the topic of EFs but raise concerns about over reliance on experiential and informal routes to knowledge. Examples of strategies to target specific core EFs were limited and perhaps signal teachers' lack of scientific knowledge about the more specific aspects of cognitive psychology, and or a lack of knowledge in how to teach such specific skills.

Summary

The intention of this study was to explore the level of NZ primary teacher knowledge, value and practice of EFs in classrooms. Results indicate that the sample of teachers' who participated have an overall understanding that there are a range of domain general skills that are important to learning, even if they do not know them by the term 'executive functions'. Deeper knowledge of the core EFs of inhibition, working memory and cognitive flexibility was low as demonstrated by limited use of those terms, limited knowledge of how the skills manifest in students within the classroom context, and limited description of how to develop them through teaching practice.

The study next examined the value NZ primary teachers place on EFs. Overall teacher ratings of the importance of EFs was high, with no discernable variation between the three core EFs of working memory, inhibition, and cognitive flexibility. The overriding sentiment expressed within the personal comments from respondents indicated that teachers not only believe EFs are important to children's' learning, but that they are also motivated to learn more about EFs and how to support the

development of them within their own pedagogy. The importance of this finding was discussed as regards how well it aligns with Deci's theory about motivation and the future success of any interventions to support the development of EFs within the classroom context.

Finally, the extent to which NZ primary school teachers currently support the development of EFs within their current classroom practice was examined. Self-reported rates of practice were high, with the provision of learning environments and learning styles that help support development of EFs the most popular examples given. The similarities between the New Zealand curriculum Key Competencies and Dweck's growth mindset were recognised and those similarities seen as a potential factor contributing to the provision of supportive learning environments and teaching practices. However, exercising caution about the findings was also discussed since self-reporting is not infallible and can also be subject to social desirability bias.

Limitations

The limitations of this study should be considered in any interpretation of the results. Despite intending to canvas a range of teachers' perspectives from across all socio-economic school groups (deciles), across all primary years, within the Auckland region, the response rate was low. The response rate to the online survey was only 38 responses from 151 emails to principals, of which only 24 were complete questionnaires, meaning that implications and conclusions drawn are tentative due to the small sample size. Moreover, due to the anonymous and voluntary nature of the survey, and the dependence on school principals to forward the survey details on to their staff, it is impossible to determine how many potential participants were reached and how many may not have been reached.

Given the sample of respondents, the findings of the study are limited to a predominant demographic group of teachers, namely experienced teachers, from decile 4 or higher schools. Ability to respond may have been an influencing factor for participants. Half of the respondents indicated that they were not currently classroom teachers, but instead taught across year levels, were in learning support roles, or were in senior management positions. Those respondents may have more time or easier access to a computer during the workday, and more experienced teachers may also have more time available. Volunteering to complete the survey may also have reflected an existing interest in cognitive psychology or neuroscience (Gilmore & Cragg, 2014), with over

half of respondents indicating they had had either formal or informal engagement with psychology. Conversely, less experienced teachers were under represented in the sample, meaning that the sample is biased towards older, more experienced teachers. Further research would ideally engage teachers in New Zealand within the full range of teaching experience.

The over representation of decile 10 school teachers and under representation of lower decile school teachers, despite the random stratification of email invitations, further limits the extent to which the findings can be applied. The knowledge, values and practices reported by teachers were therefore based on a small sample and may not represent the knowledge, values and practices of other primary school teachers in New Zealand. It would therefore be helpful to conduct further research with a larger sample that is fully representative of the population of New Zealand primary school teachers.

The voluntary nature of the survey may have limited the volume of responses and might reflect perceived value of EFs, and perhaps to a certain degree, knowledge too. The attrition rate for the survey beyond demographic information was approximately a third (37%). It is possible that the reluctance to continue might reflect a lack of knowledge of EFs, a lack of interest in EFs or a lack of perceived value of the importance of EFs. Conversely, the choice to complete the survey might reflect personal interest and value about EFs, together with at least basic knowledge of EFs. A look at the literature about what motivates people to participate in surveys highlights that there are a number of theories that are believed to influence voluntary participation, such as the theory of exchange, cognitive dissonance, self-perception, and involvement/commitment (Evangelista, Poon, & Albaum, 2012). Ultimately, however, teachers' motivations for engaging or not engaging in this survey are not known.

Finally, all data from the survey concerning teachers' pedagogical practice was in the form of self-report. Limitations of self-report data have been well documented, and include the potential for teachers to report on practice that doesn't actually happen in real life, either consciously, referred to as social desirability where the respondent gives the most desirable or socially acceptable response (Brenner & DeLamater, 2016), or unconsciously, such as in the Willis et al. (2014) study.

Implications

Analysing the data from this study, two overriding themes emerge concerning implications. Firstly, primary teachers in New Zealand have some knowledge and understanding of EFs, but lack the technical precision for describing and supporting

development of EFs. Secondly, primary teachers value EFs highly and are open and receptive to learning more about them.

Addressing the first implication regarding limited knowledge and understanding, the findings of the study are not surprising, since research into EFs has only recently begun to move from the psychological realm into the school space. The teachers themselves were not all familiar with the term ‘executive functions’ and some were using other, incorrect but related terms such as ‘student agency’ and ‘growth mindset’ in its place. Teachers are exposed to a variety of pedagogical theories and terminology through training and practice, but they also learn about methods and styles through informal routes such as collegial conversations and personal reading. The teachers in this study shared that informal routes to learning about EFs were most common, yet their knowledge of the specifics of EFs were limited or flawed, highlighting the danger of assumed or misguided knowledge (Snider & Roehl, 2007). It is easy to understand how terms and methods can become mixed together and how teachers can become overwhelmed with the sheer volume of information they are given. Furthermore, there is an abundance of popular teaching ‘methods’ that teachers come across, which although believed to be efficacious, are little more than popular myths, with little or no empirical evidence to back them up (for example teaching to personal learning styles, mixed ability grouping) (Snider & Roehl, 2007). It is therefore important to separate the ‘wheat from the chaff’ and focus on the most powerful teaching and learning theories.

Effective teaching is grounded in scientific, evidence-based practice, and the benefits of well-developed EFs have been demonstrated by cognitive psychology research as coming from a solid, empirical base. Cognitive processes such as EFs form the important building blocks for all learning, and which when developed contribute to other important skills and attributes such as managing emotional reactions and social behaviour (Zelazo et al., 2016). Furthermore, cognitive psychology research has demonstrated that the many benefits of well-developed EFs include not only student learning, but also future success, physical health, and mental health, as well as protecting against the risk of failure associated with poverty and adversity.

It is therefore important that NZ primary teachers have a clear understanding of what EFs are, and how important they are, as demonstrated in research, in order to be able to support student success. Teachers need to know the technical distinction between EFs and the subject-specific skills commonly taught in school. Whilst both sets

of skills are vitally important to learning, it is the EFs that, if supported and developed, facilitate the learning of content more readily (Zelazo et al., 2016).

Following on from this, it is also therefore necessary for teachers to understand and learn how to support the development of EFs, because research has demonstrated that the development of EF skills can be enhanced through explicit instruction and practice of EFs. The findings of this study indicate that teachers are incorporating many activities and strategies into their practice already, that support development of EFs, but without knowing exactly *how* those strategies develop EFs, or which specific core EFs they relate to. Researchers such as Dawson and Guare (2009b) have previously commented on the limited availability of resources about EFs that are relevant to teachers and classroom practice, and comments volunteered in this study confirmed a lack of access to research and training. Development of EFs correlates with brain development, and typically, teachers do not cover neurological development as part of their teacher training. Furthermore, attention has traditionally been focussed on those students who have EF *deficits* that result from a developmental or psychiatric disorder (Dawson & Guare, 2009a). However, by narrowing the focus to just those students with an identified EF deficit resulting from a disorder, professional development in the area of cognitive development is restricted to those in special education. This means that teachers in general education may be missing out on valuable professional development, and their students missing out on the opportunity to develop their EFs.

In relation to the second implication, there was a clear indication that NZ primary teachers ascribe a high level of importance to EFs and are keen to learn more about EFs. Given that research about EFs and their important role in future academic and social success has traditionally come from a psychology background does not appear to have diminished teachers' interest. It is possible one reason for this has been the increasing crossover between traditional educational theory and more scientific, cognitive psychological theory within the education sector. There has been substantial dialogue in recent years within the sector about the need to equip students with a set of transferable skills, now more commonly referred to as soft skills, necessary for the twenty first century workforce (Musa, Mufti, Latiff, & Amin, 2012).

Soft skills includes skills such as critical thinking and problem solving, collaboration, creativity and perseverance (Musa et al., 2012) which apply to work in general, rather than being specific to one particular job or industry. EFs, whilst sharper and more focused in definition than the more generic soft skills, provide an important

foundation for the development of those soft skills. Key academics such as Professor Paul Spoonley of Massey University have commented that skills such as the ability to work as a team, whilst also being able to think and work independently, together with good attitudes to work, are now equally, if not more important to employers than traditional 'hard' skills, such as specific technical knowledge (Spoonley, 2010). He also poses the question of whether education and training in its current format is equipping students appropriately for the future, given this change in labour demand.

Others have also highlighted the importance of soft skills such as flexibility, self-motivation, self-management, ability to deal with complex problems, and ability to make thoughtful decisions in order to meet the challenges of this era and provide an ideal pathway for lifelong learning (Ferguson, 2010). As highlighted in the definition of EFs in chapter two of this study, the important role EFs play in facilitating soft skills is clear. It is the core EF of cognitive flexibility that directly permits flexible thinking and the ability to tackle complex problems, for example, and the core EF of inhibition that facilitates self-management.

With robust evidence of the importance of EFs to academic success, coupled with a growing demand for soft skills in the workforce, clearly now is the time to hone and foster EFs to best equip students for their future. NZ teachers reported in this study that they can see that EFs are useful to students, and that they are motivated to engage more with the topic. Bearing in mind Deci's theory about motivation (2017), the results seem promising for supporting NZ primary teachers to help develop EFs within the classroom context.

Recommendations

The findings from this study suggest that a useful next step would be to provide professional development opportunities and resources for teachers that not only explain the cognitive processes of EFs in language and terminology accessible to non-psychology graduates, but also to outline how children's skills in EFs manifest within the classroom. This level of professional development support will require supportive policies and key actions in education practice. To focus on what teachers can do in the immediate term, recommendations focus on actions for practice.

To get started, familiarisation with the most commonly used terms for discussing EFs, namely working memory, inhibition, and cognitive flexibility, with a sound knowledge of what those terms mean would help provide a sound knowledge base for teachers and to correct any existing misinformation. To accompany the

technical definition of EFs, teachers would benefit from examples of what well-developed EFs look like within the classroom context so that they know what they are ultimately aiming to develop within their students. Finally, teachers would benefit from professional development and access to or direction towards resources that clearly and succinctly provide strategies and activities that support the development of EFs. For example, Adele Diamond, a prominent author on the subject of EFs, presents a couple of short, educational clips explaining what EFs are and how to help children develop them (See Diamond, n.d.). Teachers could also access informational briefs and videos about EFs online, from institutions such as Harvard University, Center on the Developing Child (See Center on the Developing Child, n.d).

The introduction of pedagogy and evidence based activities to promote development of EFs should be considered as complimentary to the existing classroom context. Many of the teachers currently provide an environment that adheres to the principles of the New Zealand curriculum Key Competencies, and this context is well aligned with the ambience within which EFs can also be developed. NZ teachers could therefore be reassured that no major changes to their current practice are required, just a ‘tweaking’ that will enable them to target specific EFs through a variety of games, teaching strategies, and activities. For example, evidence has shown that brief interventions (just 15 minutes) targeting specific EF components, such as reflection training to improve cognitive flexibility, have resulted in neurological changes that make reflection more automatic in future decision making (Zelazo et al., 2016).

The recommendations listed provide specific things that teachers can do to support the development of EFs in their classrooms. Given the importance of EF skills for student learning and success, it is encouraging that the teachers who participated in this study have shown they recognise the importance of EFs, are receptive to learn more about EFs, and are already attempting to promote the development of them in their practice. The time and environment appear to be right to provide New Zealand primary teachers with a sound knowledge base upon which to build their expertise and develop these important skills in today’s students.

Conclusion

Research in the field of cognitive psychology has highlighted the important role EFs play in learning and academic success. EFs not only facilitate goal-directed behaviour within the education context, but are also associated with social-emotional

learning and competency. Research has also highlighted the improvements that can be made to EFs through direct intervention and practice, with broad and long lasting benefits. The objective of this study was therefore to explore whether primary teachers know about the nature and importance of EFs, and if they know how to develop EFs in their students. The study aimed to investigate current knowledge, value and practice of EFs amongst New Zealand primary school teachers.

A detailed literature review influenced and defined the approach for the study. Three research questions emerged to guide the focus for the study:

- What are New Zealand primary school teachers' knowledge and understanding of executive functions?
- What value do New Zealand primary school teachers place on executive functions?
- How do New Zealand primary school teachers support the development of executive functions in their classroom practice?

The study used a mixed methods design to obtain qualitative and quantitative data from a random stratified sample of New Zealand Year 1 to 6 primary teachers. Teachers were invited to participate in an online survey that explored their understanding of EFs in general, and their understanding of the three specific core EFs of working memory, inhibition, and cognitive flexibility. Teachers were invited to rate the importance they ascribe to EFs for learning, and to indicate the nature and frequency with which they currently support the development of EFs within their pedagogy. Procedures were followed to ensure credibility and validity of the survey, and ethical approval from Massey University Human Ethics Committee was granted.

Data from the survey was analysed in relation to the three research questions. Overall, the findings indicated that approximately three quarters of the teachers were aware that there is a set of non subject-specific skills that are important to learning. However, their knowledge and understanding specifically of EFs was limited. Teachers in the sample rated all examples of EFs as very important to learning, with the majority of teachers reporting that they were already trying to support development of EFs within their classroom practice. Many teachers were already providing learning environments beneficial to using and practicing EFs as a result of overlaps with the philosophy of the New Zealand Curriculum Key Competencies. However, detailed knowledge about

specific activities and teaching strategies that can be used to target development of specific EFs was limited.

Two key themes arose from analysis of the study. Firstly, primary teachers in New Zealand have a rudimentary knowledge and understanding of the general topic of EFs, but are unable to provide a more comprehensive and informed description of EFs or how to support development of them. Secondly, primary teachers in New Zealand ascribe a high level of value to EFs, and are motivated to learn more about them. This research therefore highlighted that a beneficial next step would be to offer teachers professional development, support and resources in order to develop their understanding of EFs. Initially this would cover an explanation of the cognitive processes of EFs in language and terminology accessible to non-psychology graduates, as well as outlining how to identify children's skills in EFs within the classroom context. The study also highlighted a need to provide teachers with practical support and resources to incorporate into their current learning environments such as a range of teaching strategies and activities that specifically target EFs. The receptiveness of teachers participating in this study, coupled with an environment conducive to the development of EFs indicate that the time is right to provide New Zealand primary teachers with the relevant professional development about this important area of cognitive psychology to best prepare today's students for their future.

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Appendix A

Email Invitation to Participate

Executive functions are very important to student learning but are little understood. Participation in this survey will help teachers think about some of the core concepts.

Exploring Teachers' Perspectives about Executive Functions in the Classroom Context in New Zealand

Dear Principal,

My name is Claire de la Haye-Stokes and I am completing a Master of Educational Psychology with Massey University.

As part of my research thesis, I am seeking to explore the level of knowledge, current practice, and perceived value, of a cognitive psychology domain called executive functions, amongst New Zealand primary school teachers. Executive functions are a range of skills that relate to students abilities to manage their own learning and behaviour. Students with effective executive function achieve greater levels of academic success. To better understand how NZ schools might supports students' executive functions, I am interested in first learning about teachers' knowledge and practices in this area.

To this end, I am conducting an online survey to gather teachers' perspectives about executive functions. The survey is completely anonymous and no identifying information will be used in the study. The survey is expected to take no more than 15 minutes to complete. Teacher participation is voluntary.

To access teacher participants, I would be grateful if you could take a moment to forward this email to your classroom teaching staff in years 1-6, inviting them to participate.

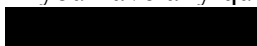
Attached to this email is a file containing an information sheet where staff can read about the research study. Then if they are interested in participating, they can click the link to complete the survey.

Survey link:



The survey will be open from 26th of July to the 11th of August.

I understand that you receive many email requests to conduct research, however I believe this research is an important first step to further understand this critical aspect of teaching and learning. In appreciation of your support, I am happy to forward you additional information and resources about executive functions. **If you could please let me know if you have forwarded this to your staff, then I can send you the information and resources on executive functions by return email.**

If you have any questions regarding the study or survey, please feel free to contact me,  or my research supervisors Tara McLaughlin t.w.mclaughlin@massey.ac.nz and Alison Kearney a.c.kearney@massey.ac.nz.

Thank you for your kind consideration.

Claire de la Haye-Stokes

Appendix B
Information Sheet for Participants
Survey Information Sheet

**Exploring Teachers' Perceptions about Executive Functions in the classroom
context in New Zealand**

Kia ora,

My name is Claire de la Haye-Stokes and I am currently working towards my Masters in Educational Psychology at Massey University. As part of my research thesis, I am seeking to explore the level of knowledge, current practice and perceived value, of a cognitive psychology domain called executive functions, amongst New Zealand primary school teachers. Executive functions are a range of skills that relate to students abilities to manage their own learning and behaviour. Students with effective executive function achieve greater levels of academic success. To better understand how NZ schools might support students' executive functions, I am interested in first learning about teachers' knowledge and practices in this area.

I would be extremely grateful if you could take 10-15 minutes to help me with my research by completing this online survey.

(A direct link to the survey is at the bottom of this information sheet)

What is the study about?

The aim of this study is to gauge primary teachers' knowledge and beliefs about the range of skills falling under the term executive functions. I am specifically interested in finding out:

1. What are NZ primary school teachers' knowledge and understanding of executive functions?
2. What value do NZ primary school teachers place on executive functions?
3. How do NZ primary school teachers support the development of executive functions in their classroom practice?

Don't worry if you think that you don't know anything about executive functions, I would still like to hear your views.

Who are the intended participants?

I am inviting Auckland-based primary school teachers who are currently classroom teachers of students in Years 1 to 6 to participate. I am seeking a sample of teachers from a range of school decile ratings. Your school principal has been approached as part of a random-stratified school selection process, and asked to forward to you the information about the survey together with an invitation to participate.

Details about the survey

The survey comprises 22 questions and should take no longer than 15-20 minutes to complete. There is a range of multiple-choice questions and some open-ended questions.

Participant Rights

There is no obligation to accept this invitation. If you *are* interested in taking part in the study, click the link below. Your responses to survey questions will be taken as your consent to participate. You have the right to decline to answer any particular question or to discontinue the survey at any point. You may contact me to ask questions about the study at any point, and you have the right to see a summary of the research findings at its conclusion if you request so.

The survey is completed anonymously. Anonymity will be upheld by ensuring that neither participants nor schools can be identified through any of the information published.

Data Management

Responses from the survey will be stored securely and will only be accessible by the researcher and the research supervisors for the sole purpose of completing this thesis and as the basis for national or international publications. Data will be destroyed after 5 years. If you would like a summary of the study findings please email me.

Ethics

“This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the university’s human ethics committees. The researcher(s) named above are responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director, Research Ethics, telephone 06 356 9099, ext. 86015, email: humanethics@massey.ac.nz “

Further information

If you have any questions regarding the study or survey, please feel free to contact me, [REDACTED] or my research supervisors Tara McLaughlin t.w.mclaughlin@massey.ac.nz and Alison Kearney a.c.kearney@massey.ac.nz .

Thank you for your time.
Claire de la Haye-Stokes

Click the following link to access the survey:

[REDACTED]

Appendix C
Questionnaire

[Exit](#)



Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

Introduction and information

My name is Claire de la Haye-Stokes and I am completing a Master of Educational Psychology at Massey University. As part of my research thesis, I am seeking to explore the level of knowledge, current practice, and perceived value, of a cognitive psychology domain called executive functions. I am inviting Auckland-based primary school teachers who are currently classroom teachers of students in Years 1 to 6 to participate.

Students with effective executive functions achieve greater levels of academic success. To better understand how NZ schools might support students' executive functions, I am interested in first learning about teachers' knowledge and practices in this area.

I would be grateful if you could help me with my research by completing this online survey. You may find the survey helps you grow your understanding in this area and provide you with some useful strategies! The survey comprises 22 questions and should take no longer than 10-15 minutes to complete. There is a range of multiple-choice questions and some open-ended questions.

Don't worry if you think that you don't know anything about executive functions, I would still like to hear your views.

There is no obligation to accept this invitation. Completion of the survey will be taken as your consent to participate. You have the right to decline to answer any particular question or to discontinue the survey at any point.

The survey is completed anonymously and no identifying information is being requested. Data will only be used for the completion of this thesis and as the basis for national or international publications. Data will be stored securely and will be destroyed after 5 years. If you would like a summary of the study findings please email me.

If you have any questions regarding the study or survey, please contact:

Researcher: Claire de la Haye-Stokes [REDACTED]
Supervisors: Dr Tara McLaughlin t.w.mclaughlin@massey.ac.nz
Dr Alison Kearney a.c.kearney@massey.ac.nz

Thank you for your time.

**This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the university's human ethics committees. The researcher(s) named above are responsible for the ethical conduct of this research.*

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director, Research Ethics, telephone 06 3569099,(86015), email:humanethics@massey.ac.nz



Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

About you 1. What is the highest qualification you hold?

- Diploma
- Postgraduate Diploma
- Bachelors Degree
- Masters Degree
- Doctorate Degree

Other (please specify)

2. What teaching qualification do you hold?

- Diploma
- Bachelors degree
- Post Graduate Certificate
- Post Graduate Diploma
- Other (please specify)

3. Have you studied psychology?

- No
- Yes, I have a psychology degree
- Yes, I have psychology papers at tertiary level
- Yes, I studied psychology as part of my initial teacher training
- Yes, I have attended short courses/professional development that was focused on psychology
- Yes, I have studied psychology informally because of a personal interest

Other (please specify)

4. How many years of teaching experience do you have?

- Less than 1 year
- 1 to 3 years

- 4 to 10 years
- 11 years or more

5. Which year group do you currently teach?

- New entrant or Year 1
- Year 2
- Year 3
- Year 4
- Year 5
- Year 6

Other (please specify)

6. What is the decile rating of your school?

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

Skills for learning at primary school

7. Executive functions are a set of skills that relate to students abilities to manage their own learning and behaviour. Please describe in your own words your understanding and knowledge about executive functions.

8. Please indicate whether you use the term 'executive functions', or an alternative term, when referring to the set of skills mentioned above.

- I use the term 'executive functions'
- This is not a set of skills that I use a term for
- I use an alternative term

(please specify term)

9. Where have you encountered information about executive functions?

- I haven't encountered information about the term before
- During undergraduate study
- During postgraduate study
- During formal training or professional development
- From personal reading and research
- During professional conversations
- Other (please specify)

Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

10. To succeed at school, how important do you think it is for students to develop the following learning skills?

	Not important	Somewhat important	Important	Very important	Extremely important
Think creatively					
Initiate play or interaction with peers					
Store and manipulate information in their head					
Have good verbal skills					
Focus on relevant information and avoid distractions					
Understand mathematical concepts					
Negotiate social conflicts					
Read with speed and fluency					
Have good spatial skills					
Be able to think flexibly					

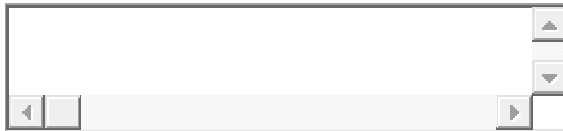
Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

Executive functions are grouped into three key subsets: **working memory**, **cognitive flexibility**, and **inhibition**.


11. **Working memory** is generally defined as the ability to hold and manipulate information in your mind. Thinking about students in your class, what skills do they demonstrate when they have successful working memory?

An empty text input field with a light gray background and a thin border. It includes standard scrollbars on the right and bottom edges.

12. **Cognitive flexibility** is generally defined as the ability to switch attention between tasks and to flexibly switch perspectives. Thinking about students in your class, what skills do they demonstrate when they have successful cognitive flexibility?

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13. **Inhibition** is generally defined as the ability to sustain focus and ignore distraction. Thinking about students in your class, what skills do they demonstrate when they have successful inhibition?

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Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

In the following section there are no right or wrong answers; I'm particularly interested in your personal opinion about which executive functions you think are important for children to have.

14. Please read the following list of working memory skills and rate their importance.

	Not important	Somewhat important	Important	Very important	Extremely important
Hold a question or comment in memory until you are able to ask or share it					
Remember and follow multistep instructions or directions					
Remember and follow rules					
Consider alternatives in a problem					
Store and manipulate information mentally to come up with new connections or combinations					
Update stored information with newly acquired information (mental reordering)					

Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

15. Please read the following list of inhibition skills and rate their importance.

	Not important	Somewhat important	Important	Very important	Extremely important
Sustain attention (stay on task)					
Inhibit inappropriate behaviour, and choose another response					
Persist on difficult tasks					
Filter out irrelevant stimuli					
Delay gratification					
Control impulsive behaviour					

Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

16. Please read the following list of cognitive flexibility skills and rate their importance.

	Not important	Somewhat important	Important	Very important	Extremely important
Transition between tasks and activities					
Adjust to changing demands or priorities					
Return to a previously unfinished task and continue working on it					
Come up with novel ways of attacking a problem					
See things from a different perspective or angle					
Continue with a game or task when the rules or objectives change					

Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

Promoting executive functions in the classroom

In the following section there are no right or wrong answers; I'm particularly interested with your personal engagement with the development of executive functions in your classroom.

** 17. To what extent are you currently trying to promote and support the development of executive functions in students in your classroom?*

- Not at all
- Occasionally
- Regularly
- Constantly
- I am unsure

Please provide a brief explanation for your response

Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

18. *What inhibits you from promoting executive functions in your classroom?*



Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

19. The following is a list of strategies and activities that may be helpful in promoting executive functions in students. Please indicate which, if any, you currently use in your classroom to support executive functions.

- Brainstorming or mind mapping
- Social pretend play and/or role play
- Visual prompts (e.g. desired behaviours, rules)
- Peer tutoring
- Games or activities requiring the sharing of resources
- Games or activities requiring taking turns
- Verbalizing problems (students say what a problem is and how they feel)
- Redirection of negative behaviours
- 'Think alouds' - teacher modelling of thought processes for problem solving
- Task information broken into smaller 'chunks'
- Memory techniques (mnemonics)
- Re-telling of stories or information, summarising main points
- Daily class routines on display
- Social (friendship/peer) problem-solving skills sessions
- Reward for hard work and perseverance
- Regular time set aside for skills practice (memory skills, thinking skills etc.)
- Teach 'shifting' strategies - for adapting content and presentation for different audiences and contexts
- Provide class time and direct instruction for revision of written work
- Peer marking/editing of work
- Strategy-sharing discussions
- Promote critical thinking
- Encouragement to stay focussed through to completion

Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

20. *Is there anything else that you do in your classroom that enables the development of executive functions?*

21. *Do you have any other comments you wish to make about executive functions?*

**The survey is now complete.
Thank you for your time.**

Appendix D

Ethics

From: humanethics@massey.ac.nz
Subject: Human Ethics Notification - 4000017532
Date: June 11, 2017 at 7:36 AM
To: A.Lindsay@massey.ac.nz, Claire.de.la.haye-Stokes.1@uni.massey.ac.nz, A.C.Kearney@massey.ac.nz,
T.W.McLaughlin@massey.ac.nz
Cc: M.E.Thomas@massey.ac.nz

HoU Review Group

Ethics Notification Number: 4000017532
Title: Exploring teachers' perspectives about executive functions in the classroom context in New Zealand

Thank you for your notification which you have assessed as Low Risk.

Your project has been recorded in our system which is reported in the Annual Report of the Massey University Human Ethics Committee.

The low risk notification for this project is valid for a maximum of three years.

If situations subsequently occur which cause you to reconsider your ethical analysis, please log on to <http://rims.massey.ac.nz> and register the changes in order that they be assessed as safe to proceed.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

"This project has been evaluated by peer review and judged to be low risk. Consequently it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director (Research Ethics), email humanethics@massey.ac.nz."

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish require evidence of committee approval (with an approval number), you will have to complete the application form again answering yes to the publication question to provide more information to go before one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

You are reminded that staff researchers and supervisors are fully responsible for ensuring that the information in the low risk notification has met the requirements and guidelines for submission of a low risk notification.

If you wish to print an official copy of this letter, please login to the RIMS system, and under the Reporting section, View Reports you will find a link to run the LR Report.

Yours sincerely

Dr Brian Finch
Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)