



The impact of executive function on stress, difficulties, and teaching behaviours of pre-service teachers on their first practicum placement

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ABSTRACT

This article describes the impact of executive function on pre-service teachers' experiences during their first practicum placement, with a focus on the key stressors and their perceptions of difficulties. Participants, pre-service teachers with normative executive function ($n = 28$) and elevated executive function difficulties ($n = 23$), answered weekly questions about their stressors and frequency of troubles while on their first practicum placement. Analyses of their responses suggest that pre-service teachers with elevated executive function difficulties report higher levels of stress and more frequent troubles than their peers with normative executive function skills. Implications for teacher education programs and practice are discussed.

1. Introduction

Friday, my students, after receiving a 1-hour lesson on responsibility and making choices, continued to be disruptive and disrespectful in the last class of the day. I was so frustrated that I had to stop the lesson and have them read because I physically could not form a coherent sentence ... I am in control of my emotions however it often feels like they're about to explode out of me without warning. (Sam, pre-service teacher, pseudonym)

As illustrated by Sam's description of feeling frustrated on her first practicum placement, learning to teach can feel overwhelming. From a cognitive point of view, early teaching experiences tend to be difficult, in part, because pre-service teachers have not yet developed "automaticity and routinization for repetitive operations" (Berliner, 2004, p. 13) that are characteristic of effective teachers. It will take many years of practice until those skills become routine. In the meantime, skills like monitoring student behaviour while teaching a lesson can cause cognitive overload. We have known for a long time that early teaching experiences tend to be stressful and overwhelming for new teachers, but what is less clear is whether pre-service teachers with elevated executive function (EF) difficulties, like Sam, have a more difficult time than their peers with normative EF. Some recent research (Haenjohn & Namyen, 2023) has suggested that EFs are an important consideration for understanding the paths of success for novice teachers, but the topic of EFs of novice teachers is still quite novel and deserving of attention. As a pre-service teacher with elevated EF difficulties, Sam's success in the program and during her subsequent career as a teacher, may rely on her

nascent abilities to inhibit her emotional responses, learn new skills, and shift from an unhelpful strategy. This study looks at the differential impact of EF on pre-service teachers' experiences during their first practicum placement, with a focus on the key stressors and their perceptions of difficulties.

2. Literature review

2.1. Cognitive components of teaching

Teaching is a complex task that regularly inundates the cognitive resources of teachers, especially for those early in their careers (Keese et al., 2023; Stigler & Miller, 2018). Effective teaching requires the mastery of countless subskills that are best learned in the moment. Each of the subskills implicated in teaching requires effortful and purposeful thought until it becomes automatic. Automatic responses generate "fast, effortless, nonconscious processing" (Feldon, 2007, p. 124) whereas controlled responses are slow, deliberate, and cognitively effortful. As teachers practice those subskills, they divert fewer cognitive resources from the time- and context-specific decisions that are necessary to manage classrooms. While experienced teachers may know several ways to efficiently distribute materials to students, pre-service teachers may lose the flow of the lesson, or lose attentional focus on the class, as they take a few moments to determine the best approach. Early in their training, pre-service teachers have a hard time responding, "fluently and effectively to classroom challenges" (Feldon, 2007, p. 130) because they

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have not developed the skills to focus on instructional goals and student behaviour simultaneously. The feeling of having one's cognitive resources overwhelmed can be deeply stressful and an impediment to effective teaching.

2.2. Teacher stress

Teacher stress is an important focus of study (Farley & Chamberlain, 2021; Harmsen et al., 2018) because the stress of the job, especially during the early years, is the top reason teachers cite to explain their decisions to leave the profession (Scheopner, 2010). Teacher stress is defined as teachers' experience of "unpleasant, negative emotions, such as anger, anxiety, tension, frustration, or depression, resulting from some aspect of their work" (Kyriacou, 2001, p. 28). In many cases, chronic work stress can lead to burnout; symptoms include emotional exhaustion (feeling overextended), cynicism (impersonal reactions to others), and reduced sense of accomplishment (no longer feeling competent at work) (Madigan & Kim, 2021). Teachers report that they are stressed about workload demands, inadequate resources, working with high need students, and poor administrative support (Karsenti & Collins, 2013; Kutsyuruba et al., 2022) but the most common predictors of stress are high psychological task demands (Harmsen et al., 2018) and negative pupil aspects (Rieg et al., 2007). Teacher stress can negatively affect teaching behaviour (Harmsen et al., 2018; Mahmoudi, 2016) and is more pronounced during the early years, including the first teaching opportunities provided during teacher preparation. In their efforts to retain novice teachers, school boards should increase support through co-teaching and strengthening team bonds among faculty (Amitai & Van Houtte, 2022).

2.3. Practicum placements

A ubiquitous component of teaching training programs is the opportunity to practice teaching under the direct supervision of an experienced teacher, a process known as practicum placements (Danyluk et al., 2021). Considered by pre-service teachers as the most useful component of teacher training programs, practicum placements are opportunities to connect theory to practice (Danyluk, 2013). While the structural specifics differ among teacher training programs in Canada, practicum placements tend to be embedded within two or three terms of academic courses so that students can apply course content to their teaching practice. The pre-service teachers' capacities are evaluated by the supervising teacher (known as Associate Teacher in some programs [Danyluk et al., 2021], including the program where the current study was conducted) with consultation with a representative from the university (University Consultant) who observes the student teaching on several occasions. During the early days of the placement, pre-service teachers acclimate to the classroom by observing procedures and participating in light duties; responsibilities for lesson planning and teaching increase over the period. In the program where the current study was conducted, pre-service teachers were responsible for teaching one third of the day by the end of the practicum; pre-service teachers spend the rest of the day supporting the Teacher Associate (e.g., answering student questions, working in small groups) and planning new lessons and activities.

2.4. Stress during practicum placements

Practicum placements play an important role within teacher training programs because decades of research on the topic of teacher preparation have shown that knowledge and application of teaching practices is primarily acquired through personal experience (Hanly & Heinz, 2022). Novice teachers learn about teaching in their academic terms, then use their practicum placements as opportunities to connect academic content with practical applications. Those placements tend to be enormously stressful because pre-service teachers need to adjust to the

expectations of the job with minimal experience. Navigating the reality of the classroom can cause *praxischock* (Veenman, 1984; Whalen et al., 2019), a protracted reality shock whereby early career teachers need to reconcile the rosy ideals espoused in teacher training programs with the "harsh and rude reality of everyday classroom life" (Veenman, 1984, p. 143). That is not an easy process for many pre-service teachers. In fact, the phrase "trial by fire" is how seven out of ten teachers described their early teaching experiences (Kutsyuruba et al. 2020). Pre-service teachers report feeling stressed during practicum placements because of their lack of experience, unclear sense of status, conflict between advice and expectations, and lack of strategies for emergency situations (Rieg et al., 2007), but the main stressors were the relationships with supervisors and mentors (Danyluk et al., 2021; Mahmoudi, 2016) and managing student behaviour (Rieg et al., 2007). Additional stressors may be related to the developmental time of pre-service teachers' lives. Many pre-service teachers come to education programs at a time in their lives when they are, for the first time, away from home and the networks of support that sustained them through adolescence. For these reasons and more, it can be a highly stressful experience when pre-service teachers walk into the classroom for the first time. Finding success in the practicum placement, a context characterized by complexity and novelty, will require effective cognitive and emotional control.

2.5. Automaticity and executive function

From a cognitive perspective, we spend most of our time on "automatic pilot" (Diamond, 2013, p. 136). We develop systems of automatized responses and cognitive short-cuts, known as heuristics or schemas (e.g., Baddeley & Hitch, 1994), to simplify our responses in contexts cluttered with complexity and detail. Tuned for efficiency, our systems of automatized responses get us through our day, especially when the routine of the day is familiar to us. However, automaticity can be a "double-edged sword" (Feldon, 2007, p. 123) because, while automatized behaviours make our decisions more efficient, we are also prone to errors. Interrupting automatized behaviours to make a purposeful decision can be difficult. Effective teaching requires both automatized behaviours as well as top-down self-management skills because teachers need a "large repertoire of activities they perform fluently" (Leinhardt & Greeno, 1986, p. 76) as well as the ability to interrupt those actions to make purposeful decisions. The framework of EF includes three primary categories: (a) inhibition, (b) working memory (updating), and (c) cognitive flexibility (also called shift) (Diamond, 2013; Friedman-Krauss et al., 2014; Roebers & Feurer, 2016).

Inhibition, the process of interrupting our automatized behaviours, is not easy. During those times, we may need to control our attention, behaviour, thoughts, and emotions to "override a strong internal predisposition or external lure" (Diamond, 2013, p. 137). Unless we make change, we tend to cling to our habits and remain under the control of environmental stimuli. Inhibition is also important for problem solving because learning to delay responses can improve performance (Simpson et al., 2012). Managing one's own emotions during stressful times is an example of how inhibition is implicated in early teaching experiences.

Working memory is our "mental workspace" (Diamond, 2013, p. 144); it has a robust capacity but comes with strict limitations and a penchant for being overwhelmed. Working memory is essential for making sense of the world because it refers to the capacity to hold and work with information that is out of perceptual range (e.g., remembering door code, solving mental math problems). Teachers use their working memory regularly in the hustle of the classroom, but as skills become routinized working memory is required less often. Managing a busy classroom can be very taxing for teachers but, over time, even teachers with poor working memory will find teaching easier.

Cognitive flexibility is important for teachers. Persevering at a task despite its difficulty is an important skill for teachers, but it is also important to be able to revise actions and plans in response to dynamic circumstances. The skills involved in knowing when and how to switch

strategies is known as cognitive flexibility. Another component of cognitive flexibility is the ability to change perspectives spatially (imagining what students can see from the back of the classroom) or interpersonally (anticipating how a colleague might feel about a decision you made). Changing approaches is a crucial skill for teachers in their efforts to support at-risk learners or when a teaching strategy is not effective.

2.6. Teacher stress and EF

The relationship between EF and stress appears to be bi-directional (Corcoran & O'Flaherty, 2017; Diamond, 2013; Shields et al., 2016). Elevated EF difficulties can cause situations that are stressful, and feelings of stress adversely affect EF. Diamond (2013) referred to EF as the canary in the coal mine because they are the “first to suffer, and suffer disproportionately, if something is not right in your life” (p. 153). A meta-analysis of the literature on stress and executive functions (Shields et al., 2016) found that stress adversely affects working memory and cognitive flexibility but has a nuanced effect on inhibition. People tend to deal with stressors by focusing closely on the stressors; this process means they allocate executive control resources to the stressor situation (inhibiting other distractors, including working memory and cognitive flexibility). We may not know all the interactions between stress and executive function (Diamond, 2013), but what is well understood is that people tend to perform poorly on skills that require EF when they are stressed, sad, lonely, sleep deprived, or not physically fit. Conversely, people perform better on EF tasks when they are energized by their passionate interests, feel like they are part of a supportive community, and are healthy and strong (Diamond, 2013).

EF skills are primarily useful when we are learning new things and are less necessary for well-practiced tasks. The hard work of learning to teach comes with investing the cognitive resources necessary to make the many novel activities (e.g., classroom management, organizing resources) less cognitively taxing. The research on the EF skills of teachers shows that EF impact teaching practice (Corcoran & O'Flaherty, 2017). For example, teachers that perform well on cognitive flexibility tasks (Trail Making Test) reported feeling more in control of their classroom and being less irritated by student behavior (Friedman-Krauss et al., 2014). Hiver and colleagues (2021) noted that effective metacognition was predictive of effective teaching practices and that, when it comes to dealing with unpredictable classrooms, “mindful teaching is the antidote to technical routines and procedural compliance” (p. 500).

In summary, understanding the EF capacity of pre-service teachers is important because teaching is stressful, especially for early career teachers that have not yet developed sets of “well-rehearsed practices and schemas” (Hiver et al., 2021, p. 502) that tend to come with experience. Early career and pre-service teachers must attend to novel demands with effortful thought and careful decision-making (Kyriacou & Kunc, 2007). That cognitive demand is draining and stressful and may lead to less effective teaching practices and teacher attrition.

2.7. Purpose

This study explored the relationships among EF capacity, reported stressors, and experiences of pre-service teachers during practicum placements at a teacher training program at a mid-sized university in western Canada. Prior to beginning their practicum placement, they completed a measure of executive function. On each of the five Fridays of their practicum placements, we invited them to respond to a series of Likert-style questions (e.g., “During the last week, how often did you have trouble doing more than one thing at a time?”). We also asked them to describe their experiences with an open-ended question (e.g., “Without using names, describe the most stressful thing that happened this week. How did you respond?”). At the end of the practicum, participants completed a survey that asked them to rate their level of stress. This study sought to address the following questions:

To what extent are EF scores associated with levels of reported stress and troubles during practicum?

What stressors do pre-service teachers identify during practicum placements?

To what extent do practicum experiences differ between those with normative EF and those with elevated EF difficulties?

3. Method

3.1. Participants

The participants for the current study ($n = 51$) were pre-service teachers at a Bachelor of Education degree program during their first practicum placements, representing two cohorts from subsequent years (see Table 1). During the first year of data collection, 34 pre-service teachers participated in the study and 17 pre-service teachers participated in the second year of data collection; both cohorts participated during their first full academic term of the program, which included their first practicum placement. The two cohorts of pre-service teachers participated during two different years; their data were combined and analysed together. Participants were asked to specify their gender by checking either “Male” or “Female” as they completed the executive function measure. Most of the participants reported female ($n = 38$); 12 reported male, and one reported “non-binary.” Most participants identified as “white” ($n = 44$); five of those participants identified a second descriptor (white and indigenous, $n = 2$; white and Asian, $n = 2$; white and Paraguayan, $n = 1$). The remaining participants identified as Egyptian or north African ($n = 2$), Albanian ($n = 1$), and Asian ($n = 4$). The average age of participants was 23.25. Most of the participants were 30 and younger ($n = 50$), one was aged 31–40, and one participant was aged 41–50. Questions related to previous experience in teaching roles, or in non-teaching roles related to supporting children (camp counsellor, coach), were not included in the demographic questions.

3.2. Measures

3.2.1. Executive function

Executive function (EF) was measured using the Behaviour Rating Inventory of Executive Function – Adult Version (BRIEF-A; Roth et al., 2005), which is a 75-item self-report measure of behavioral problems associated with EFs. The measure includes 6–10 items for each of its nine scales, such as *I have a short attention span* (working memory), *I have trouble sitting still* (inhibit), and *After having a problem, I don't get over it easily* (cognitive flexibility). For each item, participants designated how often the described behaviour was a problem over the last month by circling N (never a problem), S (sometimes a problem), or O (often a problem). Higher raw scores represent greater impairment in EF than lower raw scores; raw scores were used to calculate *T*-score age-specific, comparison tables, according to the manual. The BRIEF-A was standardized with adults from a wide range of educational, ethnic, and geographic characteristics; it is considered valid and reliable and has been used as a measure of pre-service teachers' executive function (e.g., Corcoran & O'Flaherty, 2017). Validation of the BRIEF-A was performed by measuring internal consistency of reliability using Cronbach's alpha

Table 1
Age and gender of sample.

		Cohort 1 (1st year)	Cohort 2 (2nd year)	Combined
Age	21–30	33 (64.71 %)	16 (31.37 %)	49 (96.08 %)
	31–40	1 (1.96 %)	-	1 (1.96 %)
	41–50	-	1 (1.96 %)	1 (1.96 %)
Gender	Female	26 (50.98 %)	12 (23.53 %)	38 (74.51 %)
	Male	7 (13.72 %)	5 (9.80 %)	12 (23.53 %)
	Non-binary	1 (1.96 %)	-	1 (1.96 %)

Percentages refer to the full sample (Cohort 1, Cohort 2 combined).

method ($\alpha=0.96$). The Cronbach's alpha coefficients for each of the nine domains of EF were within the normal range: inhibit (0.76), shift (0.69), emotional control (0.89), self-monitor (0.79), initiate (0.78), working memory (0.84), plan/organize (0.89), task monitor (0.79), and organization of materials (0.91). These coefficients are similar to what has been reported elsewhere (e.g., Haenjohn & Namyen, 2023). Participants were organized into categories of normative EF or elevated EF difficulties based on the threshold of one standard deviation above the mean (T -score of 60), which is standardized at a T -score of 50. While some researchers have used 1.5 standard deviations from the mean as a threshold for executive function deficits (e.g., Biederman et al., 2004) the threshold for elevated EF difficulties in the current study was one standard deviation (i.e., T -score of <60 and ≥ 60) because T -scores of 60 and above are considered elevated (Roth et al., 2005). Additionally, differences in reported stress were significant at this threshold; also, the threshold allowed for similar-sized groupings.

3.2.2. Teacher stress

Stress during the practicum placement was measured using a 16-item inventory of stress called the Teacher Stress Inventory (Fimian, 1988) after the practicum experience. Participants reported the intensity of their stress on a Likert-type five-point scale from 1 (not stressful) to 5 (highly stressful) related to three types of stress: work-related stress (e.g., *I have too much work to do*; $\alpha=0.63$), professional investment stress (e.g., *I lack control over classroom decisions/matters*; $\alpha=0.62$), and discipline and motivation stress (e.g., *I feel frustrated having to monitor pupil behaviour*; $\alpha=0.82$). The Cronbach's alpha coefficient for the full scale was within the normal range ($\alpha=0.83$). Scores from the full scale are reported and used in the analyses.

3.2.3. Weekly stressors

In addition to the BRIEF-A and the Teacher Stress Inventory, the participants were asked every week to answer researcher-developed open-ended questions: "Without using names, describe the most stressful thing that happened this week. How did you respond?" According to Veenman (1984), researchers should find ways to distinguish between "complaining about" and "true experience" (Veenman, 1984, p. 166), such as asking contemporaneous questions in the flow of the day. By asking them to describe the most stressful thing each week, without identifying the people involved, we sought to understand the factors that most adversely affected them without having them complain unnecessarily about specific colleagues or students. The participants answered by typing their responses in text form.

3.2.4. Weekly troubles

Using a series of researcher-created questions that were developed for this purpose, we asked them to rate how frequently they had trouble with tasks related to EF (cognitive flexibility, emotional regulation, organization of materials) at the end of each week using a three-point scale. For each of the following three questions, the respondents chose one of the following options: 1=never (I had no trouble at all), 2=sometimes (I had trouble with that from time to time), 3=often (I regularly had trouble).

1. During the last week, how often did you have trouble doing more than one thing at a time? (Example: managing classroom noise while teaching the lesson, remembering to keep reflection notes during the busy day, dealing with students individually while keeping an eye on the class)
2. During the last week, how often did you react more emotionally than you would expect? (Example: feeling stressed about uncooperative students, feeling emotional about feedback from Teacher Associate, you felt like you had to mask your frustration)
3. During the last week, how often did you have difficulty related to your organization skills? (Example: cannot find important resources

when you need them, workspace is a mess, not enough planning for your lessons)

3.2.5. Open-ended questions

The pre-service teachers were also asked open-ended questions on a survey after the practicum. Reported in the current study were these two questions: "Without using names, can you describe what your practicum experience has been like for you so far?" and "What is one thing that you would like to improve for your next practicum placement?" The answers from these questions were used to address the third research question: "To what extent do practicum experiences differ between those with normative EF and those with elevated EF difficulties?"

3.3. Procedure

In the teacher training program where the study was conducted, the first term was structured so that it included eight weeks of in-class instruction, followed by five weeks of practicum placement. During the period of in-class instruction, and prior to being recruited for the current study, pre-service teachers completed a measure of their own executive function (BRIEF-A) as a component of their regular course load, using paper forms that were completed by hand in class. As part of their courses, pre-service teachers were provided with feedback in the form of one area of strength and one area of weakness from their instructors, as well as some suggestions for their practice. The purpose of offering feedback on their executive function results was to provide practical opportunities to learn about executive function, their own capacities as educators, and assist them in developing their practice. For example, pre-service teachers with elevated EF difficulties related to organizational skills are presented with organizational strategies and encouraged to use those strategies to mitigate their elevated difficulties.

Participants were recruited for the study during the in-class portion of the term, through a two-step process. The first step was to seek pre-service teachers' permission to allow the research team to review the BRIEF-A results that were collected previously as part of their coursework. To protect the voluntariness of their participation, participants were recruited for the study by research assistants, who visited the university seminar classes, not their instructors. An email was sent to the pre-service teachers to follow up from the in-class visit. The recruitment script presented by the research assistants, and in the email, explained that the first step was allowing the research team to review their results for the purposes of recruiting them for the study. Those who were interested in allowing the research team to review their results provided written permission by email. The second step of recruitment was to invite those participants that allowed their results to be reviewed to participate in the study. Only the pre-service teachers that allowed their results to be viewed by the research team were invited to join the study.

Besides the results of their BRIEF-A, which were included with permission from the participants, the first data collection for the study happened during the five-week practicum placement. Participants were emailed at the end of each week of the practicum placements and were prompted to respond to questions about their recent week through an online survey tool, Qualtrics. The questions were designed to be completed in a short amount of time and included an open-ended question related to stressors ("What was the most stressful thing that happened to you this week? What did you do?") and Likert-style questions about any difficulties they faced (e.g., "During the last week, how often did you have trouble doing more than one thing at a time?").

After the end of the practicum, the participants completed a survey that included standardized measures (e.g., Teacher Stress Inventory), open-ended questions about their placement, and demographic information. This process was approved by the university ethics review committee (ID: Pro00122157).

3.4. Analysis

Results from the BRIEF-A were scored according to the instructions in the manual for calculating *T*-scores (Roth et al., 2005), which includes completing the scoring summary table and calculating index raw scores. The raw scores were converted to *T*-scores using the normative conversion tables. Additional scoring mechanisms were completed but not reported here, including confidence intervals, negativity scales, infrequency scales, and inconsistency scales. The *T*-score results ranged from 41 to 86 and, taken together, the sample's mean Global Executive Control *T*-score results was 58.38. The mean Global Executive Control score of those with normative EF was 50.96; the mean score of those with elevated EF difficulties was 67.74. Of the 51 participants, 23 had elevated EF difficulties (≥ 60 *T*-score). Eleven of the 23 participants in the elevated EF difficulties group had scores between 60 and 64, a score considered "mildly elevated" (Gioia et al., 2015, p. 33). Twelve of the 23 participants in the elevated EF difficulties group had *T*-scores of 1.5 standard deviations above the mean (*T*-score of 65 or higher), a score that is considered "abnormally elevated" (Roth et al., 2005, p. 13).

The independent-samples *t*-tests were calculated using Social Package for Social Sciences (Version 29). Independent-samples *t*-tests were used to test the null hypothesis that there were no statistically significant differences in the means of reported stress and weekly troubles between pre-service teachers with normative EF and pre-service teachers with elevated EF difficulties.

Data analyses of the open-ended questions (e.g., Stressful Things questions) were conducted by two research assistants as well as the lead researchers. For each stage of the analysis, at least two coders independently coded responses in terms of the nature of each stressor. Codes for stressors included: participant felt the stress was caused by (a) student behaviour, (b) school-related factors out of their control, (c) feeling ill-prepared for the work, (d) personal factors out of their control, and (e) the decisions and behaviour of their co-professionals. Interrater reliability of the independent codes was calculated as a simple percentage (85 % agreement) and agreement reached 100 % through collaboration. See Table 2 for examples of stressors and how they were coded.

4. Findings

Since this study was designed to explore the relationship between EF capacity, reported stress, and experiences of pre-service teachers during practicum placements, the results are organized around three objectives:

Table 2
Examples of coding for stressful things question.

Response to the question "Without using names, describe the most stressful thing that happened this week. How did you respond?"	Coding
My lesson was completely boring and I needed to change my lesson so that they'd be more engaged with the material. How do I do that? Agh! But I managed to improvise and accept a student's suggestion of gamifying the activity instead. (4 N)	feeling ill-prepared for the work
Getting the feedback. I thought I did a lot better than what my Teacher Associate thought. I kept calm throughout my debrief with her as I just told myself that it's my first couple lessons and I'm not meant to be perfect right off the bat. (1E)	decisions and behaviour of their co-professionals
Have multiple kids start crying in phys-Ed class. I responded by having the kids take deep breaths and sitting out for a second. I also offered them to get a drink. I managed to not react emotionally and have them choices to make them feel better. (27 N)	student behaviour

NOTE: Quotes are identified by participant number and either N (normative EF) or E (elevated EF difficulties).

(a) determine the extent to which EF scores are associated with reported levels of stress and troubles during practicum, (b) describe the stressors pre-service teachers identified during practicum placements, and (c) determine the extent to which practicum experiences differ between pre-service teachers with normative EF and those with elevated EF difficulties. Other than Sam, who was identified by pseudonym, quotes from the pre-service teachers are attributed to their participant number and EF score category, either N (normative EF difficulties) or E (elevated EF difficulties).

4.1. Stress and troubles predicted by EF capacity

A series of independent-samples *t*-tests were performed to compare the level of stress and frequency of troubles reported by pre-service teachers with normative EF and pre-service teachers with elevated EF difficulties. Pre-service teachers with elevated EF difficulties were more likely to report high levels of stress during their practicum ($M = 2.54$, $SD = 0.58$) than those with normative EF ($M = 2.12$, $SD = 0.48$), $t(49) = 2.78$, $p = .008$, as measured by the Teacher Stress Inventory. Pre-service teachers with elevated EF difficulties were also significantly more likely to report troubles with all three categories of situations (managing more than one thing at a time, reacting more emotionally than expected, difficulty with organization) than pre-service teachers with normative EF (see Table 3).

4.2. Stressors identified by pre-service teachers

Asked during each of the five weeks of their practicum placements to identify the "most stressful thing" that happened to them that week and how they responded, pre-service teachers provided brief answers (255 responses, of about 83 words on average) that described their primary stressors and their responses to those situations. These contemporaneous accounts of their stressors described situations related to the following categories of difficulties: student behaviour (e.g., off-task behaviour, $n = 93$), school-related factors out of their control (e.g., unexpected assembly, $n = 58$), feeling ill-prepared for the work (e.g., inadequate lesson plans, $n = 57$), personal factors out of their control (e.g., illness; $n = 23$), and the decisions and behaviour of their co-professionals (e.g., cooperating with other teachers, $n = 24$). As seen in Fig. 1, situations related to *student behaviour* were most identified type of stressor; those stressors represent at least a third of all stressors, throughout the five weeks. Stressors related to *feeling ill-prepared for the work* were identified about a third of the time for the first three weeks but were less frequent in week four and week five. Stressors related to *personal factors out of their control* were generally quite rare ($<10\%$), other than in week 4 when they were more frequent. Stressors related to *school-related factors out of their control* increased in the last two weeks of the practicum placement.

4.2.1. Student Behavior

The most frequently cited stressor identified by the pre-service

Table 3
Differences of troubles reported by pre-service teachers.

	Normative EF ($n = 28$)		Elevated EF difficulties ($n = 23$)		Difference <i>p</i> -value	Effect size Cohen's <i>d</i>
	Mean	SD	Mean	SD		
Trouble managing more than one thing	1.83	.32	2.18	.37	$<0.001^{**}$	.34
React more emotionally than expected	1.55	.38	1.89	.43	.004**	.40
Difficulty with organization	1.30	.29	1.82	.41	$<0.001^{**}$	.35

**statistically significant.

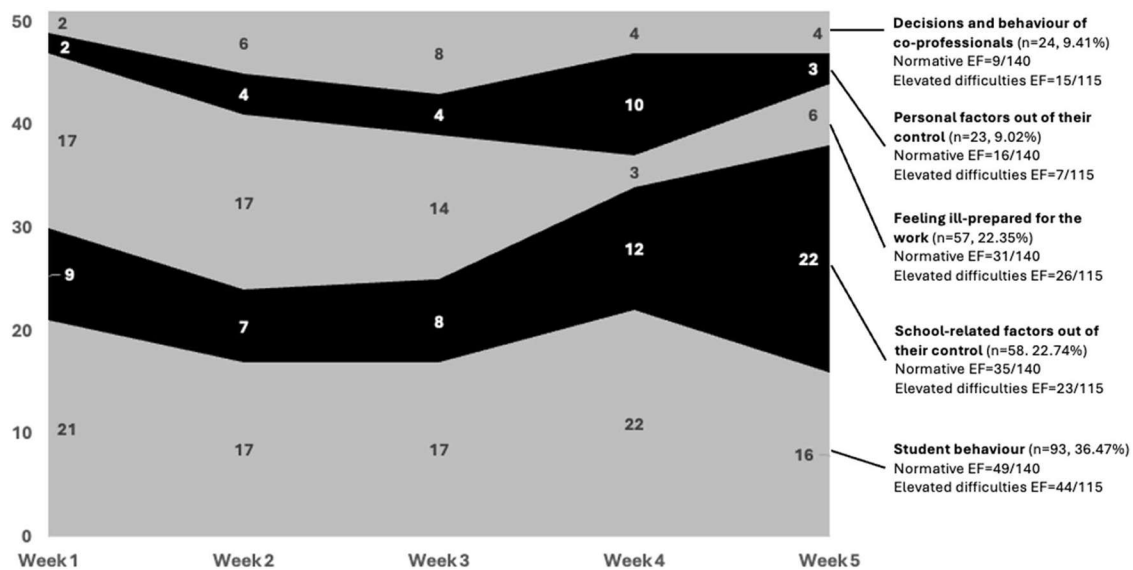


Fig. 1. Trends of stressors during the five-week practicum placement.

teachers was responding to decisions and behaviour of students ($n = 93$). Managing disruptive noise ($n = 30$; “My class has a lot of students who need to move and fidget all of the time” 11 N) was the most common type of student behaviour that caused stress, followed by students that refused to work ($n = 15$; “Students hated the game so much that a few sat on the side and refused to participate” 8E) and students that became aggressive towards other students ($n = 12$; “The student is very impulsive and if you turn your attention away for a moment the student will hit or insult another student” 22E). Other types of student concerns included dangerous behaviour (e.g., throwing items in class) ($n = 7$), students bickering among themselves ($n = 7$), and academic disengagement ($n = 7$). Violence directed at the teacher or another adult in the room was extremely rare ($n = 2$). Pre-service teachers also reported feeling stressed while supporting students with learning difficulties ($n = 5$) and students that injured themselves while at school ($n = 8$). There were no major differences between pre-service teachers with elevated EF and normative EF in terms of how frequently they identified stressors related to student decisions and behaviour.

Most of the time, pre-service teachers reported that their response to the student behaviour was to talk to individual students or small groups of students that were involved in the moment ($n = 46$; “I responded by having a chat with the student but he melts down when things don’t go his way so I let him self-regulate and brought it up when he felt a bit better and was able to listen” 34E) or talk to the entire class about the behaviour ($n = 23$; “I kept giving them reminders about the noise level and it worked for a bit but then they got so immersed in what they were doing that I think they forgot a little about our rules” 51E). Other approaches included using proximity (supervision from a short distance) ($n = 3$) or ignoring the behaviour ($n = 4$). For some pre-service teachers, their response was to wait until the situation was calm and then discuss the situation with the student ($n = 2$), get advice from the Teacher Associate ($n = 7$), or reflect on next steps alone ($n = 3$). For five of the stressors, the teacher response was not described.

An analysis of the reported responses to student behaviour demonstrated a difference in how those with normative EF and those with elevated EF difficulties responded to student behaviour concerns, either by speaking to the entire class or by speaking to an individual or small groups of students. When dealing with student misbehaviour, pre-service teachers with normative EF were more likely to respond to students individually or in small groups (57.14 %, 28/49) than responding by speaking to the entire class (14.28 %, 7/49). Pre-service teachers with elevated EF difficulties tended to respond to student behaviour concerns

by addressing the entire class (36.36 %, 16/44) nearly as often as they responded to individuals or small groups of students (40 %, 18/44). Interpreting these differences should be done carefully because these findings are based on frequency comparisons and not statistical evidence.

4.2.2. School-Related factors out of their control

As pre-service teachers learned quickly during their first practicum, they must be flexible when it comes to stressors related to school factors beyond their individual control ($n = 58$). Examples of *school-related factors out of their control* include absent Associate Teacher, school-wide events, and scheduling complications caused by holiday-related events. The stressors in this category fell into four types: (a) unanticipated responsibilities, (b) unexpected events, (c) program pressures, and (d) school policies.

4.2.2.1. Unanticipated responsibilities. Pre-service teachers found it stressful to be assigned with unanticipated responsibilities ($n = 27$) during their practicum placement. When Associate Teachers were called away from the classroom for a short-term need, pre-service teachers were sometimes asked to take over the class (“I had to take over gym class suddenly since another adult ended up having to talk to my teacher,” 4 N). Pre-service teachers also reported feeling stressed when their Teacher Associate was away from the school for a day or more: “It’s stressful when you don’t know if your Teacher Associate is going to be in... It’s also stressful when a [substitute] comes in and they weren’t prepared for a student teacher” (36 N). When qualified substitutes were not available to replace absent teachers, pre-service teachers were sometimes asked to add students to their class (“Teachers were very sick and there were no subs or educational assistants to cover. My class took in a grade 4/5 classroom on Thursday to help the school,” 23E) or teach the class on their own (“This week my Teacher Associate was sick and couldn’t come into school, there was no sub to come in that day...I was thrown headfirst into teaching a lot in one day without a lot of notice,” 46 N).

4.2.2.2. Unexpected events. Despite their best planning, pre-service teachers reported that unexpected events interfered with their teaching work ($n = 14$). As described by a pre-service teacher, the day can become “chaotic” when unexpected events complicate the day: “We had a surprise fire alarm, two kids from my class were sent to the office, and another kid was found with a vape pen” (10 N). Other examples of

unexpected events include student injuries (“Someone got a nose bleed and we were in the art room and I couldn’t leave the kids unattended,” 27 N), difficulty with technology (“The quiz didn’t open because...it couldn’t be ‘shared outside my organization,’” 50 N), and student absences (“Many of them had been gone for over a week so they were out of practice with the routines and classroom management became more difficult,” 37 N).

4.2.2.3. Pressures of program. A small percentage of stressors related to responsibilities associated with their participation in their teacher training program ($n = 11$). Most of the stressors related to pressures of observations, especially when the observation was complicated for some reason, such as being observed while teaching a new class (“Having my University Consultant watch me when I was teaching to my Teacher Associate’s partner class who is a lot more out of control,” 25 N) or being observed by a new person (“Another teacher that was not my Teacher Associate would come and observe in the place of my Teacher Associate,” 42E).

4.2.2.4. School policies. While pre-service teachers concentrated on understanding the procedures and calendar of their classrooms, they may be surprised by school-wide policies that were not fully explained to the pre-service teacher or school-wide events that seem to pop up in the middle of the day ($n = 6$). Examples of school policies that were identified as stressors include school-wide events that came as a surprise (“Due to an event that happened in the day [my lesson] got cut in half so it was really stressful trying to adapt my lesson and cut out half of the activities,” 31 N), school policies about outdoor recess (“The school has a risky play philosophy, but I found it very hard not to step in when I could see kids doing things that could put them at risk for hurting themselves,” 10 N), and keeping students in for recess on a cold day (“It’s been cold so they’ve had indoor recesses all week and I understand that is contributing to their restlessness but it’s getting very difficult to manage and keep my head screwed on straight,” 32E).

4.2.3. Feeling ill-prepared for the practicum

Considering that the practicum placement was the first time they were required to teach a portion of the day, it will not be a surprise that many of the pre-service teachers’ stressors related to feeling ill-prepared in terms of knowledge, training, or planning ($n = 57$). Those stressors related to difficulty with: (a) planning the lesson ($n = 16$), (b) presenting the lesson ($n = 26$), (c) managing the resources of the lesson ($n = 6$), and (d) adjusting to the pace of the job ($n = 9$). Pre-service Teachers identified stressors related to feelings of being ill-prepared more often during the first three weeks (week 1, $n = 17$; week 2, $n = 17$; week 3, $n = 14$) but appeared to feel less stressed about their own sense of preparation after the third week (week 4, $n = 3$; week 5, $n = 6$). There was no difference between the frequency of stressors related to feeling ill-prepared (elevated EF difficulties, 26/115, 22.61 %; normative EF, 31/140, 22.14 %).

4.2.4. Personal factors unrelated to school

A small percentage of the stressors identified by the pre-service teachers were associated with personal factors unrelated to the school ($n = 23$). For example, many pre-service teachers reported that they were stressed when they became ill or injured ($n = 13$) either because they had to miss school (“I was sick for 3 days and couldn’t come to school...I felt like I really needed to be there and I was worried how it would reflect on me for missing days,” 26 N) or go to school despite not feeling well (“I got sick 2 days before practicum was ending [and had to] just push through for the sake of the kids,” 40 N). Managing their own mental health concerns was also a stressor ($n = 6$): “This time of year I often experience a depressive episode...over the weekend I was struggling with my mental health and didn’t make it out of bed on Saturday” (13 N). Other stressors included being over-committed with part-time

jobs or other projects ($n = 4$) (“I work...so managing that and my practicum is stressful every day,” 26 N). Students with normative EF were more likely to identify personal illness or injury as a stressor during their practicum ($n = 11$) than those with elevated EF difficulties ($n = 2$).

4.2.5. Actions or decisions of another co-professional

Interactions with co-professionals (other teachers, administrative leaders, and education assistants) were stressors about 10 % of the time ($n = 24$). Receiving harsh feedback was the most common stressor in this category ($n = 15$): “I thought I did a lot better than what my Teacher Associate thought” (1E). Pre-service teachers also reported that some stressors came from feeling unsupported ($n = 5$): “My Teacher Associate gives really late responses or no responses at all for my lesson plans” (2E). It was also stressful when they felt coerced by their co-professionals ($n = 4$): “My Teacher Associate wants me to teach in the same style as her but I do not see myself using that style in my future classrooms” (50 N). Stress related to the actions or decisions of another professional peaked during Week 3, a time when the University Consultant tends to complete a second visit and when formalized feedback (mid-term formative assessment) is provided for the pre-service teachers.

4.3. Differences of practicum experiences (Normative EF and elevated EF difficulties)

Increased stress and frequency of troubles were not the only ways that the experiences of pre-service teachers with elevated EF difficulties differed from the experiences of those with normative EF. Other differences included: (a) responding to the need to improve, (b) the emotionality of their language, (c) level of positivity in final reflection, and (d) the goals identified for next term. These differences need to be interpreted carefully because they come from frequency analyses, reported as percentages, and are not the result of statistical analyses.

4.3.1. Responding to the need to improve

A common topic of the “stressful things” answers related to the stress that comes with realizing, on their own, that a lesson they taught needed improvement. Of the 255 answers to the question “What was the most stressful thing that happened this week and what did you do?”, 93 of the answers described lessons that the students admitted needed improvement (e.g., “My lesson was completely boring,” 4 N; “My lesson wasn’t going according to plan...students weren’t getting it,” 19E). Of those 93 responses, 27 of the stressor answers described situations where, despite their own belief that the lesson went well, the pre-service teachers received unexpected and negative feedback from their Teacher Associate or their University Consultant.

In their descriptions of lessons that did not go as well as they hoped, pre-service teachers tended to either attribute blame to others (“During my observed lesson, my students were the worst behaved they have ever been,” 8E) or take responsibility themselves (e.g., “I asked them to put things away but got distracted teaching and didn’t follow up as I should’ve,” 10 N). The pre-service teachers were also differentiated by how they described what they did next. Some focussed on describing their emotional experiences and managing their emotions (“Luckily my Teacher Associate saved me but I was quite embarrassed and overwhelmed as that was my first lesson. I almost cried at the end of the day!” 40E), while others focused on developing the next steps they would take to improve their teaching: “I think I responded surprisingly well (at least for me) and I took it in stride and used the feedback to pin down a couple of major goals I want to work on for myself” (12E). As shown in Table 4, Pre-service Teachers with elevated EF difficulties were more likely than those with normative EF to respond to negative, unexpected feedback by blaming others rather than taking responsibility themselves. Pre-service Teachers with elevated EF difficulties were not likely to describe a plan to improve their classroom practice.

Pre-service teachers with elevated EF difficulties tended to believe

Table 4

Response to being told that lessons need improvement.

Type of response	Normative EF (<i>n</i> = 11)	Elevated EF difficulties (<i>n</i> = 16)
Blame or complain	0 (0 %)	11 (68.75 %)
Take responsibility	5 (45.45 %)	3 (18.75 %)
Manage own emotions	2 (18.18 %)	1 (6.25 %)
Make plan to improve	4 (36.36 %)	1 (6.25 %)

that others were to blame for their negative feedback (e.g., “[The University Consultant was] asking unreasonable and unrealistic expectations from me and my lessons” 1E). Conversely, Pre-service teachers with normative EF tended to acknowledge their own role in the outcome (“I realize now that it was not the best lesson” 33 N) and set specific goals for moving forward (e.g., “I need to be better at using a ‘teacher voice’ and waiting/pausing before teaching or giving instructions” 30 N). These results should be interpreted carefully because they are based on frequency comparisons, not statistical comparisons.

4.3.2. Using emotionally charged language

All 255 answers to the Stressful Things question described situations that were stressful, however 27 of those answers used emotionally charged language that went beyond the usual verbiage. These answers included phrases such as: “It made me feel very frustrated and quite inadequate” (42 N). These answers described private efforts to deal with stress (“Once the student had gone home, I cried in the bathroom” 23E) and often sounded like desperate calls for help (e.g., “My brain felt like it was gonna explode,” 32E). These emotionally charged answers came from pre-service teachers with elevated EF difficulties (14.78 %, 17/115) twice as often as from those with normative EF (7.14 %, 10/140). These findings are based on frequency percentages and need to be interpreted carefully.

4.3.3. Positivity of final reflections

During the final survey, the pre-service teachers were asked the following open-ended question: “Without using names, can you describe what your practicum experience has been like for you so far?” Their brief responses (on average, 50 words) described their experiences during practicum in one of three ways: (a) entirely positive (e.g., “My practicum was amazing! The students were very kind and I learned a lot. Every day brought something new,” 10 N), (b) entirely negative (e.g., “They were a difficult class to start out with. I would say that my experience with my Teacher Associate was what made my practicum as bad as what it was,” 5E), and (c) mixed (e.g., “At times it was exhausting and challenging, but I am really happy with the experience,” 24E). Pre-service teachers with normative EF were more than twice as likely as those with elevated EF difficulties to describe their practicum experience as entirely positive (see Table 5).

4.3.4. Goals for next practicum

Pre-service teachers identified a variety of goals in their answers to the following open-ended question: “What is one thing that you would like to improve for your next practicum placement?” (see Table 6). Their answers described goals related to lesson implementation skills such as differentiation, time management, and assessments (*n* = 26; e.g., “I would like to be more creative with the lessons I deliver” 17 N); classroom management skills (*n* = 15; e.g., “Setting my expectations right from the start, being firm with them and having set expectations and

Table 6

Goals for next practicum.

Type of response	Normative EF (<i>n</i> = 28)	Elevated EF difficulties (<i>n</i> = 23)
Lesson implementation	19 (67.85 %)	6 (26.09 %)
Classroom management	7 (25 %)	8 (34.78 %)
Lesson planning/preparation	1 (3.57 %)	7 (30.43 %)
Self-care	1 (3.57 %)	2 (8.69 %)

consequences” 33 N); lesson planning and preparation (*n* = 8; e.g., “I want to get better at...making more in-depth lesson plans,” 12E), and, for a few of them, self-care (*n* = 3; e.g., “Not worrying about having the perfect lesson and allowing myself to get enough sleep,” 49E). Pre-service teachers with normative EF were more than twice as likely as those with elevated EF difficulties to identify goals related to lesson implementation for their next practicum placement. Conversely, pre-service teachers with elevated EF difficulties identified lesson planning and preparation skills as goals about a third of the time. These results are based on frequency comparisons so they should be interpreted carefully.

5. Discussion

The findings of the current study suggest that the practicum experiences of pre-service teachers with elevated EF difficulties are different than the experiences of their peers with normative EF in important ways. Those with elevated EF difficulties reported high levels of stress and, by their own reports, frequent troubles related to multi-tasking, emotional control, and organizational skills. Qualitative analyses of the pre-service teachers’ responses suggested that interactions with co-professionals were more frequently identified as stressors for those with elevated EF difficulties than for those with normative EF. Even their classroom practice decisions differed in important ways, such as how they responded to student behaviour. By the end, about three quarters of the pre-service teachers with elevated EF difficulties were mixed or negative about their practicum experiences, according to the qualitative analyses.

5.1. Stressors and EF

The current study focused on experiences of pre-service teachers during their first practicum experiences with direct questions about stressors. According to the pre-service teachers in the current study, their stressors were student behaviour (36.47 %), school-related factors out of their control (22.74 %), feeling ill-prepared for the work (22.35 %), personal factors out of their control (9.02 %), and the decisions and behaviour of their co-professionals (9.41 %). These results align with other research on the types of stressors during teaching. For example, a similar question was asked by Chaplain (2008): “What did you find most stressful about your placement?” In Chaplain’s study, the stressors identified related to managing pupil behaviour (about 40 %), planning and administration (about 30 %), actions of co-professionals (15 % of women, 19 % of men), and self-worth/agency (14 % of women, 8 % of men). These findings corroborate past research identifying classroom management as a primary stressor for teachers and pre-service teacher (Clarke et al., 2012; Paquette & Rieg, 2016).

What remains unclear from the current study is why those with elevated EF difficulties were more stressed and experienced more troubles. Turning to the extant literature, stress impairs cognition (Diamond, 2013) but the impact of stress on cognition is not necessarily a straight-forward phenomenon. Stress can improve some components of cognition; for example, stress can improve our memory encoding and decision-making (Shields et al., 2016). In times of stress (spotting a snake on the hiking trail ahead), cognitive resources are focused to attend to the stressor. Our hyper-focus on the stressor is possible because we focus our resources to ignore non-snake related information (inhibition), but that benefit comes as a detriment to other EF (e.g., working

Table 5

Final reflections on practicum experience.

Type of response	Normative EF (<i>n</i> = 28)	Elevated EF difficulties (<i>n</i> = 23)
Entirely positive	19 (67.86 %)	6 (26.09 %)
Mixed response	8 (28.57 %)	12 (52.17 %)
Entirely negative	1 (3.57 %)	5 (21.74 %)

memory, cognitive flexibility). For pre-service teachers, the “snake” stressor may be the potential of failing the program, teaching content inaccurately, or receiving disapproving feedback from the Teacher Associate. For those pre-service teachers with elevated EF difficulties, their cognitive resources are localized around the stressor (even if that stressor is abstract) instead of other important skills, such as imagining new approaches (working memory) or switching to an approach that better aligns with their goal (cognitive flexibility). The difficulties that students faced on their practicum may have happened, in part, because their working memory and cognitive flexibility were impeded by the stressor.

5.2. Feedback

The frequency comparison analysis of the pre-service teachers’ responses to the Stressful Things question suggests that EF control influences how people take feedback. When they described how they responded to learning that improvements were necessary, pre-service teachers with elevated EF difficulties tended to complain or blame others when explaining why they did not do as well as they hoped. Without a statistical analysis, it is not clear whether those differences are statistically significant. However, these findings align with decades of research on the mechanisms and impact of attributions on goal-directed behaviour (Hunt et al., 2013; Weiner, 1985). Hunt and colleagues (2013) found that attribution decisions have considerable influence on goal-directed performance. According to Weiner (1985), we make sense of the events in our lives through a process of outcome evaluations he described as the “constant pursuit of ‘why?’” (p. 548). After an outcome, we determine the extent of our role in the outcome by considering three dimensions: locus of causality (whether cause is internal or external), stability (permanence of the outcome), and controllability (self-control over the outcome). In the example of receiving negative feedback for a lesson that went poorly, the pre-service teacher’s decisions about next steps are predicted by whether they believe the fault is primarily their own or someone else’s (locus of causality), how changeable that outcome will be in the future (stability), and how likely personal efforts might improve the outcome in the future (controllability). Responding to negative feedback is an example of “learning through cognitive conflict” (Brod et al., 2020), a process that is particularly difficult for people with elevated EF difficulties. Consolidating the unpleasant surprise (the lesson needs improvement) with previous beliefs (lesson was adequate) requires an ability to inhibit the initial belief (inhibition), change strategies (shift), and potentially manage one’s own emotions (emotional control).

5.3. Goals

When asked to identify goals for their next practicum placements, pre-service teachers with elevated EF difficulties tended to identify lesson planning and preparation as a concern for them, a view that was presumably informed by direct feedback, their experiences teaching, and their own sense of efficacy. Lesson planning is a pervasive challenge in pre-service programs (Derri et al., 2014; Enama, 2021; König et al., 2020). Learning to develop effective lesson plans requires considerable resources, opportunities to practice, and direct feedback from a more knowledgeable other (Derri et al., 2014; Enama, 2021). Effective lesson plans are developed in consideration of a wide variety of factors, such as content knowledge, lesson goals, student characteristics, sequencing and timing, and assessment (Enama, 2021). Developing lesson plans with all these considerations is extremely difficult for pre-service teachers (Enama, 2021), who lack the context-specific information that is necessary to anticipate how the lesson will unfold. For example, novice teachers may focus on details related to the content of the lesson and it is not until much later that novice teachers understand the role of lesson plans to describe and respond to student learning needs (König et al., 2020). As noted previously, without statistical comparisons, these

findings need to be interpreted carefully.

5.4. Classroom management

In the current study, pre-service teachers with normative EF were more likely than those with elevated EF difficulties to speak privately to the individuals demonstrating the behaviour instead of addressing the whole class. This finding comes from an analysis of the frequency of participants’ responses and not a statistical comparison, so this finding needs to be interpreted carefully. However, the association between high impact pedagogical approaches and capacity for EF has been documented in the literature. Barraza and Rodriguez (2023) found that expert teachers (teachers with experience, pedagogical skills, and disciplinary knowledge above what is expected for good teaching practice) performed better than control group (professional, non-teachers) on EF tasks. Identifying the specific individuals that cause the problematic behaviour can be very difficult for someone whose working memory is overtaxed. In their expert-novice comparison study, Berliner and colleagues (1988) reported that many of the novice teachers did not notice the off-task behaviours: “Few of the [novice teachers] seemed to know how to deal with these issues, and therefore, became blind to them” (p. 88). The framework of EF might provide an alternative explanation: blindness to behaviours came because their working memory was over-taxed. When working memory is at capacity, other stimuli is ignored. Whatever the core deficit, what remains clear is that pre-service teachers with elevated EF difficulties struggle to respond to student behaviour in the moment. This explanation of teacher “blindness” is informed by the existing literature but will remain conjecture until the hypothesis is tested specifically.

5.5. Implications for teacher education programs

Teacher education programs can help pre-service teachers learn strategies for easing the impact of difficult situations during their practicum placements. Despite their high rates of reported stress, many of the participants with elevated EF difficulties described strategies they used during their placements during times of stress and difficulty to mitigate the worst effects of their difficulties. The pre-service teachers in the current study reported that they used metacognitive strategies to identify their areas of weakness (“I am currently trying to strategize and figure out how to remember the little things”). Communication with their mentors (Associate Teacher, other professionals in building) was also cited as a useful strategy.

Pre-service teachers can be taught to understand their own EF capacities. As was done at the university in the current study, pre-service teachers need to know about their own levels of EF so they can anticipate difficulties and thereby improve their practice. For example, pre-service teachers that demonstrate deficits with working memory can use supports to externalize information (e.g., calendars, timetables, to do lists; Barkley, 2011; Paquette & Rieg, 2016). Increased understanding of executive function and its role in early teaching experiences may help to reduce the *praxisshock* that is common during practicum placements. Indeed, externalized supports would be helpful for novice teachers with normative EF as well. While teachers with elevated EF difficulties would certainly benefit from being directly taught learning processes that provide a framework for initiating and engaging in projects (e.g., goal setting, planning, monitoring progress, reflection), those with normative EF would also benefit from those lessons. Pre-service teachers who struggle with inhibition, irrespective of their EF profiles, can be directly taught delay and calming techniques that they could implement prior to responding in emotionally charged situations (Barkley, 2011). Likewise, those challenged by deficits in cognitive flexibility can receive direct instruction on how to understand the perspectives of others, the role of contexts in shaping actions and perceptions, and to think divergently about possible outcomes related to their own actions and the actions of others.

6. Limitations and concluding statements

A limitation of the current study was its participant recruitment. Participants were recruited from one university, an approach used by other researchers (e.g., Geng et al., 2015), but the narrow sample may reduce the generalizability of these findings. Generalizing the findings of the current study to other contexts needs to be done carefully, with consideration of the programmatic features of the program as well as the characteristics of the pre-service teachers themselves. For example, the association between elevated EF difficulties and reported stress may not be as prevalent in programs that utilize robust support programs during practicum placements. Also, executive function skills tend to mature throughout adulthood, so these findings may not apply as directly to teacher programs with higher rates of mature students. Another limitation of the sample is the grade level of the practicum placements. Other studies compared stress of pre-service teachers across three levels of student age (early childhood, primary, secondary; Geng et al., 2015), but this study focused on primary education because primary placements are typical for the first practicum experiences at the teaching training program where the study was completed. Another limitation of the current study was the data collection. Instead of pairing interviews with in-person observations (as has been done by others, such as Burn et al., 2003), we decided to ask a small number of brief questions each week to reduce the extent to which the participants' stress levels were inadvertently increased by the data collection methods. Finally, our decision to measure EF using the BRIEF-A instead of a set of behavioural measures (Stroop test, Trail Making test, Wisconsin Card Sorting Task) may be seen as a limitation. Again, we decided to use the BRIEF-A because we considered its quick completion time and simply worded questions to be useful in avoiding adding unnecessary strain on the participants. Future research should focus on developing interventions at the "point of performance" (Barkley, 2011, p. 46), a concept which will require careful thought to be meaningfully applied to practicum placements where the academic work of the campus has reduced influence. Another area for research should be the development of longitudinal studies that track EF and success of pre-service teachers over the span of the program years as well as during the first years of their careers. While the current study suggests that elevated EF difficulties adversely affect early teaching efforts, what needs to be better understood is the factors that mitigate those deficits.

Despite these limitations, the current study suggests that differences in EF may have an impact on the level of stress and troubles experiences during practicum placements and, as such, the experiences at practicum of those with elevated EF difficulties were different than those of their peers with normative EF skills. With placements characterized by high levels of stress, frequent troubles, and poor management strategies, many of the pre-service teachers with elevated EF difficulties struggled through their first practicum placement. Teacher training programs and teacher-mentor programs should be built on an understanding that when pre-service teachers feel overwhelmed during their early years, their teaching practice might suffer and they may be at risk of leaving the profession early (Amitai & Van Houtte, 2022; Hanly & Heinz, 2022; Madigan & Kim, 2021). From a cognitive perspective, teaching is a complex set of skills that will take years to develop competence. In the meantime, teacher training programs should understand the differential impact of EF on teaching practice and provide deliberate supports for everyone, especially those with elevated EF difficulties.

CRedit authorship contribution statement

Jeffrey William Harris MacCormack: Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Charlotte Ann Brenner:** Writing – original draft, Project administration, Formal analysis, Data curation.

Declaration of competing interest

We have nothing to declare.

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