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Understanding Teacher Perspectives on Executive Functions in Mathematics

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Executive Summary

"Executive function skills obviously go a long way in helping them to [learn]. When we have metacognition, thinking about what they are thinking, the steps.....this is not just important, it is mandatory [and] vital for success." -Teacher focus group participant

Prior research documents the role of Executive Function (EF) skills, specifically working memory, cognitive flexibility, inhibitory control, planning, and metacognition, for supporting mathematics learning (Bryck & Rhodes, 2024; Bull & Lee, 2014; Cragg & Gilmore, 2014). Yet there is limited research on how teachers understand and support EF skills in the context of mathematics teaching and learning. And there is little to no research on this topic for teachers primarily serving Black and Latinx students and students experiencing poverty, despite documented racial and class disparities in teachers' perceptions of students' EF skills suggesting inequities in student learning opportunities (Garcia et al., 2018; Miller-Cotto et al., 2022).

In this study, we set out to gather insights from teachers serving grades 3-8 Black and Latinx students and students experiencing poverty (we refer to this as our priority student population, and to their teachers as our priority teacher population), regarding the teachers' perceptions of EF skills for mathematics learning. We conducted this study on behalf of EF+Math, a program of the Advanced Education Research & Development Fund (AERDF).

Specifically, we sought to shed light on several key questions not addressed by prior studies of teachers' knowledge of EF skills:

1. What do teachers in our priority teacher population know and believe about EF skills for mathematics learning?
2. How do they approach EF skills in their teaching practice?
3. How interested are they in professional development to help them support students EF skills to enable them to learn and engage in challenging mathematics, and what would they prefer it look like?
4. How interested are they in using a mathematics learning product/approach that supports students' EF skills, and what would these products or approaches ideally look like?

To address these questions, we surveyed teachers across the U.S. who currently work with our priority student population. We then conducted 90-minute focus groups with a sub-sample of survey respondents. Teacher survey respondents were drawn from the ETS Educator Insights Panel. Invitations were emailed to 1,056 teachers who indicated they: (a) taught in any of grades 3-8, (b) taught in a Title I school (a proxy for teaching the priority student population), and (c) expressed an interest in participating in research studies as part of their inclusion in the ETS Educator Insights Panel. Our final survey sample included 121 priority teachers in grades 3-8. Sixteen of these teachers participated in one of three focus group interviews.

Next we present key findings for each of the study questions and topics.

Teachers' Current Knowledge & Beliefs Related to EF Skills for Mathematics

Neary all teachers in the study (97%) indicated they were familiar with EF skills as cognitive skills that influence how students learn and participate in mathematics. The majority (82%) of teachers in the study reported knowing at least something about EF skills. On survey items about specific EF skills, most teachers indicated familiarity with planning, persistence, and emotional regulation. Fewer teachers indicated familiarity with the EF skills of inhibitory control and cognitive flexibility.

When asked about all the ways they had previously learned about EF skills, the most popular responses indicated teachers learned about these skills through their own observations of their students using EF skills in their class (70%); through professional development (PD) or workshops (69%); through their own engagement with podcasts, books, or online resources (63%); through prior academic coursework (61%); and from instructional coaches (44%). Most teachers who had previously attended PD on EF skills (78%) indicated these experiences were provided by their school district, offered in-person, and focused on EF skills in a general sense or on EF skills in connection to mathematics, literacy, or other topics including social and emotional learning.

How Teachers Define EF Skills

When asked to describe EF skills in open-ended survey items, fewer than half (42%) provided a partial or complete description. Teachers with less reported prior familiarity with EF skills tended to view EFs in terms of organizational skills and skills related to planning, managing, and prioritizing task demands. These results suggest that teachers may not understand EF skills as well as they think they do. Relatedly, the survey and focus group data showed that teachers may associate EF skills with general behaviors and attitudes that support mathematics learning. These behaviors and attitudes, such as organizational skills, are influenced by, but are not, EF skills.

Teachers' Beliefs about EF Skills

Survey results highlighted several beliefs about EF skills held by most priority teachers, including that EF skills can be developed over time and are influenced by students' cultural and other experiences. Most priority teachers agreed EF skills are not fixed (83%) and that individual differences in EF skills relate to students' innate characteristics (84%). The majority of teachers (83-88%) agreed with a growth mindset view of EF skills, implying a belief in students' ability to grow regardless of where they start.

All or nearly all teachers also agreed with statements about EF skills in mathematics being influenced by students' prior experiences in and out of school (100%), their cultural perspectives (98%), and their personal goals (96%). Most also agreed that it is important to contextualize the teaching of EF skills by teaching them as part of mathematics lessons (91%) and by incorporating students' prior experiences and culture (86%).

In focus groups and open-ended survey comments, several teachers described EF skills as something higher-performing students have and lower-performing students lack, making it challenging for them to accurately complete their schoolwork. Yet, this seemed to be more of an artifact of the way teachers are trained to view and talk about students with differing needs, rather than an indicator of a deep belief that EF skills must be framed in terms of deficits. A minority of teachers' open-ended comments and focus group responses suggested a deficit-framed view of EF

skills. For example, some of these comments described EF skills primarily as something on which special needs students require additional support.

Teachers' Beliefs About EF Skills Influencing Mathematics Success

Teachers reflected positive beliefs about the potential impacts on students of incorporating EF skills in mathematics teaching. Most teachers reported that incorporating EF skills into their mathematics teaching (which many indicated they were already doing) improves student mathematics success (74%), engagement in mathematics lessons (62%), and students' mathematics attitudes and beliefs (58%). Focus group participants added context to these survey results by explaining that incorporating EF skills in mathematics class can help students to be more self-aware of their problem solving strengths, more focused, more likely to take their time when solving mathematics problems, better able to explain their problem solving process, more willing to share ideas, better at planning out the steps to solve a problem, and better at working and learning independently.

Teachers' Approaches & Barriers to Incorporating EF skills in Mathematics

Teachers' Approaches to Supporting EF Skills in Mathematics

In response to survey items asking directly about EF skills supports, teachers reported frequently incorporating them when planning mathematics lessons (every lesson: 31%, weekly: 39%) or teaching mathematics (every lesson: 44%, weekly: 36%). They reported less frequent explicit discussions of EF skills when teaching (every lesson: 18%, weekly: 34%). Yet, their responses to items asking how often they teach behaviors that directly use EF skills indicated that they are teaching these behaviors more frequently, suggesting that they may be implicitly teaching EF skills more often than they are aware. For example, whereas 44% of teachers said they incorporate EF supports into every mathematics lesson, 67% said in every lesson they teach students to sustain their attention long enough to complete tasks and 62% said in every lesson they teach their students to use reasoning to clarify and reinforce their learning.

Indeed, a few teachers in focus groups said that they had realized through the survey and focus group discussion that they were already supporting EF skills to some extent in their teaching. This was the case even for teachers who had limited familiarity with the concept of EF skills prior to participating in our study. The small minority of teachers (N=6) who had not previously heard of EF skills before completing the survey reported that, while they had not heard of the skills before, they recognized the skills described in our provided definition from their experiences as a teacher.

Barriers to Incorporating EF Skills in Mathematics

In terms of barriers to incorporating EF skills into their mathematics teaching, most teacher survey respondents cited competing priorities and a lack of instructional resources and training for teaching EF skills in mathematics. When asked about specific competing priorities, 76% indicated their mathematics curriculum prioritizes time on content over EF skills, whereas 80% indicated other educational priorities pose a barrier to teaching EF skills. Twenty-five respondents (21%) described other challenges and barriers they face when focusing on EF skills in their classes. These responses primarily expanded on existing survey response options, specifically issues relating to external teaching pressures and to the complexities of teaching diverse and/or high poverty student groups. A few respondents also mentioned a lack of specific resources, like professional

development or online tools. Other barriers mentioned in open-ended survey comments included restrictions on the curriculum set by the district, as well as a focus on student evaluation, insufficient time to incorporate EF skills into their instruction, and, finally, low district support.

Teachers' Interest in Professional Development to Incorporate EF Skills into Mathematics Teaching

Nearly all teachers were interested in PD on how to help their students develop the EF skills that will help them learn challenging mathematics. The majority of teacher survey respondents (62%) said they were very interested in such PD and another 26% were moderately interested. In contrast, only 2 teacher respondents were not at all interested in such PD.

Most teachers preferred professional development focused on supporting students' EF skills for mathematics learning. Fewer teachers, though still a majority (64%), expressed a desire for PD focused on defining EF skills. In focus groups, teachers emphasized that ideal PD would provide practical strategies and examples for immediate classroom use. They preferred PD that builds on existing teaching methods and curricula. Themes also included that PD should show, not just tell, how to support students' EF skills through videos or observations of actual classroom teaching. Participants preferred a series of brief sessions incorporating peer mentoring. Many suggested embedding these sessions within a professional learning community. Teacher comments also indicated a preference for virtual meetings spanning multiple dates and times to accommodate scheduling needs. Teachers indicated that incentive payments would motivate them to participate in PD on EF skills for mathematics learning.

When asked about useful supports for helping students develop EF skills in challenging mathematics, most teachers indicated interest in curriculum materials that incorporate EF skills, targeted PD and peer coaching on how to best support EF skills for mathematics learning, and additional planning time.

Teachers' Interest in Products & Approaches for Incorporating EF Skills into Mathematics Teaching

The majority (66%) of teachers surveyed said they would use a product or program focused on improving both mathematics learning and EF skills to help students learn challenging mathematics. Teachers reviewed descriptions of examples of three such programs and shared what would increase their interest. On the survey, 70–77% expressed strong interest in the programs, and focus group participants shared similar enthusiasm.

Teachers expressed interest in the idea of a movement-based supplemental mathematics program supporting EF skills, noting in focus groups that such a program could help students take more risks and improve mathematics learning. At the same time, they were also concerned about the logistical challenges of space needed for engaging students in such a program. Teachers also showed interest in online supplemental programs for mathematics facts fluency and problem solving, especially the gamification aspect and the idea of an online collaboration space. They also voiced concerns about the challenge of monitoring students' engagement and on-task behaviors while using online programs.

Finally, teachers participating in the study suggested that teacher interest in PD, programs, or products that focus on EF skills for mathematics learning may be increased by research evidence that incorporating EF skills into mathematics teaching supports student engagement, improves students' mathematics attitudes or beliefs, and fosters student mathematics success. Other motivating factors mentioned included recommendations from experts, testimonials from other teachers, and district buy-in.

Conclusions & Recommendations

The survey and focus group findings point to several conclusions addressing the key questions guiding the study. We extrapolate from these conclusions several recommendations on how best to assist priority teachers so that they can support their students' EF skills for mathematics learning.

1. What do teachers in our priority teacher population know and believe about executive function (EF) skills for mathematics learning?

Priority teachers indicated familiarity with the concept of EF skills and generally agreed that supporting these skills helps all students engage in challenging mathematics. At the same time, teachers may not deeply understand some EF skills and may conflate them with general behaviors and attitudes that support mathematics learning. This makes sense, given that teachers must focus their time and energy on the student behaviors that directly support learning.

On the survey, priority teachers indicated that they view EF skills as something students can develop and improve upon, rather than a fixed set of skills. They also indicated a preference for approaches to supporting EF skills for mathematics embedded within mathematics instruction and connected to students' cultural perspectives.

Based on the data, our recommendation is that designers of teacher PD on EF skills for mathematics should carefully consider what and how much knowledge about EF skills is necessary for teachers to successfully enact instructional strategies that support EF skills development to enable challenging mathematics learning. For example, is it sufficient for teachers to hold a very 'general cognitive skills' view of EF and see its value? Or is it more helpful, or even necessary, for teachers to deeply understand EFs such as working memory, cognitive flexibility, and response inhibition in order to use and see value in programs to support EF skills? Future research could also address these questions. Regardless of how deeply teachers must understand EFs in order to successfully support EF skills for mathematics, many teachers may still need to learn more about the importance of EF skills for mathematics learning.

2. How do they approach EF skills in their teaching practice?

The survey and focus group data indicate that many priority teachers are already using some strategies that support students' EF skills for mathematics learning, or support behaviors related to EF skills. Moreover, most teachers are not assessing students' EF skills. Based on these findings, our recommendation is for designers of teacher PD on EF skills for mathematics learning to take a close look at instructional strategies teachers are already using that implicitly or explicitly support their students' EF skills for mathematics learning. Such an approach values and builds upon teachers' expertise. Efforts to help teachers support EF skills for mathematics learning may need to incorporate assessments of students' EF skills within the context of mathematics.

The study findings suggest that many priority teachers who are familiar with EF skills may have primarily viewed EF skills for mathematics from a deficit perspective. This may be related to the fact that, in many cases, teachers' knowledge of EF skills is related to their work with students with special needs or disabilities, who tend to be approached from the perspective of deficits in need of support. Our recommendation is to include opportunities for teachers to discuss and practice asset-based framing of student skills and needs in EF skills PD and related supports.

3. How interested are teachers in PD to help them support students EF skills to enable them to learn and engage in challenging mathematics, and what would they prefer it look like?

The study findings suggest that priority teachers are highly interested in PD on how to support students' EF skills for mathematics learning, and that such PD would ideally focus most on building skills through practice and take the form of an ongoing series of brief sessions involving peer teachers (similar to a professional learning community (PLC)). Each session could focus on helping teachers understand, observe, and practice a specific EF skill and the strategies and moves necessary to support it with students with a range of prior experiences and strengths. In focus groups, priority teachers noted a preference for opportunities to observe other teachers successfully implementing techniques or strategies to support students' EF skills for mathematics learning. They felt that, while such PD could include time for learning *about* EF skills for mathematics learning, the bulk of the PD time should focus on *how* to support students' EF skills for mathematics. Focus group participants also suggested tailoring the design of each EF in mathematics-focused PLC to build upon and integrate with the mathematics curricula in use by teachers.

In summary, the study findings point to a need for opportunities for teachers to try out and practice the work of supporting students' EF skills in mathematics, but in risk-free environments, such as through peer rehearsals or digital teaching simulations. They also suggest a preference for PD on supporting students' EF skills in the context of students' culture, identities, and strengths.

4. How interested are the priority teachers in using a mathematics learning product/approach that supports students' EF skills, and what would these products or approaches ideally look like?

Priority teachers reported a desire for actionable strategies to support students' EF skills in mathematics, aligned with their existing curricula and standards. They also reported interest in supplemental mathematics programs or products to support students' EF skills. Data suggest that teachers' interest in PD, programs, or products to support EF skills for mathematics would be bolstered by research evidence and testimonials documenting improvements in students' mathematics success, attitudes toward mathematics, and/or engagement in mathematics lessons. Teachers' interest would likely also be bolstered by evidence that a supplemental mathematics program or product that supports EF skills for mathematics learning may be more effective than a supplemental mathematics program that does not support EF skills. Finally, the study results suggest that interest could also be increased through demonstrations giving teachers and school and district leaders opportunities to experience the supplemental mathematics program or product.

Introduction

Prior research documents the role of EF skills, specifically working memory, cognitive flexibility, inhibitory control, planning, and metacognition, for supporting mathematics learning (Bryck & Rhodes, 2024; Bull & Lee, 2014; Cragg & Gilmore, 2014). Yet there is limited research on how teachers understand and support EF skills in the context of mathematics teaching and learning. In this study, we set out to gather insights from grades 3-8 mathematics teachers primarily serving Black and Latino students and students experiencing poverty (we refer to this as our priority student population, and to their teachers as our priority teacher population), regarding the teachers' perceptions of executive function (EF) skills for mathematics learning.

Specifically, in conducting this study on behalf of EF+Math leaders, we sought to shed light on several key questions not addressed by prior studies of teachers' knowledge of and approaches to supporting EF skills. The questions address two important topics: 1) priority teachers' current knowledge of and practices supporting EF skills for mathematics learning and 2) priority teachers' interest in professional development on incorporating EF skills into classroom practices.

To address the study questions, we conducted a survey of teachers who currently work with our priority student population. We then conducted 90-minute focus groups with a sub-sample of survey respondents. Teacher survey respondents were recruited from the 1,056 teachers in the ETS Educator Insights Panel who indicated they 1) taught in any of grades 3-8 and 2) taught in a Title I school (a proxy for teaching the priority student population). Our final survey sample included 121 grades 3-8 teachers of our priority population students; 16 of these teachers participated in one of three focus group interviews to gather additional insights on the context and detailed perspectives behind their survey responses. Close-ended survey item data were tabulated and open-ended item responses and focus group responses were thematically coded. Additional details on the study methodology are included in Appendix A. Throughout this report, survey item results include all 121 teachers, unless otherwise noted.

In the following sections we lay out the study findings organized according to the research questions, highlighting key takeaways on each. Section I addresses the first research topic covering five research questions related to teachers' current knowledge of and practices related to supporting students' EF skills:

1. What do mathematics teachers currently know about EF skills?
2. What do mathematics teachers believe about EF skills?
3. How do mathematics teachers approach EF skills?
4. What challenges and barriers are faced by teachers interested in incorporating EF skills for mathematics into their teaching?
5. How do teachers perceive or expect changes in students' mathematics performance or behavior related to incorporating EF skills for mathematics into their teaching?

Section II of the report addresses the second study topic covering three key questions related to priority teachers' interest in professional development on incorporating EFs into classroom practice:

6. To what extent are teachers interested in professional development related to EF skills for mathematics learning?
7. What supports do teachers need to incorporate EF skills into classroom practice?
8. To what extent would teachers be more interested in using a supplemental mathematics learning productor approach in their classroom if it also supported students' EF skills?

In addition to triangulating survey and focus group interview findings, the report presents key takeaways at the beginning of each section. The study conclusions and recommendations for addressing them are included at the end of the report.

Section I. Current Knowledge and Practice of Executive Function skills

1. What do mathematics teachers currently know about EF skills?

Key Takeaways:

The majority of teachers in the study (82%) reported they knew something or a lot about EF skills. Similarly, most teachers indicated they were familiar with each of the specific EF skills. Nearly all were familiar with the EF skills of planning and persistence, and just over half were familiar with inhibitory control.

Nearly all teacher survey respondents were aware that EF skills are cognitive skills. When asked to define them, 42% of the sample provided partially complete or complete definitions including descriptions of EF skills. Teachers with less prior familiarity with EF skills tend to define EFs in terms of organizational skills and skills related to planning, managing, and prioritizing task demands.

Most teachers learned about EF skills from PD programs or workshops, through their own observations of their students using EF skills in their class, through podcasts, books, or other resources and their academic coursework.

Most teachers who had previously attended PD on EF skills (78%) said these experiences were provided by their school district, offered in-person, and focused on EF skills in a general sense or on EF skills in connection to mathematics, literacy, or other topics including social and emotional learning.

At the beginning of the survey, we asked teachers to select the best-fitting description of their awareness and knowledge of EF skills. They were than asked to rate their familiarity with key terms often used in conjunction with or to describe specific EF skills, and to define and explain in their own terms what EF is and why it matters. Most (82%) of the sample reported knowing a lot (28%) or something (54%) about these skills, and the remaining 18% reported little or no awareness of them (Figure 1). When asked about terms related to EF, nearly all teacher respondents indicated they were "familiar" or "very familiar" with terms such as *planning (97%), persistence (97%),* and *emotional regulation (90%)*, which have broad usage within non-academic/EF domains (see Figure 2). Fewer teacher survey respondents, but still the majority, indicated familiarity with *working memory (93%), cognitive flexibility (74%),* and *metacognition (81%)*. Finally, just slightly over half of

teacher respondents (53%) indicated familiarity with the term *inhibitory control*, suggesting that interventions and PD that address this construct should not assume prior knowledge of it.

Figure 1: Teachers' Awareness & Knowledge of EF Skills

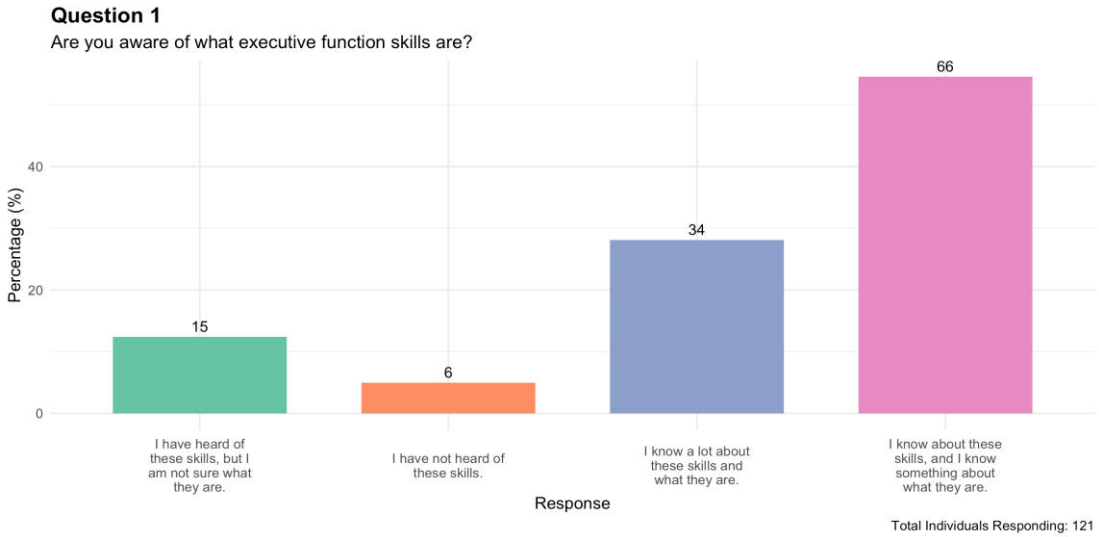
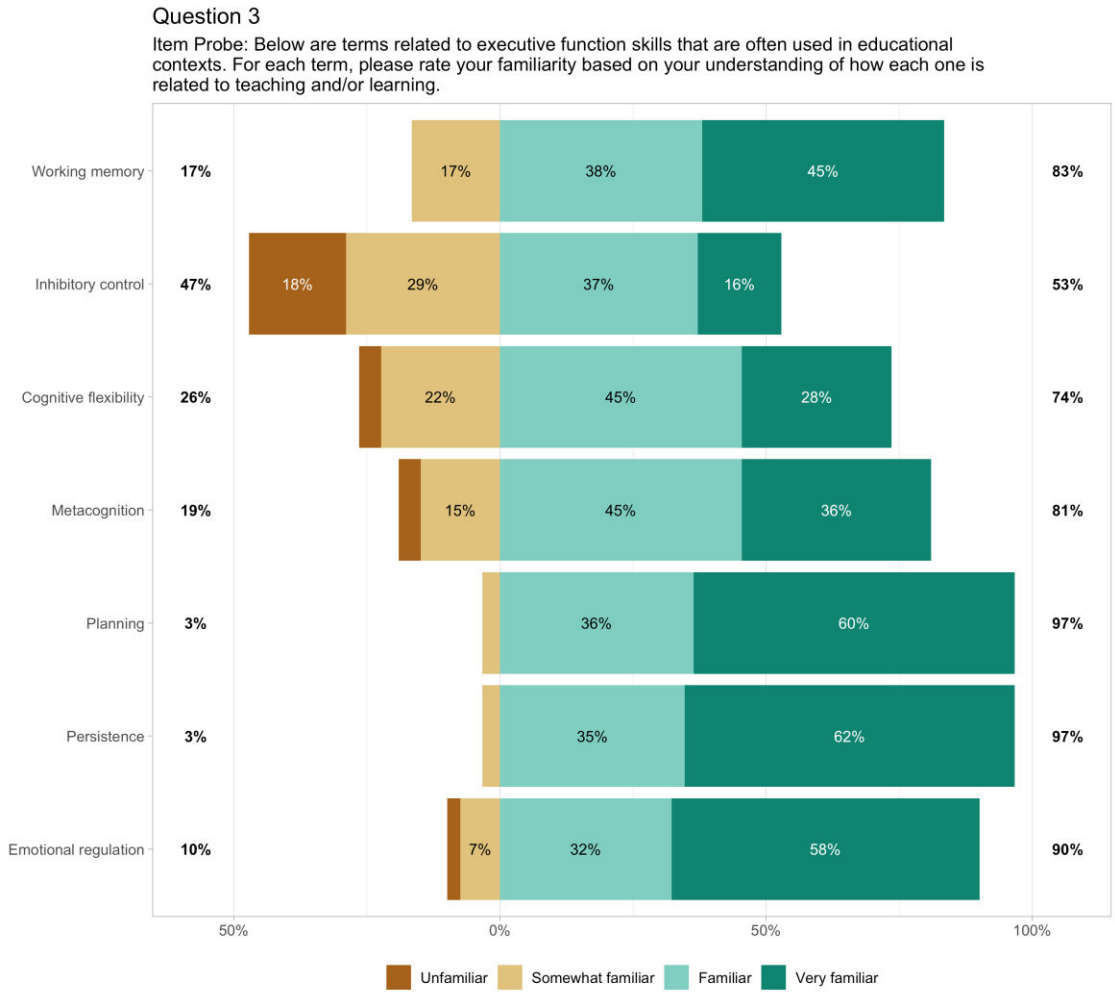


Figure 2: Teachers' Self-Reported Familiarity with Specific EF Skills



How do teachers define executive function skills?

To address this question, we asked teachers to describe and discuss EF skills in their own words in response to two short response questions within the survey and several discussion questions within the focus group. The survey responses indicated that most teachers are familiar with EF skills as cognitive skills that influence how students learn and participate in mathematics. Among teachers with less prior familiarity with EF skills, we saw a tendency across both the three focus groups and the survey for them to view EFs in terms of organization skills, and planning, managing, and prioritizing task demands. For example, one teacher stated in a focus group, *"The big thing that I think a lot of learners struggle with is that organization, being able to organize their thought processes and strategies in order to solve these more challenging type mathematical problems."*

What do you believe executive function skills are?

All 121 survey participants were asked to provide a short description of what they believe EF skills are, prior to being provided with a definition. We coded participant responses by first identifying the main themes present across definitions, and second, assigning a rating to each definition based on its completeness (see Table 1 for the rating rubric).

Overall, we found that most teachers (97%) are aware that **EF skills are cognitive skills** (e.g., their definitions received a rating of 1 or more) and 67% of our sample provided definitions that provide further specification differentiating types of skills, discussing their function and, in some cases, providing examples.

Table 1: Teachers' Definitions of EF Skills

Survey Q2a: What do you believe executive function skills are?		
Rating *Total n*	**Criteria**	**Examples**
0 *N = 3*	**Incorrect** – description had little to do with EF skills	- "Admin skills" - "Executive functioning skills are the skills needed to do things independently without the assistance of technology or other human beings"
1 *N = 37*	**Too general** – description was too general, often mentioning mental/cognitive skills or general abilities	- "Mental skills necessary for learning" - "Skills you need to navigate everyday life" - "Higher-level cognitive skills"
2 *N=30*	**Limited** – These descriptions often focused on only a few skills often missing key dimensions of EF or identifying skills that are indirectly related. These definitions have little to no description of the function/role these skills play.	- "Executive functioning skills are skills that people use to organize and manage their lives." - "Soft skills, time management skills, self-sufficiency skills, task completion, self-regulating skills" - "The ability to manage emotions to complete tasks well"
3 *N= 27*	**Partial** – These descriptions mention a few different skills (either directly or indirectly related to EF) and make some connections to function/role.	- "Cognitive skills that help students manage time, plan and organize their schedules, be in control of their goals. - "Executive Function Skills are those skills that help us organize our thoughts, complete tasks, make connections to our learning, think about our learning, keep up with a daily schedule, get from place to place, and be fully present in the moment." - "I believe executive functioning skills are organizing, planning, goal setting and behavior regulating."
4 *N = 12*	**Complete** – These descriptions mention multiple different skills as well as describe the function/role. Unlike a limited or partial response, these definitions focus on skills generally viewed as EF skills.	- "Executive function skills are mental skills that assist with completing a continuum of tasks related to planning, organizing, analyzing and problem solving. " - "Executive function skills are organizational skills. As well as planning, being able to focus on a task until completion. A lot of people with ADHD have a hard time wit

Survey Q2a: What do you believe executive function skills are?		
Rating *Total n*	**Criteria**	**Examples**
		h this skill. When you lack these skills the n you have a difficult time making decisio ns or trying to solve a problem."
5 *N = 12*	**Excellent -** This coding was reserved for truly comprehensive definitions that captured a fairly complete range of EF skills. These all discuss what these skills are used for and often provide examples.	- "Executive function skills are the mental processes that enable individuals to plan , focus attention, remember instructions, and juggle multiple tasks successfully. T hese skills are essential for goal-directed behavior and self-regulation. They are often categorized int o three main areas: 1. Working Memory – The ability to hold and manipulate information in the mind for sh ort periods. 2. Cognitive Flexibility – The capacity to shift thinking and adapt to new situations or p erspectives. 3. Inhibitory Control (Self-Regulation) – The ability to control impuls es, resist distractions, and maintain focu s on a task. These skills develop over tim e and are critical for academic success, p roblem-solving, decision-making, and social interactions. Deficits i n executive function can impact learning, emotional regulation, and daily life activi ties." - "a set of cognitive abilities that allow you to manage complex tasks, including plan ning, organizing, prioritizing, focusing atte ntion, controlling impulses, and adapting to new situations - essentially, the skills n eeded to effectively navigate daily life an d achieve goals; key components include working memory, cognitive flexibility, and inhibition control. "

For definitions that captured a general, limited, or partial view of EF skills, we identified the primary themes that came across in the definitions provided. We did not include our Complete or Excellent definitions in this analysis since, by definition, they touched on multiple themes in their definition. In alignment with the focus group themes, **themes of these open-ended survey responses defining EF skills reflected a tendency to focus on EF skills in terms of organizational skills and skills related to planning, managing, and prioritizing task demands**. Teacher responses

infrequently addressed working memory, cognitive flexibility (often discussed in terms of adaptation) or inhibitory control (frequently discussed in terms of emotion regulation). Meta-cognition was primarily mentioned in reference to self-regulation and self-monitoring skills.

Primary themes Identified in definitions presenting a general, limited or partial view of EF skills:

- Organize, manage, prioritize, plan (43)
- Mental skills, learning, thinking (18)
- Problem solving (10)
- Self-regulation and time management (7)
- Adaptation (2)
- General use to support task completion and teaching (14)

In focus groups, when asked to define EFs, teachers also tended to mention organization, planning, problem solving. They also defined EFs as staying focused, metacognition, working memory, and cognitive flexibility. One participant noted that EFs are different from growth mindset, which they were more familiar with. Although all focus group participants had all completed the survey, which included a definition of EFs, when asked to define EFs several focus group participants described other concepts such as work ethic, mathematics skills, motivation, long-term memory, skills mastery, and collaboration. Rather than describing the EFs themselves, this subset of teachers described behaviors viewed as necessary for successful learning, which are not EFs but may be influenced by them.

How, if at all, do you believe EF skills influence students' learning or participation in mathematics classrooms?

This open-ended survey question asked teachers about their beliefs about how EF skills influence learning or participation in mathematics, along with examples from their experiences (see Table 2 for example responses by theme). All 120 teachers who provided an answer to the question expressed agreement that EF skills were important; however, their responses differed in terms of their reasoning and examples to support this assertion. Teachers primarily identified examples of EF skills supporting students mathematics work and, to a lesser extent, supporting the learning process itself. The comments of a minority of teachers (N=16) implied a deficit view of EF skills by explaining its importance through examples of students who struggled with those skills. For brevity we've omitted themes for 11 responses that communicated general agreement with no further explanation (7) or discussed general EF skills as something that should be taught (4).

Table 2: Teachers' Beliefs Around How EF Skills Influence Learning: Example Responses by Key Themes

Survey Q2b: How, if at all, do you believe EF skills influence students' learning or participation in mathematics classrooms? If you can, we encourage you to use an example from your experience as a mathematics teacher or your own mathematical practice to explain your thinking.	
Key Themes *Total N*	**Examples**
EF supports doing mathematics *N = 62*	"I think they play a huge part. Students need to be able to be flexible in their thinking when solving problems, they need to be able to organize information, plan the steps they need to t ake, manage frustration when things do not go as expected,

Survey Q2b: How, if at all, do you believe EF skills influence students' learning or participation in mathematics classrooms? If you can, we encourage you to use an example from your experience as a mathematics teacher or your own mathematical practice to explain your thinking.	
Key Themes *Total N*	**Examples**
	and they need to be able to maintain attention to instruction and tasks. Some students struggle with where to start, are to o quick to work and do not attend to being neat or checking f or reasonableness. Organization is super important in mathe matics so that is one of the areas where I have seen my stud ents struggle the most."
EF supports processes related to learning (e.g., practice, instruction, making connections to prior knowledge) *N= 15*	"I believe that EF skills are inseparable from learning in all ar eas, including mathematics. For example, my school used th e iReady mathematics curriculum which suggests that teach ers present a problem, allow students time alone and in sma ll groups or pairs to solve it, and then come together as a whole group for students to share different ways of solving th e problem. This method of teaching requires students to thin k flexibly and solve the same problem different ways. It requi res sustained attention, problem solving and planning on ho w to solve the problem or what to do when you get stuck, eva luating whether or not a method will work to solve the proble m and, if it does, evaluating various methods to determine w hich may be best for the individual student or which may be most efficient. It requires persistence when things are hard a nd the ability to selfmonitor and make changes as necessary . It involves active listening and attention as peers share thei r methods. Even if mathematics isn't taught this way, solving mathematical problems in general requires a variety of EF an d problem- solving skills, even in things that can typically be more rigid li ke algorithmic worksheets."
Deficiencies in EF skills presented as evidence of its importance to learning. *N=16*	"In my own experience, I have had several students who eith er struggled with executive functioning or didn't have any exe cutive functioning skills at all. This has impeded their ability t o participate in mathematics lessons and be able to complet e assignments. For example, one of my students who struggl ed with executive functioning would get frustrated with a pro blem. Instead of asking for help or continuing to try on his ow n, he would tear up his paper, break his pencil, and start thro wing desks. After a lot of work with our OT, this student learn ed skills to help him regulate his emotions so that he would be able to complete (any) assignment."
EF supports sense-making and building understanding in mathematics	"Executive functioning supports mathematics classrooms b ecause it helps students initiate and start to make sense of t he mathematics without the support of a teacher"

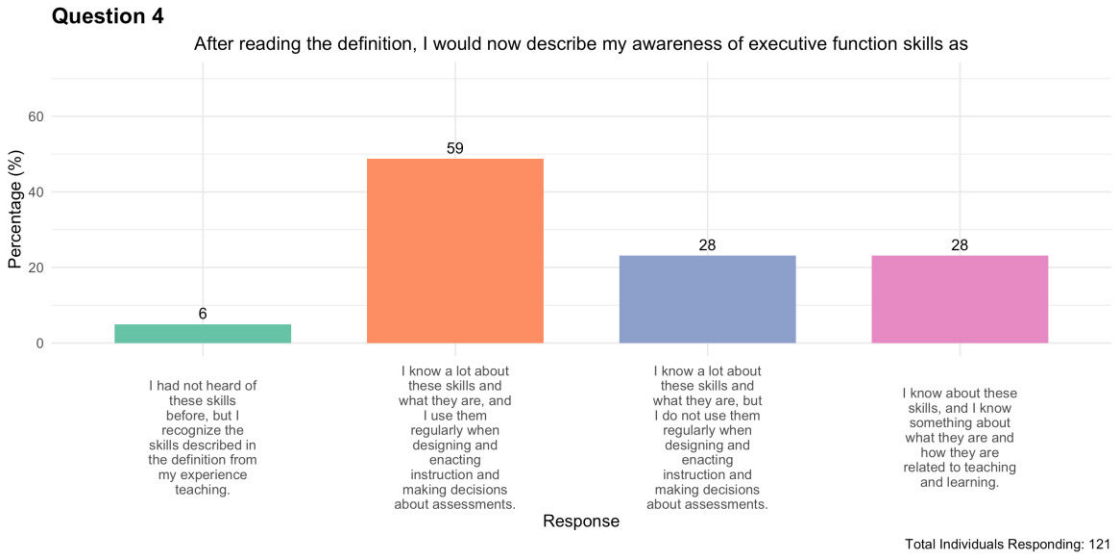
Survey Q2b: How, if at all, do you believe EF skills influence students' learning or participation in mathematics classrooms? If you can, we encourage you to use an example from your experience as a mathematics teacher or your own mathematical practice to explain your thinking.	
Key Themes *Total N*	**Examples**
N= 5	
EF supports ability to focus and manage time *N= 7*	"I believe EF skills help students manage their workload and in identifying what's important in that moment to know and li sten to. For example, my students benefit from managing the ir time wisely by using class time to ask me questions about things they don't understand."
EF supports students' motivation, independence, and ability to persevere *N = 5*	"I believe that students who have strong EF skill are able to p ersevere when mathematics becomes difficult. If one is una ble to overcome EF blocks which occur, one may shut down or even become aggressive."

Introducing Executive Function Skills

Following the survey open response questions asking teachers to describe and discuss EF, we provided them with the below definition of EF and asked them to re-evaluate their knowledge of EF skills. All 6 participants who had not previously heard of EF skills before the survey reported that, while they had not heard of the skills before, they recognized the skills in the definition from their experiences as a teacher. Across all respondents to this question, 49% reported using EF skills regularly in their own teaching, whereas 23% reported not using them regularly despite knowing a lot about them (see Figure 3). Note that focus group participants were also presented with this definition after answering a question about what they know or remember (from the survey) about EF skills. However, they were not asked to discuss their level of familiarity after hearing the definition again; instead, they were asked how EF skills influence students' participation in and learning of mathematics. They echoed many of the responses provided to questions 2a and 2b (above). One additional theme arising in these focus group comments was a focus on EF skills enabling students to work and learn independently.

Provided Definition: *Executive function skills are a set of cognitive abilities that every student possesses, enabling them to manage and direct their learning process. These skills include the ability to maintain and manipulate information in the mind, focus attention based on personal priorities, and flexibly adapt thinking strategies as needed. Through executive function skills, students exercise agency over their attention, emotions, and actions to facilitate their own paths towards their goals. In formalized learning environments, they also use executive function skills to plan out how they will approach an assignment, and to reflect on how well their chosen strategies are working to support their learning and engagement in class.*

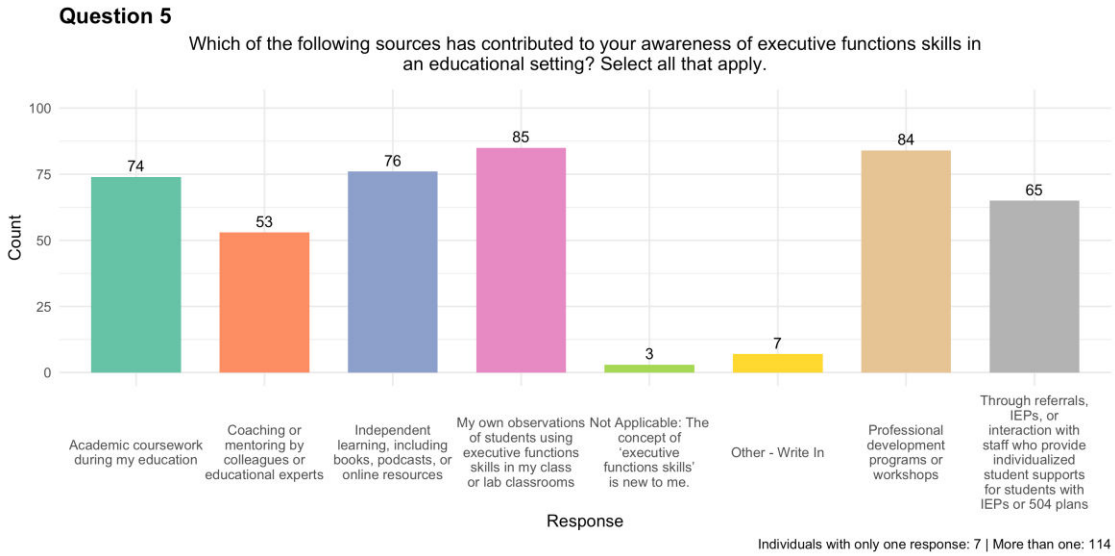
Figure 3: Teachers' Self-Reported Awareness of EF Skills After Reviewing Our Definition



Where does teachers' prior knowledge of EF skills come from?

Of the 97% of teacher survey respondents who indicated they had prior knowledge of EF skills, the majority (72-74%) reported that this knowledge came from some combination of professional development (PD) programs and their own observations of students in their classrooms. They also learned about them through podcasts, books, or other resources (63%), their academic coursework (61%), and/or through coaching or mentoring (44%) (see Figure 4; note that 114 of the 121 respondents selected more than one source of prior knowledge on EFs). Of the individuals who chose to write in responses, three cited their experience as special/exceptional education teachers as sources for their knowledge. The other responses focused on life experience (2) and prior academic research on this topic (1).

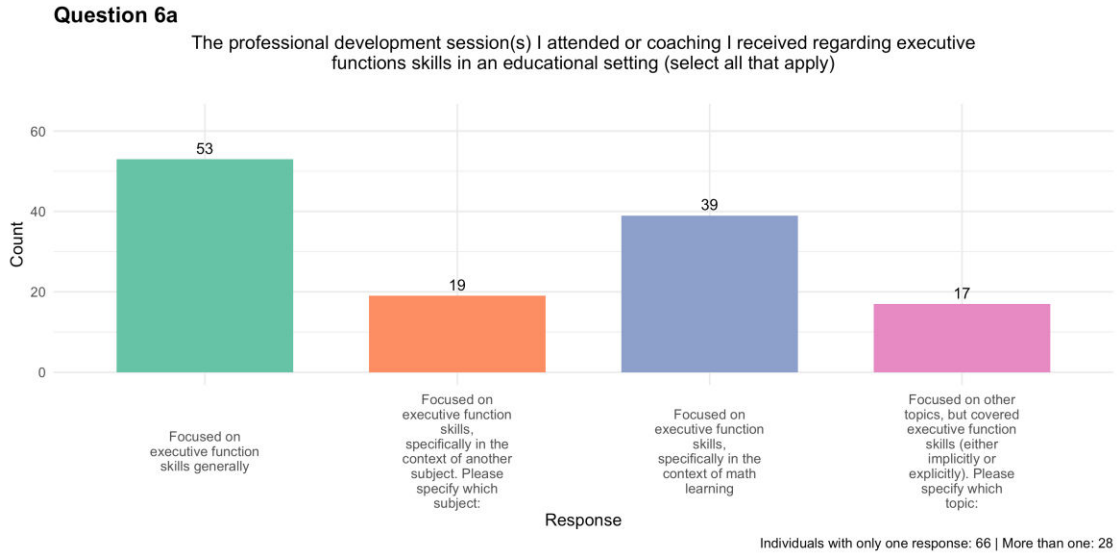
Figure 4. Sources of Teachers' Knowledge of EF Skills in an Educational Setting



Prior EF-related PD

Of the 94 individuals (78% of survey respondents) who reported receiving some type of prior PD on EF skills, 28 selected more than one of the PD or coaching response options. Fifty-three reported PD that focused on EF skills generally, whereas 39 received PD focused on EF skills in the context of mathematics learning (see Figure 5). Of those who reported receiving PD focused on EF skills in the context of another subject (19), 8 reported these PD sessions were focused on non-academic subject areas (such as social and emotional learning, student well-being, trauma, and special education). The remainder indicated they received EF training within PD focused on other non-mathematics academic subject areas, the most frequent being English language arts (see Figure 5). We also had 17 teachers report receiving PD for other topics which they reported covered EF skills either explicitly (e.g., "Behavior intervention and impact of EF [on] skill development") or implicitly (e.g., "They [are] usually content specific, but iReady Math really addresses executive functioning in their PD without saying it.").

Figure 5. Primary Focus of Prior PD Sessions or Coaching on EF Skills (N=94)



The PD individuals reported receiving was primarily provided through a district (65 said their own and 28 said another district) (see Figure 6). These sessions were typically in person (66) or virtual (48), and most were offered as a one-time training (37) as opposed to a series of sessions (18) (see Figure 7). Overall, most individuals who received some sort of PD or coaching on EF skills reported that their experience(s) led to moderate to substantial improvement in their knowledge of EF skills (79%) and led to changes in their teaching practices (72%).

Figure 6. Provider of Prior PD Sessions or Coaching on EF Skills (N=94)

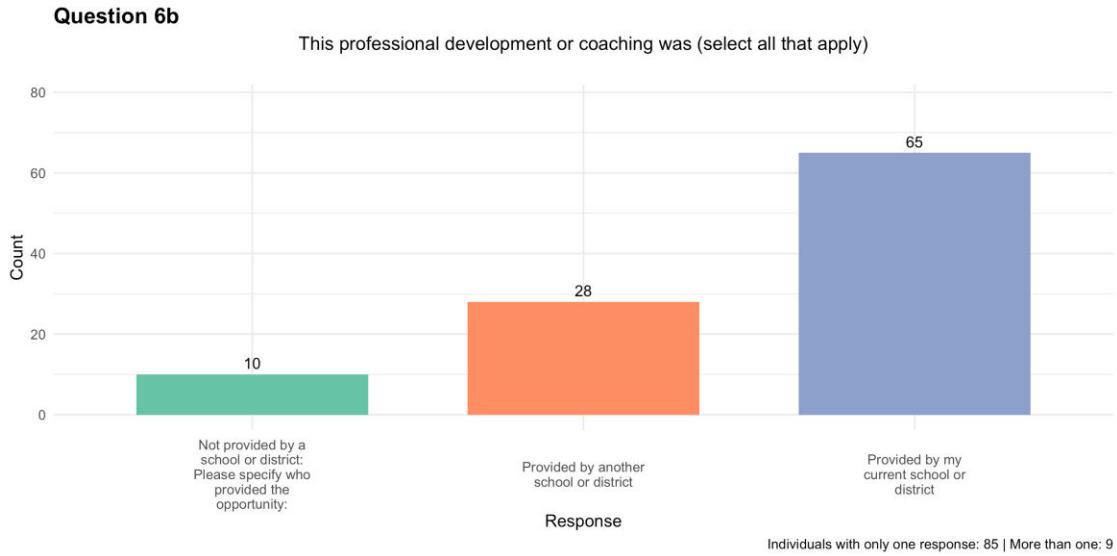
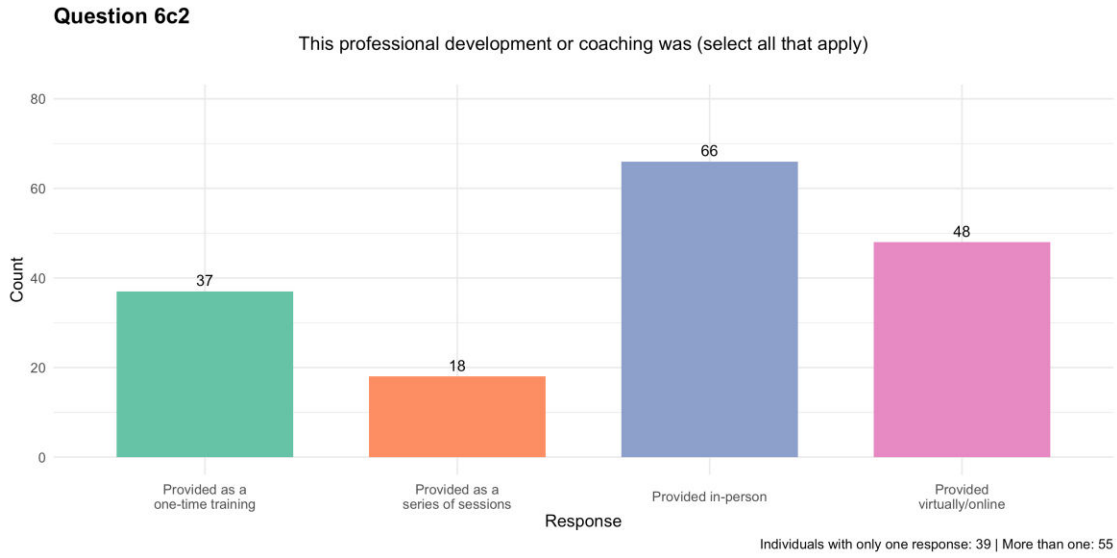


Figure 7. Format of Prior PD Sessions or Coaching on EF Skills (N=94)



2. What do mathematics teachers believe about EF skills?

Key Takeaways:

Teachers consistently reported strong beliefs that EF skills are important to success in mathematics. Yet, they spoke more of student behaviors and mindsets that are important for mathematics learning and are influenced by, but are not, EF skills.

They tended to talk about EF skills in terms of student deficits; yet this seemed to be more of an artifact of the way teachers are trained to view and talk about students with differing needs.

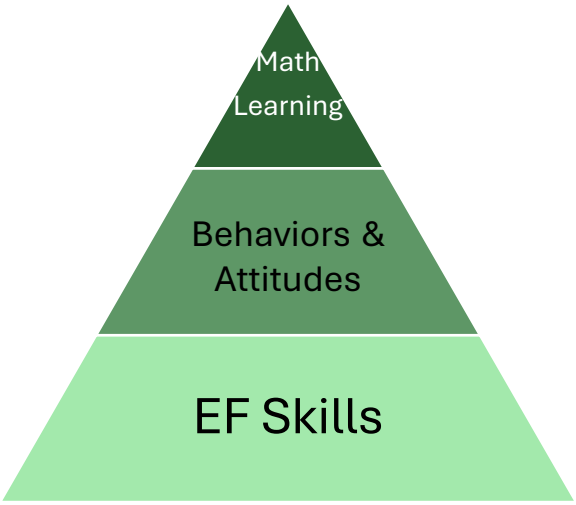
Most teachers agreed EF skills are not fixed and that individual differences in EF skills are related to students' innate characteristics. Together these items speak to a belief in students' ability to grow regardless of where they start.

Most teachers view EF skills as influenced by culture and as best taught in the context of a subject such as mathematics.

The survey also asked participating teachers about their beliefs and experiences related to EF skills in the context of teaching and learning mathematics. These questions specifically asked teachers to answer based on their experiences as mathematics educators. The vast majority of teachers agreed both that there were many ways a student can use their EF skills to learn (100%) and that teachers can support their students in using these skills (98%).

In line with responses to the earlier question regarding how EF skills influence mathematics learning, responses across these questions about teachers' responses showed consistently strong beliefs that EF skills are important for success in mathematics. At the same time, teacher focus group participants spoke more often of the student behaviors and mindsets that are important for mathematics learning, that are themselves influenced by EF skills, rather than speaking about EF skills (see Figure 8).

Figure 8. Conceptual Pathway of EFs Influence on Math learning



To what extent do teachers approach EF skills as strengths that students bring to learning?

Several survey and focus group questions addressed the extent to which priority teachers view EF skills as strengths students bring to learning. While teachers may view EF skills as student strengths, when describing what they knew about EF skills many teachers spoke first about EF deficits impeding student mathematics learning. In those responses and in focus group discussions of how they learned about EFs, many teachers described their knowledge of EF skills as coming from their experience working with students with special needs. They talked about EF skills as something for which special needs students require additional supports, noting EF skills may even be included as goals on Individualized Education Plans (IEPs). Several teachers spoke of

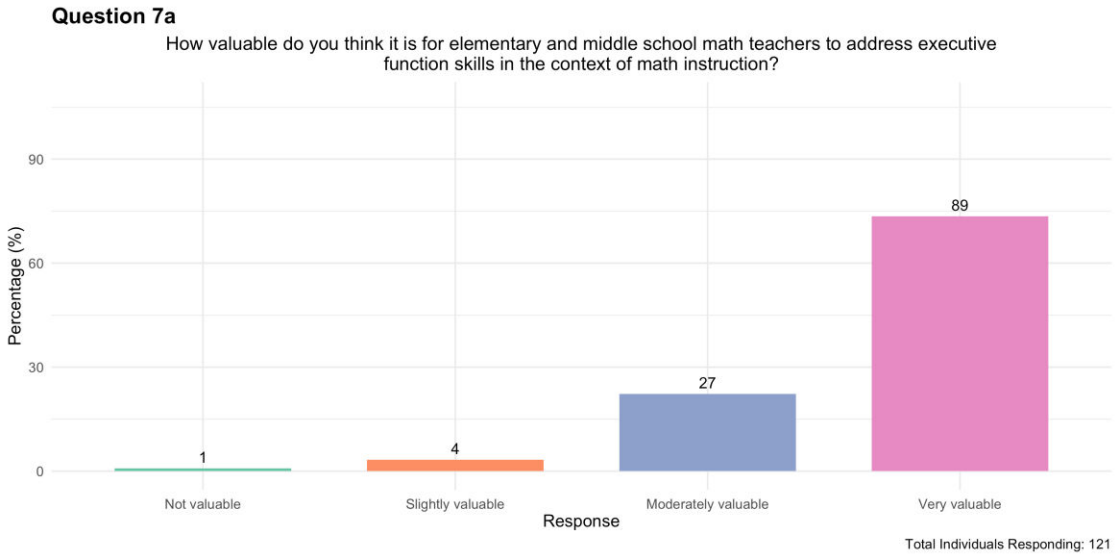
EFs as something higher-performing students have and lower-performing students lack, making it challenging for them to accurately complete their schoolwork. As one teacher noted, “They all have different levels of ability and different disabilities that might affect that. So, if we look at things like ADHD, for example, that can be from a very mild case to a really severe case. They have those different levels of executive functioning skills that we have to focus in on and we have to finetune and it's really difficult at some point.”

In some cases, survey and focus group questions and discussions were intentionally framed from an asset-based perspective. For example, when teachers in a focus group were asked if they could give an example from a strengths-based perspective, they easily “flipped” their narrative and spoke about successful students using EFs to support mathematics learning. Thus, it seems likely that the descriptions of EF skills from a deficit perspective are more of an artifact of the way teachers tend to view and talk about students with differing needs, rather than an indicator of a belief that EF skills should only be framed in terms of deficits.

To what extent do mathematics teachers view EF skills as important to mathematics learning?

Almost all (96%) teacher survey respondents indicated it was either moderately or very valuable for elementary and middle school mathematics teachers to address EF skills in the context of mathematics instruction (see Figure 9).

Figure 9. Teachers’ Perceptions of How Valuable it is for Elementary and Middle School Math Teachers to Address EF Skills in the Context of Math Instruction

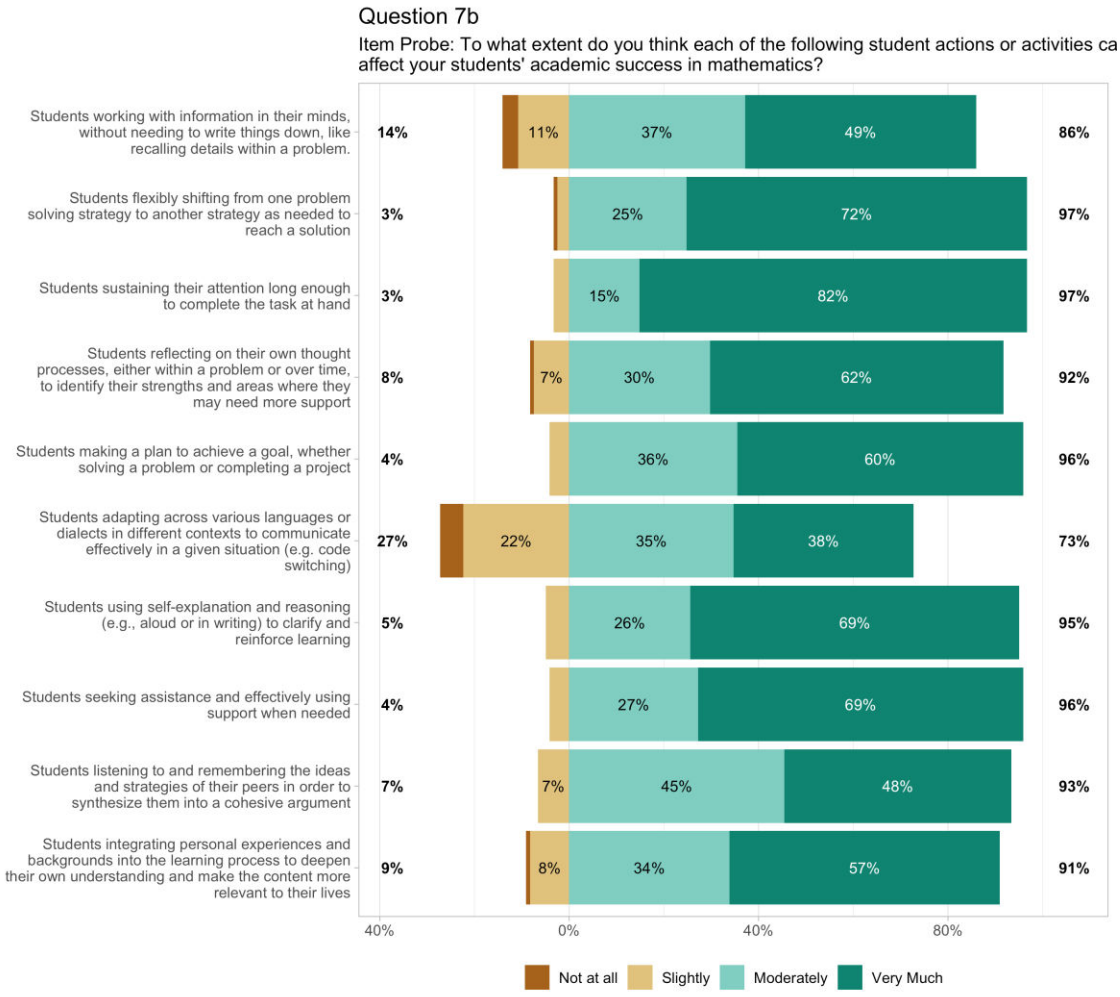


When asked to reflect on specific examples of student behaviors that might engage EF skills to support mathematics learning, most behaviors received over 90% agreement that they were either moderately or very important to academic success in mathematics (see Figure 10). The behaviors receiving the highest levels of agreement that they were very important to mathematics success included **inhibitory control** [sustaining attention long enough to complete a task] (82%), **cognitive flexibility** [flexibly shifting from one problem-solving strategy to another, as needed, to reach a solution (72%)], **meta-cognition** [using self-explanation and reasoning to clarify and reinforce

learning](69%), and seeking assistance and effectively using support when needed (69%). **Planning** [students make a plan to achieve a goal] was also rated as very important for mathematics learning by 60% of teachers. The two EF-related behaviors with the **lowest agreement involved using working memory and code switching**.

In focus groups, several teachers explained that they believe EF skills such as metacognition and planning are important for mathematics learning. For example, one teacher noted, "Executive function skills obviously go a long way in helping them to [learn]. When we have metacognition, thinking about what they are thinking, the steps I see.....this is not just important, it is mandatory to vital for success." They also noted that strong EF skills are necessary for students to learn independently. For example, one teacher said, "It's the difference between students who can, when it's time for independent practice, who are able to work independently versus students who, during that time when you let them work on practice problems, are still needing one-on-one support or small groups, usually those students who don't do well, whose executive functioning skills are not all the way there, they usually can't... They usually need guidance along the way like guiding questions."

Figure 10. Teachers' Perceptions of the Extent Student Actions or Activities Can Affect Math Success

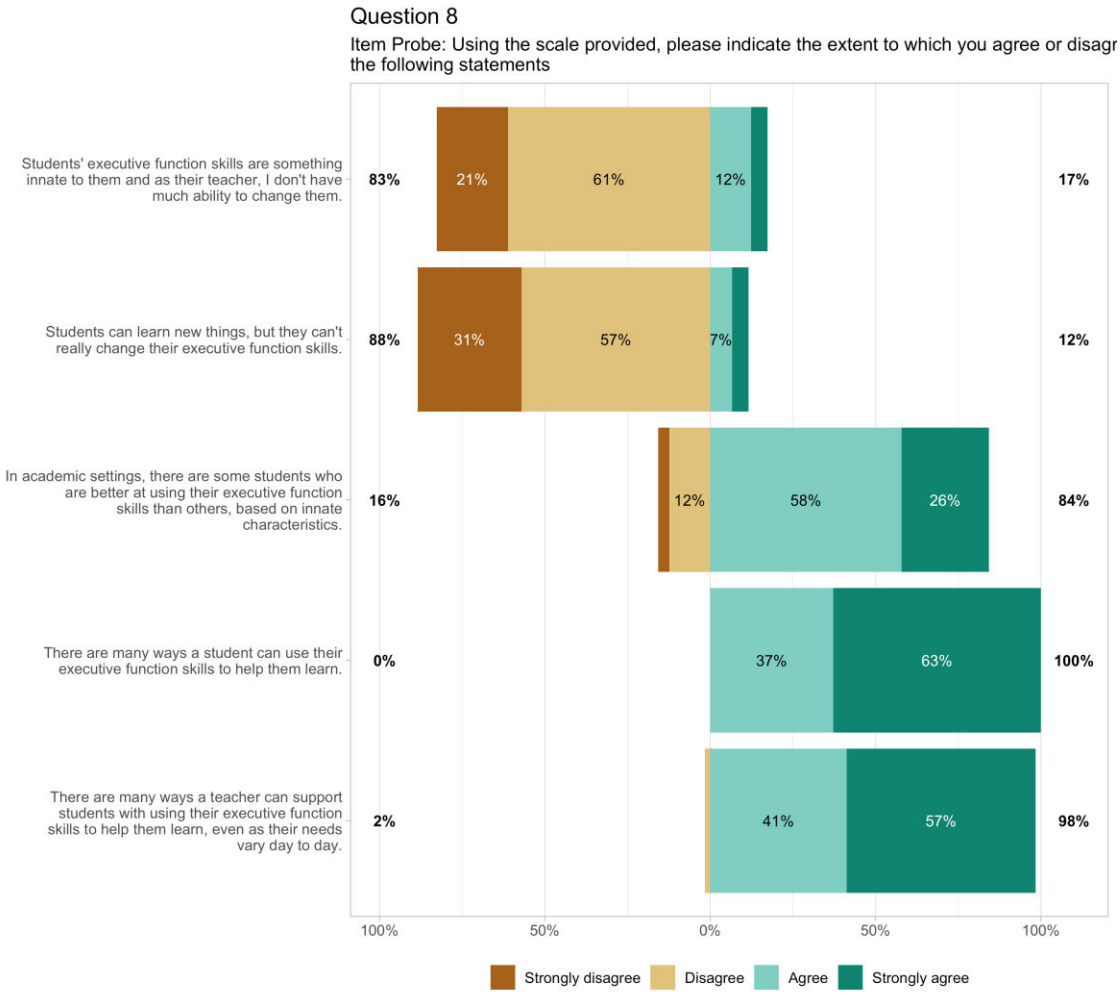


To what extent do mathematics teachers view EF skills as dynamic?

While many teachers (84%) reported viewing EF skills as innate characteristics that differ from student to student, **similar proportions of teachers (83-88%) agreed with items representing a growth mindset view of EF skills**, indicating a view that these skills can be changed (see Figure 11).

Across the three focus groups, teachers also tended to agree that EF skills can be developed with practice. One teacher noted, “I think it can be developed with practice. I don't think you are born with it, especially if it's started at a younger age. I think that if it's not introduced until high school, it might be a bit of a challenge to develop because those students might be pushing back a little bit against it. So, I think that starting it as soon as they hit that school age might be the best option so that they develop that routine and build upon it each year of school.” The one teacher who spoke about innate differences also agreed that EF skills can be developed: “It's very innate, I would say for students that are just naturally of a higher intelligence in terms of like, the resilience trying to find different approaches, viewing things from different perspectives. And that is something that will have to be trained for some. I think it is natural for some, but for some it does have to be trained and it can be trained.”

Figure 11: Teachers' Perceptions of the Extent to Which EF Skills Are Fixed* or Innate



** Note that the first two items are reverse-coded such that they represent a fixed mindset view.*

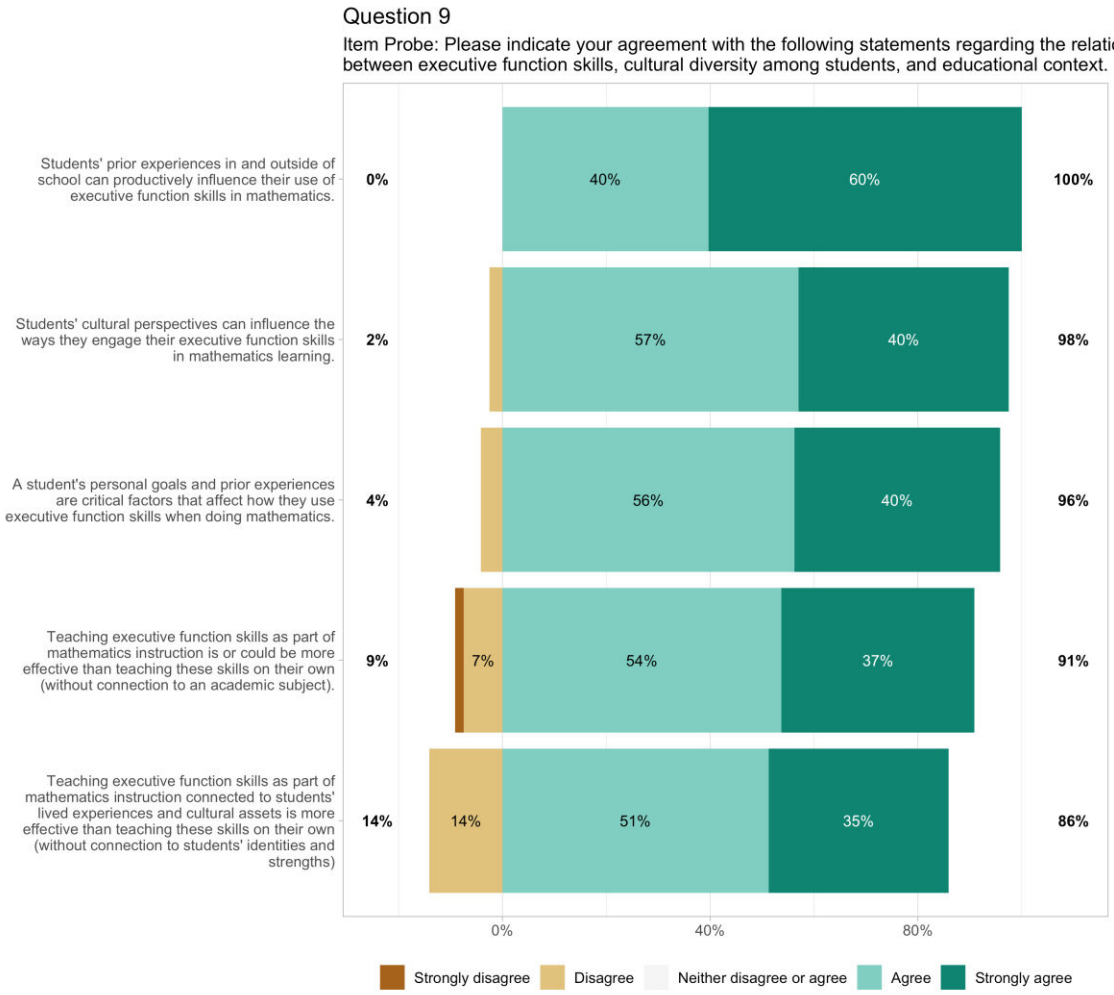
To what extent do mathematics teachers view EF skills as culturally relevant and/or better supported in context?

We observed high respondent agreement (96-100%) with statements that related students' use of EF skills to their prior experiences in and out of school, to their cultural perspectives, and to their personal goals (see Figure 12). A large majority (86%) of teachers also agreed that it would be more effective to connect student learning of EF skills for mathematics to their lived experiences and cultural assets. Focus group participants tended to agree that students' cultural backgrounds and home life experiences influence their EF skills and how well they use them at school. For example, one teacher said, "I think that's something that can be very much a cultural thing, whether they're rigid in terms of their thinking, very structured, or they're willing to try different out-of-the-box type of strategies." A few teachers explained that lack of planning and organization at home will lead kids to lack these skills at school. Conversely, some teachers noted that students growing up in homes led by organized and planful parents tend to display stronger planning skills at school. Yet, at least one teacher mentioned seeing stark differences in the academic engagement and EF skills of

siblings raised in the same family. Such comments highlighted the influence of different abilities and neurodivergence on differences in EF skills.

While only 32% of our sample learned about EF skills in a mathematics context (see Figure 5), 91% of teachers agreed that teaching EF skills as part of mathematics instruction could be more effective than teaching these skills on their own (see Figure 12).

Figure 12: Teachers' Perceptions of the Extent to Which EF Skills are Culturally Relevant and Better Supported in Context



While teachers in focus groups tended not to discuss cultural differences related to race, ethnicity, or any other background characteristic, one respondent did note that he views Latino culture as discouraging of children doing things for themselves, which he thinks explains why some of his Latino students are less comfortable working independently. He noted, "I think independence as well, like working in lower grades, especially in 3rd grade. You get some kids that are super mature, super independent. And some that are still babied. And when you look at the household, that's really where it's coming from." A teacher in the same group countered with his own experience of his Latino first-generation students being more motivated to try in mathematics classes than other

students. Neither teacher explicitly mentioned EF skills, but rather implied that these differences in behaviors were related to differences in EF skills.

3. How do mathematics teachers approach EF skills?

Key Takeaways:

Teacher survey respondents reported frequent incorporation of EF skills supports when planning lessons or teaching mathematics (every lesson: 44%, weekly: 36%). Explicitly discussing EF skills when teaching occurred less often (every lesson: 18%, weekly: 34%), according to survey data.

Most teachers reported designing mathematics activities that require students to use their EF skills, such as multi-step problems, and providing tools and resources to support the development of students' EF skills.

In the focus groups, several teachers observed that after being introduced to our definition of EF skills, they realized that, while they didn't know it at the time, they had already been supporting EF skills in their classes.

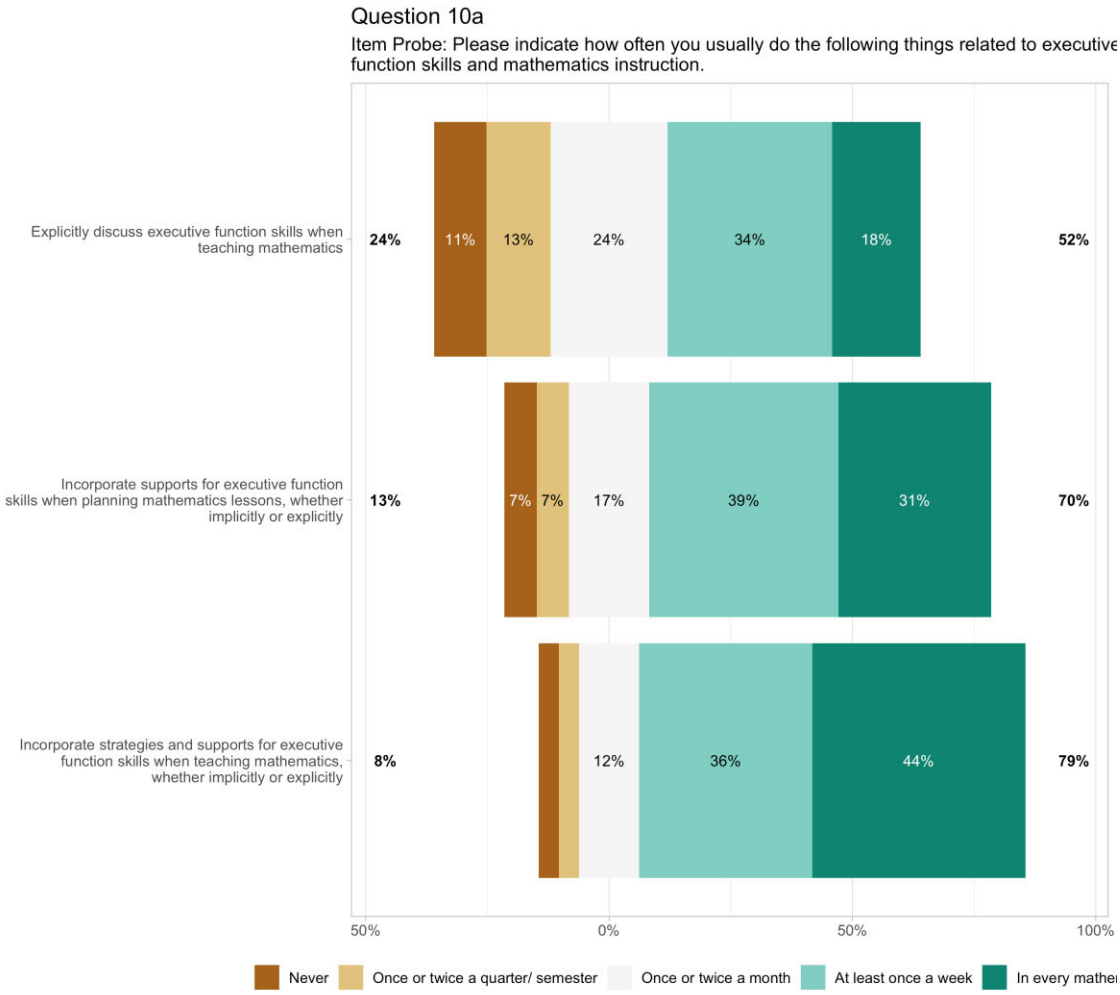
Most teachers reported that their students did not take any type of assessment that gathered information on their EF skills.

How often, if at all, do teachers discuss EF skills with students in mathematics contexts?

Teacher survey respondents reported frequent incorporation of EF supports when planning lessons and teaching mathematics (every lesson: 44%, weekly: 36%). Explicitly discussing EF skills when teaching was reported less often (every lesson: 18%, weekly: 34%), with 24% of individuals stating they never or rarely (once or twice a semester) discuss these skills with students (see Figure 13). However, when asked to rate how frequently they teach behaviors that directly use EF skills (see Figure 14), teachers indicated teaching these behaviors more frequently, suggesting that they may be implicitly teaching EF skills more often than they are aware. For example, whereas 44% of teachers said they incorporate EF skills supports into every mathematics lesson (Figure 13), 67% said in every lesson they teach students to sustain their attention long enough to complete tasks and 62% said in every lesson they teach their students to use reasoning to clarify and reinforce their learning (Figure 14).

Indeed, a few teachers in focus groups said that they had realized through the survey and focus group discussion that they were already supporting EF skills to some extent in their teaching. One teacher described engaging students in activities designed to support their conceptual understanding and metacognition around strategy use by having them explain their thinking without using any operation words, for example.

Figure 13: Frequency of Teachers' Practices Related to EF Skills and Math Instruction

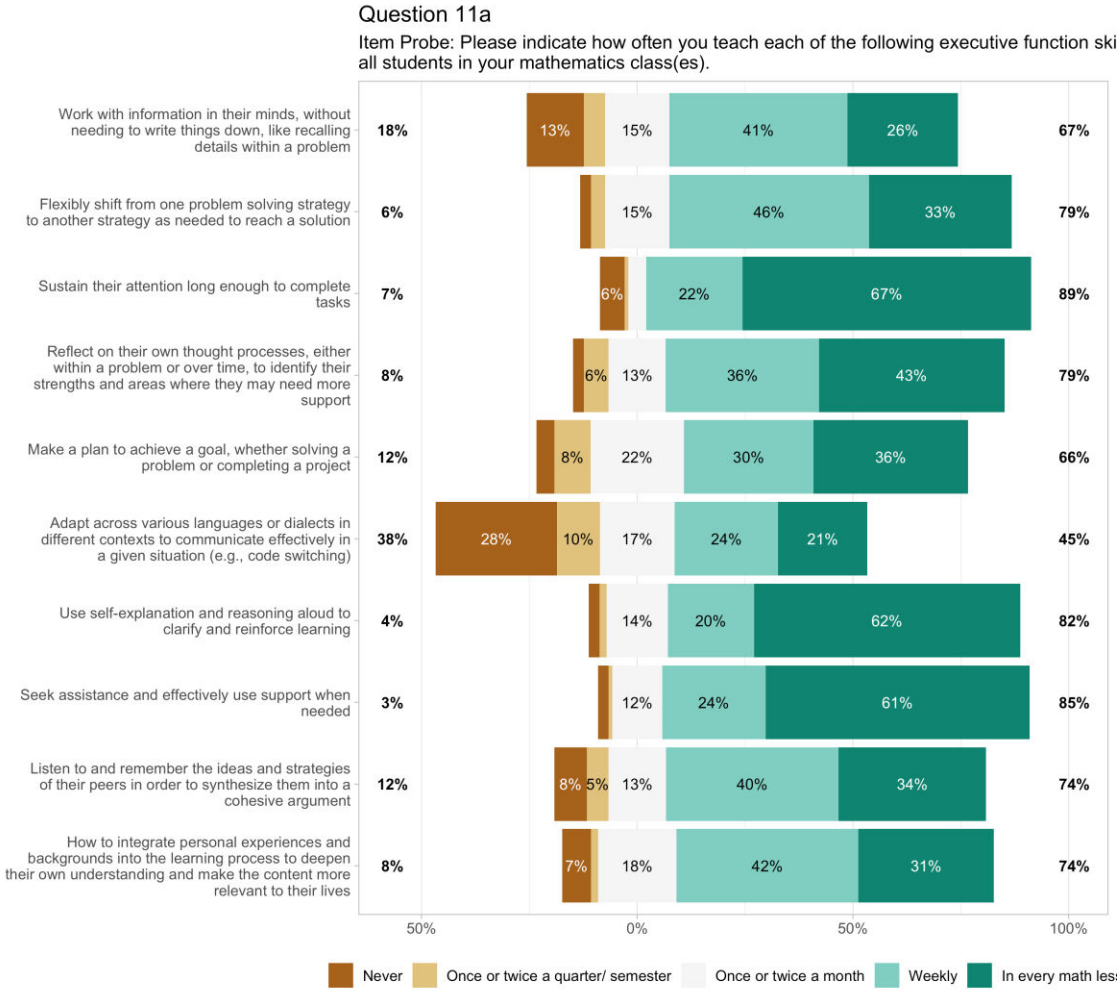


Several teachers described teaching their students to engage in behaviors that can help them to be successful mathematics learners. While these behaviors were not EF skills themselves, teachers implied that the behaviors were influenced by EF skills. For example, they taught their students to consult a provided list of problem-solving strategies, follow a series of steps to solve a word problem, and limit time spent on test questions to make sure they get to all of them. A few teachers also mentioned that approaching children with a positive attitude and encouragement helps them to take risks and view themselves as capable, which can help them persist through hard tasks. This example focused more on teacher behaviors to help students with lower EF skills than on explicitly teaching an EF skill.

Teachers also described scaffolds they provide to help students remember problem-solving strategies and processes, including anchor charts posted on the wall to remind students how to plan out the steps to solve a word problem. As we noted above, teachers tended to focus more on behaviors that would be influenced by EF skills, such as using planning skills to identify problem-solving steps, than on the EF skills themselves. This makes sense as they view these behaviors as increasing mathematics learning and comprehension. However, consistent use of scaffolds without reducing them may actually impede students' use of some EF skills; this should be

addressed in any PD efforts to support teachers' use of supports for student EF skills for mathematics learning.

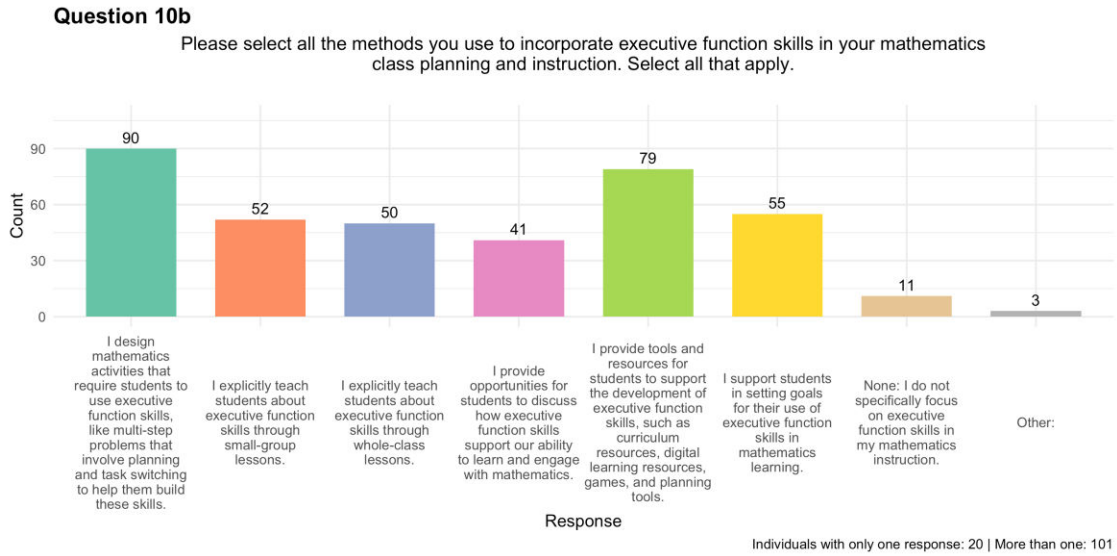
Figure 14: Frequency of Teaching of Specific EF Skills in Math



In what ways do teachers consider EF skills in their instruction, whether in planning or enactment?

The survey results indicate that teachers tend to focus on creating activities that give students the opportunity to use these skills, as opposed to activities involving discussion or direct instruction (see Figure 15). Teachers were asked to select all options that apply to them from a list of methods teachers might use to incorporate EF skills into their mathematics instruction, and almost all of them (84%) selected more than one method. The largest proportion of teacher respondents (74%) indicated that they design mathematics activities that require students to use their EF skills, such as multi-step problems. The second most commonly used method, selected by 61% of teachers, is to provide tools and resources for students to support the development of EF skills. As noted above, focus group responses seem to indicate that teachers may believe some of their instruction focuses on teaching EFs when it actually focuses more on teaching behaviors.

Figure 15: Methods Teachers Use to Incorporate EF Skills in Their Math Class Planning & Instruction



We also asked teachers to provide an example of how they have incorporated EF skills in their mathematics teaching. In some cases, teachers discussed supporting EF in terms of supporting mathematics problem solving skills, whereas others discussed supporting specific EF skills. In line with the themes we observed regarding teacher's perceptions of EF skills, many teachers described strategies related to teaching skills for organization, time management and prioritization. In Table 3, we highlight a few response examples for each of five EF skills. Of the below constructs **teachers primarily focused on planning and metacognition** and, as noted in Table 3, when teachers did discuss working memory and cognitive flexibility, they often referred to a broader set of skills than are typically considered 'EF skills'.

Table 3: How Teachers Have Incorporated EF Skills in Their Mathematics Teaching

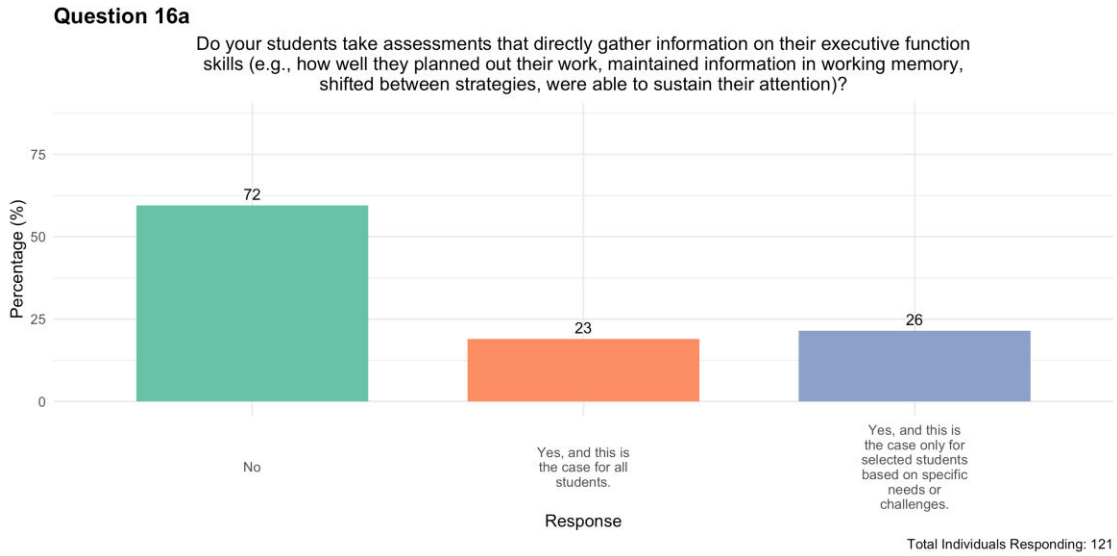
Question text: Please provide an example of how you have incorporated executive function skills in your mathematics teaching	
EF Skill	**Examples**
Working Memory *Note we do see in these responses many cases where teachers discuss memory in general, or long-term memory (retrieving mathematics facts)*	"When giving the example of how they can use EF skills, I use myself. I will say something like, "My brain just has a hard time remembering which step comes first. So **here's how I keep track of the steps I need to do**…." and then I model for the students what I would do. This allows them to realize that they are not the only ones with that particular EF deficit and they can still do hard things in spite of it" "Working Memory: Playing **memory games to reinforce lesson concepts.** Using mnemonic devices or songs to help students retain information."
Inhibitory Control	"During small groups, we discuss ways to regulate our emotions when we encounter harder problems. After reading the problem we strategize ways to plan out the problem, adapt to new strategies shared within the group

Question text: Please provide an example of how you have incorporated executive function skills in your mathematics teaching	
EF Skill	**Examples**
	and the importance to **resist distractions to solve the problems in a timely manner"**
Cognitive Flexibility *Note that while we might debate whether this would be considered cognitive flexibility, we noticed in teacher responses many viewed strategic flexibility and cognitive flexibility as the same.*	"By using problem-based learning and having students use a greater degree of autonomy. **I also explicitly teach students cognitive flexibility by trying different strategies**, and working memory when using the 3 read strategy" "Teaching different approaches to solving a problem and **encouraging students to be flexible** and choose the strategies that work best for their minds."
Metacognition	"In my mathematics teaching, I incorporate executive function skills by structuring lessons that support students' working memory, cognitive flexibility, and self-regulation. For example, I use explicit instruction and guided practice to help students break down multi-step problems into manageable parts, reinforcing their ability to plan and organize their approach. Additionally, I integrate structured routines, such as warm-up exercises and graphic organizers, to support task initiation and sustained attention. **To enhance metacognition, I encourage students to reflect on problem-solving strategies and explain their reasoning, helping them develop self-monitoring skills and adaptability when faced with challenging problems.** By embedding these strategies into daily instruction, I help students build the executive function skills necessary for mathematical success."
Planning	"When solving word problems and multi-step word problems **I explicitly discuss the importance of understanding the situation presented and creating a plan to solve the problem**. I model examples and think aloud to show my thought process as I do so. I model how to mark up the question and use scratch paper to organize relevant information, determine what information is needed, and make a plan to solve it. I give students time with support and independently to practice these skills and strategies."
Other related skills	"I teach students how to **organize the information** on the page and how to parse out what is needed from what is extraneous" "An example is teaching students **different strategies** to use in mathematics so they stay focused on the task at hand and build up their cognitive skills."

To what extent are students' EF skills assessed in some way? If so, how, and is the development of EF skills tracked across time?

Most teachers reported that **their students did not take any type of assessment that gathered information on their EF skills (60%).** Among teachers that reported some type of assessment of EF skills, 21% reported that these assessments were only provided based on specific needs or challenges and 19% said that all students EF skills were assessed in some way (see Figure 16). The 49 individuals who reported at least some assessment of EF skills (either full class or specialized) indicated that these assessments were primarily informal observations teachers conducted themselves as part of their classes (71%) or done as part of formal individualized student supports such as IEPs (65%) (see Figure 17). Of the teachers reporting students' EF skills were formally assessed, 19 reported this was only a few times a year (fall, winter, spring; or semesterly), whereas 17 reported testing on a more frequent basis (monthly or weekly) (see Figure 18). Informal assessment was reported to be conducted much more frequently with 28 reporting assessing on a weekly or daily basis (see Figure 19). In 87% of cases teachers report that information from these assessments is sometimes or always shared with them, and most teachers who are provided this information use it to inform their teaching (83%), diagnose student needs (79%) and identify formal supports needed to address student issues (79%) (see Figure 20). When asked how changes or progress on student EF skills are tracked (see Figure 21), 74% of teachers noted that this information was part of student evaluation records and/or was handled by special education or related services (53%).

Figure 16: Whether & Which Students Take Direct Assessments of EF Skills*



* Note that Q16a is a branching question - only individuals who responded yes to Q16a were asked the following questions.

Figure 17: How Students' EF Skills are Assessed (N=49)

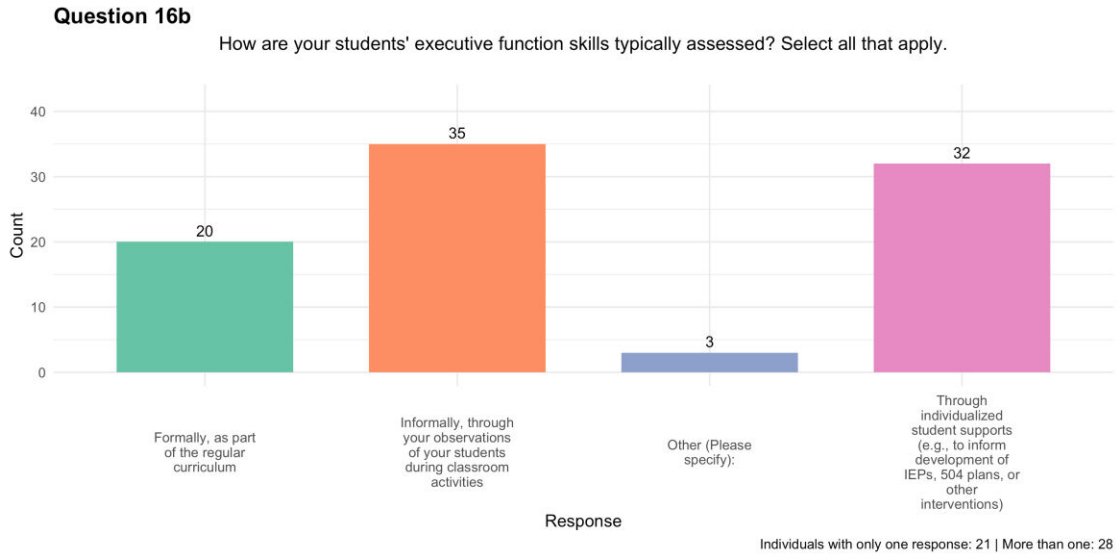


Figure 18: Frequency of Formal Assessment of EF Skills (N=49)

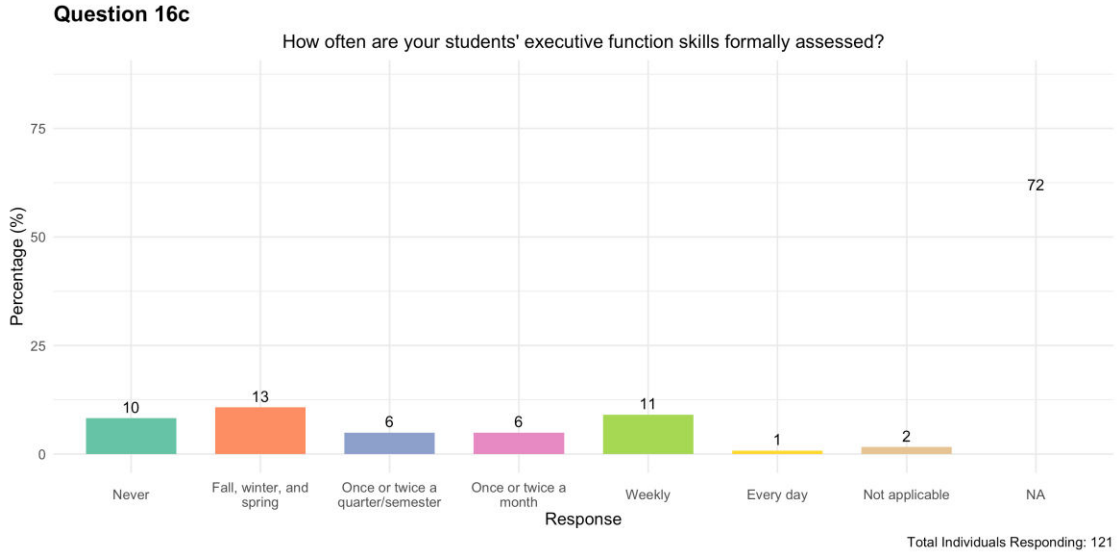


Figure 19: Frequency of Informal Assessment of EF Skills (N=49)

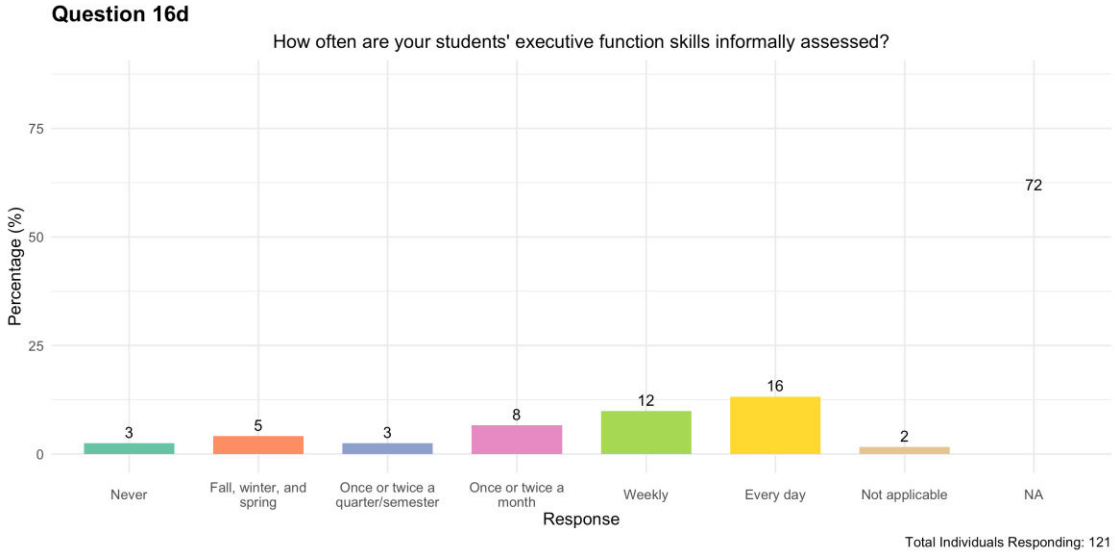


Figure 20: How Information from EF Skills Assessments is Used (N=49)

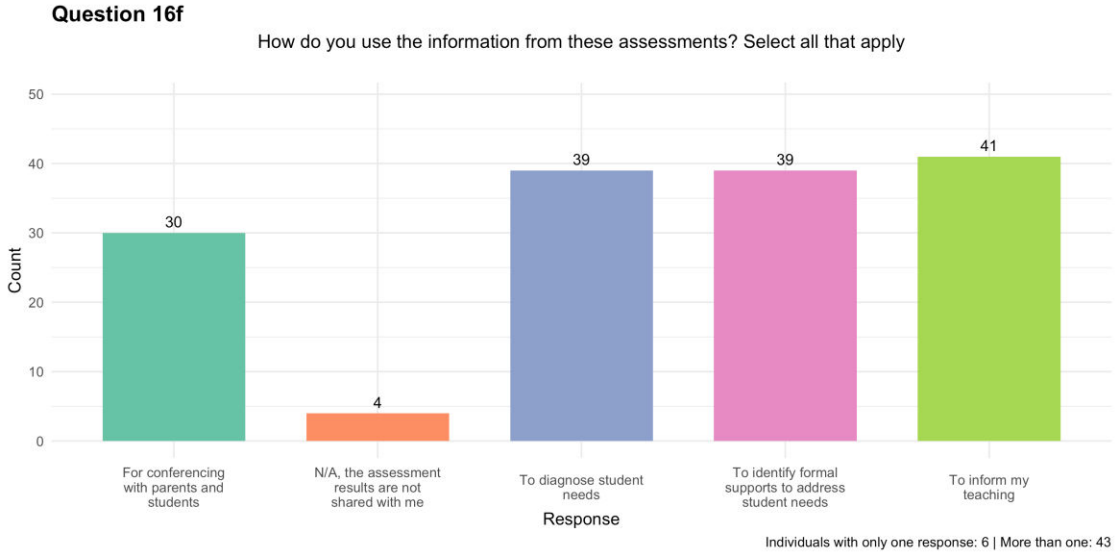
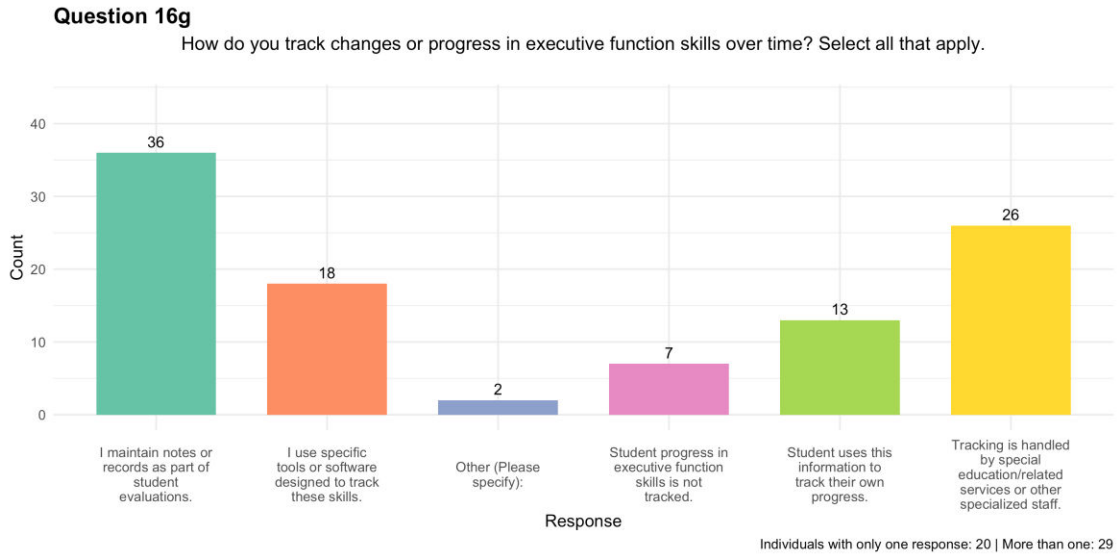


Figure 21: How Changes in Students' EF Skills Are Tracked Over Time (N=49)



Teachers who track EF skills formally or informally mentioned a range of different approaches in open-ended comments. In responding to this question one teacher commented, "*I am the one assessing as the teacher, as our school does not have any formal evaluation processes, but I pay attention as I use that information to help guide my lesson planning and best ways to meet student needs"*. Similarly, in a focus group a teacher described how she has her students tell her what they know and explain their thinking, to learn about students' depth of knowledge without making any assumptions up front. She explained that she had realized, as a result of the survey or focus group, that alongside the information she's getting about students' knowledge she is also getting information about their ability to engage in EF skills. She commented, *"I'm not purposely testing their executive function, but what I am doing is…checking their executive function. Now that I realize what I'm doing and some of these cases, I have them talk to me and explain to me a lot."*

Overall, teachers' responses to questions regarding how they assess EF skills suggest that class-wide evaluations of EF skill function are rare, and typically occur informally. This type of approach is likely to lead to inconsistent support for EF skills across the class, and in cases where evaluations are only focused on individualized supports further contribute to a 'deficit-based' view of EF skills as opposed to a broader perspective of these skills as strengths all students bring to learning.

4. Barriers Faced by Teachers with EF-related Efforts in Place in Their Classrooms

Key takeaways:

Most teachers indicated that it was difficult to focus on EF skills in their mathematics classes due to competing priorities and lack of instructional resources and training for teaching EF skills in mathematics.

Some teachers described the challenges of external teaching pressures, restrictions on the curriculum set by the district, a focus on student evaluation, not having enough time to incorporate EF skills instruction, and low district support.

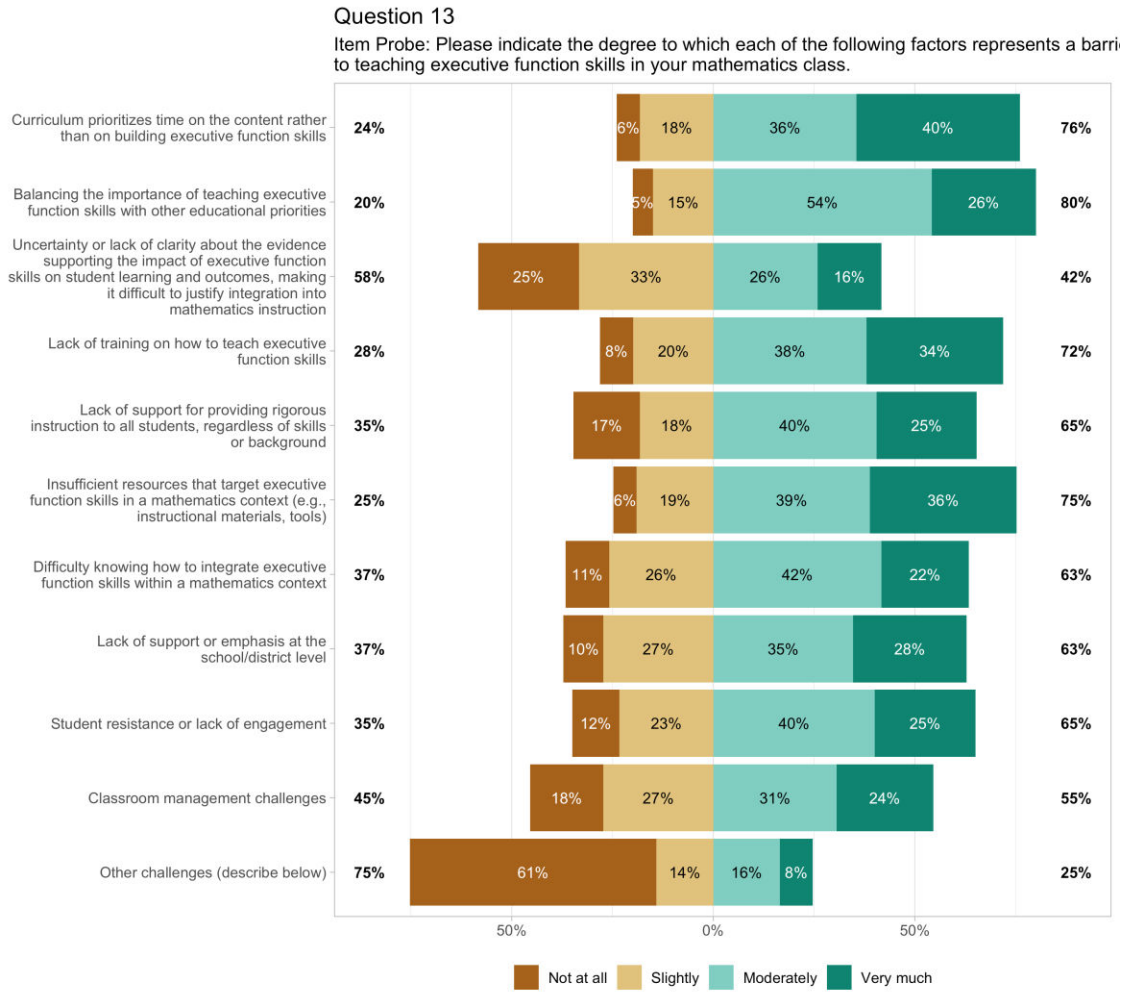
Only 4 out of our 121 respondents reported never discussing EF skills or incorporating supports and strategies for EF skills within their lessons, and the majority of teachers reported supporting EF skills on a monthly, if not weekly, basis. In the following sections we summarize findings on the barriers and challenges reported by teachers trying to incorporate supports for EF skills into their mathematics teaching, along with teachers' perceptions of how these supports influence students' mathematics performance and behaviors.

What challenges or barriers make it difficult to focus on EF skills in mathematics classes?

Overall, the primary barriers teachers cited for focusing on EF skills in their classes were related to **competing priorities** (76% indicated their mathematics curriculum prioritizes time on content over EFs, whereas; 80% indicated other educational priorities pose a barrier to teaching EF skills) alongside **lack of instructional resources** (75%) and **training** (72%) **for teaching EF skills in a mathematics context** (see Figure 22).

Twenty-five respondents (21%) described other challenges and barriers they face when focusing on EF skills in their classes. These responses primarily expanded on existing survey response options, specifically issues relating to external teaching pressures and to the complexities of teaching diverse and/or high poverty student groups. A few respondents also mentioned a lack of specific resources, like professional development or online tools.

Figure 22: Barriers to Teaching EF Skills in Math Class



External teaching pressures mentioned in open-ended comments included restrictions on the curriculum set by the district, as well as a focus on student evaluation, and not having enough time to incorporate EF skill instruction, as well as low district support. For example:

> *"The amount I have to cover to stay on the pacing guides creates struggles to spend the needed time on the essential EF skills."*
>
> *"Barriers with horizontal and vertical alignment - PLCs usually prioritize strictly curriculum-based mathematical skills."*
>
> *"District curriculum, guidance, lack of professional development and having time during the day or after school or before school to get together in PLCs with colleagues to help master functioning skills."*
>
> *"Main challenges for me include: classroom management with challenging behaviors; no support from the district, teaching time, trainings on teaching executive skills (within mathematics), and difficulty knowing how to integrate executive functioning skills into certain mathematics contexts."*

"At times, I feel challenged by administrators to produce data, analyze data, depend on data, over-evaluate my students, and it results in stress (unproductive stress). I feel challenged to produce "smart robots" while not being rewarded monetarily."

The complexities of teaching diverse and/or high poverty student groups covered a wider range of responses, including classroom/behavior management issues, language barriers, and absenteeism, as well as various teacher perceptions of their students, including lack of student exposure to EF instruction, low parent support, poverty and home culture, and students being below grade level, unmotivated, or having low self-confidence. Example comments regarding challenges include:

"In my setting my students are very low in mathematics. So, trying to teach at grade level feels virtually impossible. I often feel like we are juggling a lot- like trying to expose them to grade level mathematics, but being stuck catching them up."

"Behavior issues and avoidance"

"At times, Administration does not seem to see how language barriers greatly affect mathematics learners' progress."

"Metacognition can be really tough for kids, especially if they haven't really been taught about it or engaged with it before. It can feel like another barrier to teach children about this difficult concept in order to try and help them understand difficult mathematics concepts and I don't want to just get them totally overwhelmed and confused."

"Time and student/parent apathy."

5. How do teachers perceive or expect changes in students' mathematics performance or behavior related to incorporating EF skills for mathematics into their teaching?

Key Takeaways:

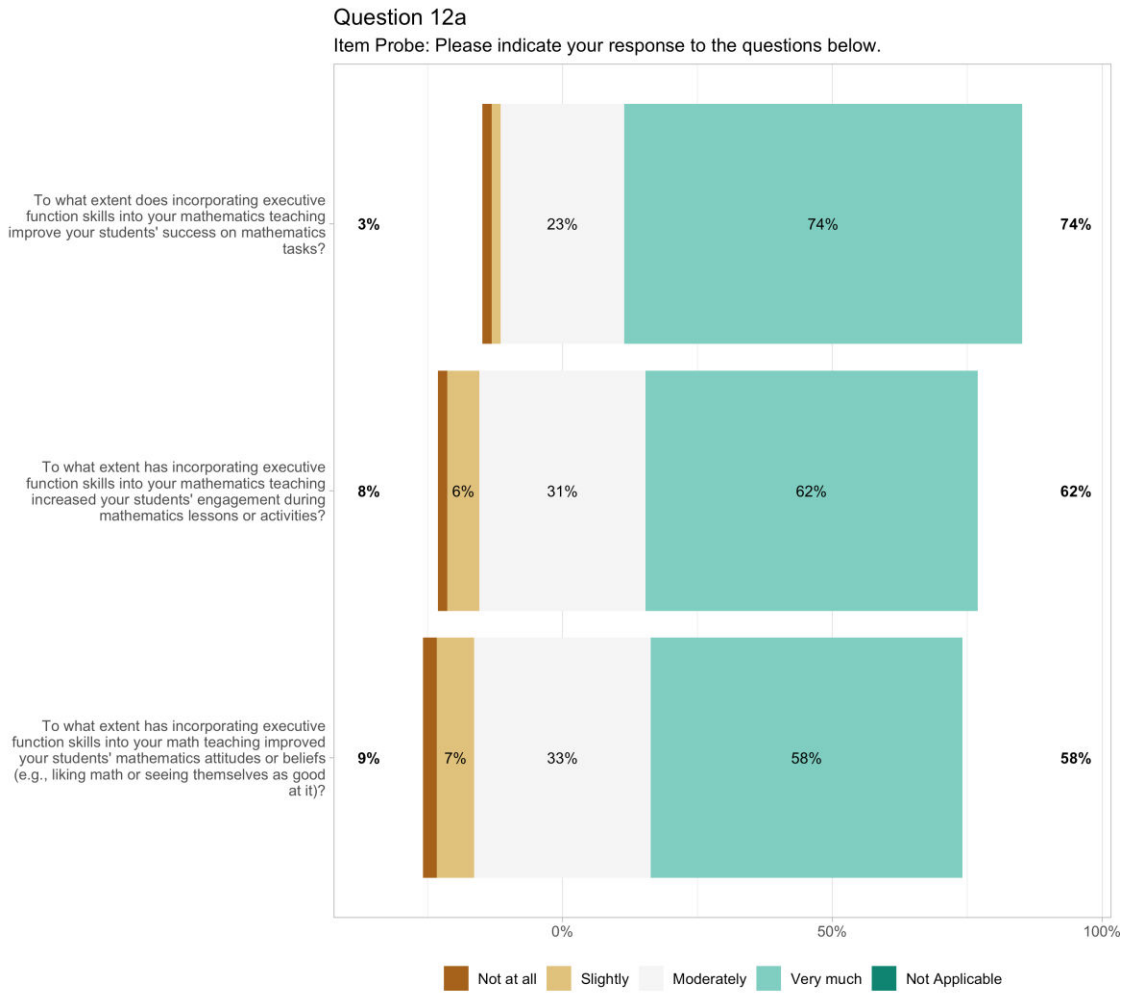
When incorporating EF skills for mathematics into their teaching, teachers perceived positive influences on student mathematics success, engagement in mathematics lessons, and students' mathematics attitudes and beliefs.

Many teachers provided examples of how they incorporated EF skills and how doing so led students to improve in specific areas including problem-solving, focus, explaining their problem-solving process, better planning, and more mathematics skills mastery.

Over 90% of our teachers reported that incorporating EF skills into their mathematics teaching improved student mathematics success, engagement in mathematics lessons, and students' mathematics attitudes and beliefs (moderately or very much) (see Figure 23). In open-ended comments on what happens when EF skills are incorporated in mathematics instruction, teachers provided a variety of examples both of how students responded when they incorporated these skills in their teaching and how students improved (See Appendix Q12b and Q12c for all responses). While these two questions were designed to separate out student response from student

improvement, upon reviewing responses we found that teachers often described student improvement in describing their responses, so we present this information together in the table below.

Figure 23: Extent to Which Incorporating EF Skills Into Math Teaching Improves Students' Math Success, Engagement, or Attitudes



While in many cases responses to these questions appear to capture general teaching strategies and behaviors (i.e., not specific to EF skills), we highlight a few relevant observations in the table below. We noted themes around **increased engagement, understanding, and confidence**.

Q12b question text: Please provide an example of how students respond or what you have observed when you incorporate executive function skills in your mathematics teaching **Q12c question text:** Please provide an example, if any, of how students improved in reaching mathematics objectives when you incorporate executive function skills in your mathematics teaching
"I noticed that when incorporating Ex functions in mathematics class, the students are **more self -aware of their strengths** in problem -solving strategies. They were also **more focused** and [h]ad less tendency to rush through the problem at hand."

Q12b question text: Please provide an example of how students respond or what you have observed when you incorporate executive function skills in your mathematics teaching **Q12c question text:** Please provide an example, if any, of how students improved in reaching mathematics objectives when you incorporate executive function skills in your mathematics teaching
"When incorporating various EF skills in class, I notice that the students that actually use the given skills and strategies have an **easier time staying engaged** and solving problems on their own. For example, when I can describe problem solving steps to my emerging bilingual students in Spanish, they can solve the mathematics problems given to them in English without much help from me. Especially after having them turn and talk with other students, they are able to score well on certain topics/questions."
I have noticed an increase in **students' ability to explain the solution process of problems** along with the strategies that they've executed to help them reach the solution, such as effective planning and memory skills.
I saw a lot of growth during group work when I started introducing EF. Students started being **more willing to share ideas** and my language learners were even raising their hands!
The organization of their thought processes allowed the students to demonstrate **better focus and improve their planning** for the steps needed to solve the problem or complete a project. This led to higher percentage of mathematics standard mastery.
I have a handful of students in every class that don't believe they're great at mathematics, but as they have increased their attention span in mathematics and their ability to describe various processes to each other, I find them becoming **more self-sufficient** over time and they are more able to navigate problems of varying difficulty with less and less assistance from me.

Section II. Interest in Professional Development (PD) on Incorporating EFs into Classroom Practice

The majority of teachers thought it was very important for both elementary school (77%) and middle school mathematics teachers (76%) to learn how to support students in developing and using EF skills as part of learning challenging mathematics (see Figures 24-25). We asked teachers several questions to better understand what professional development opportunities, practices, and resources they would prefer related to EF skills.

Figure 24: Teachers' Perceptions of the Importance of Elementary Teachers Learning to Support Students' EF Skills for Math

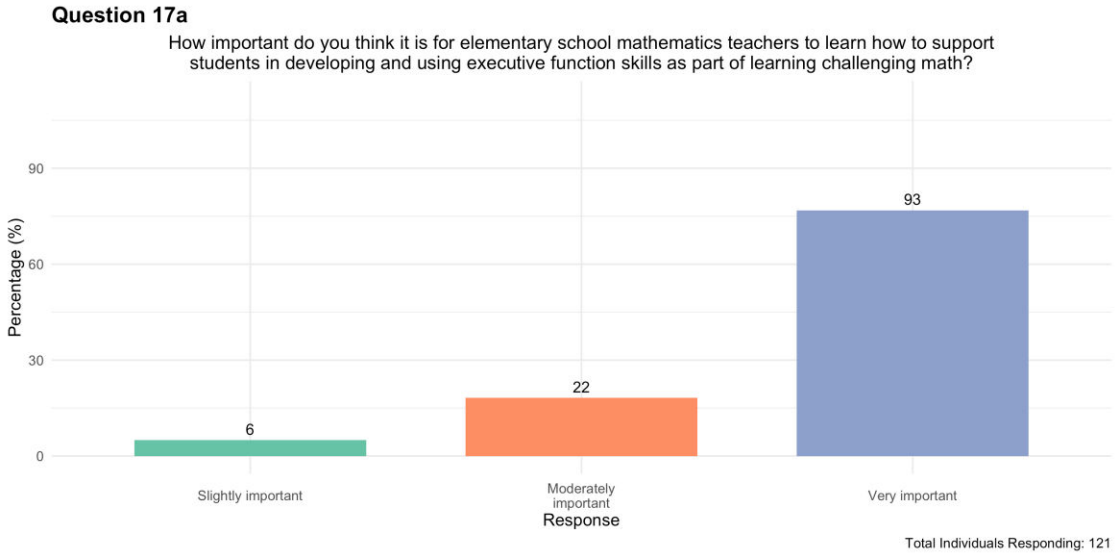
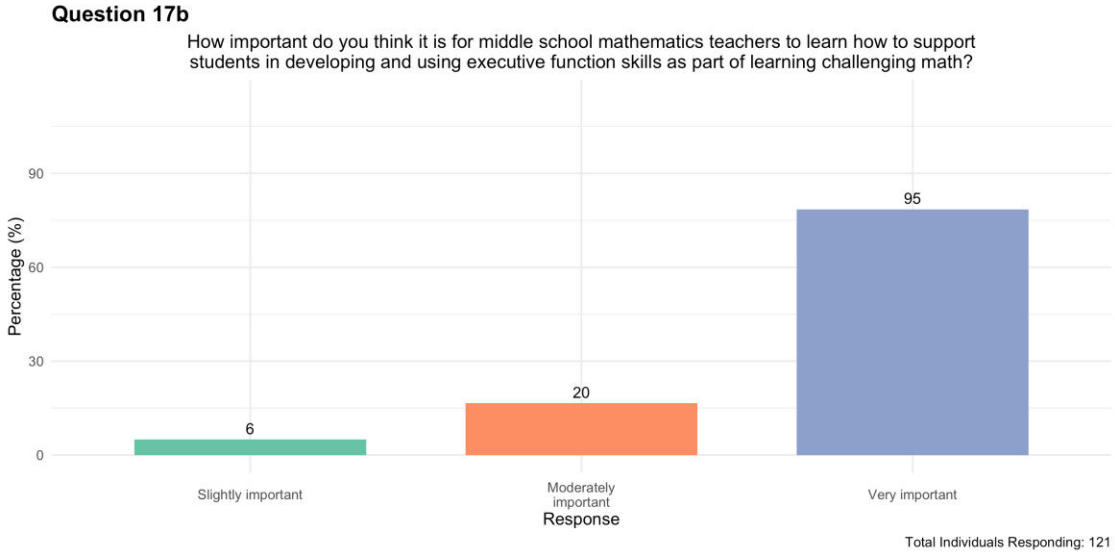


Figure 25: Teachers' Perceptions of the Importance of Middle School Teachers Learning to Support Students' EF Skills for Math



6. To what extent are teachers interested in PD related to EF skills?

Key Takeaways:

Most teachers indicated a strong interest in PD on how to support their students' EF skills for mathematics learning.

Teachers would prefer such PD focus primarily on practical, immediately applicable strategies to support their students, with less of a focus on what EF skills are. They requested opportunities to observe the strategies in action and even to practice them.

For many teachers, the ideal PD experience focused on EF skills for mathematics would take the form of a series of brief sessions incorporating peer mentoring, such as in a professional learning community, and tailoring lessons to their specific students' learning needs. At the same time, many teachers would prefer the PD be offered virtually.

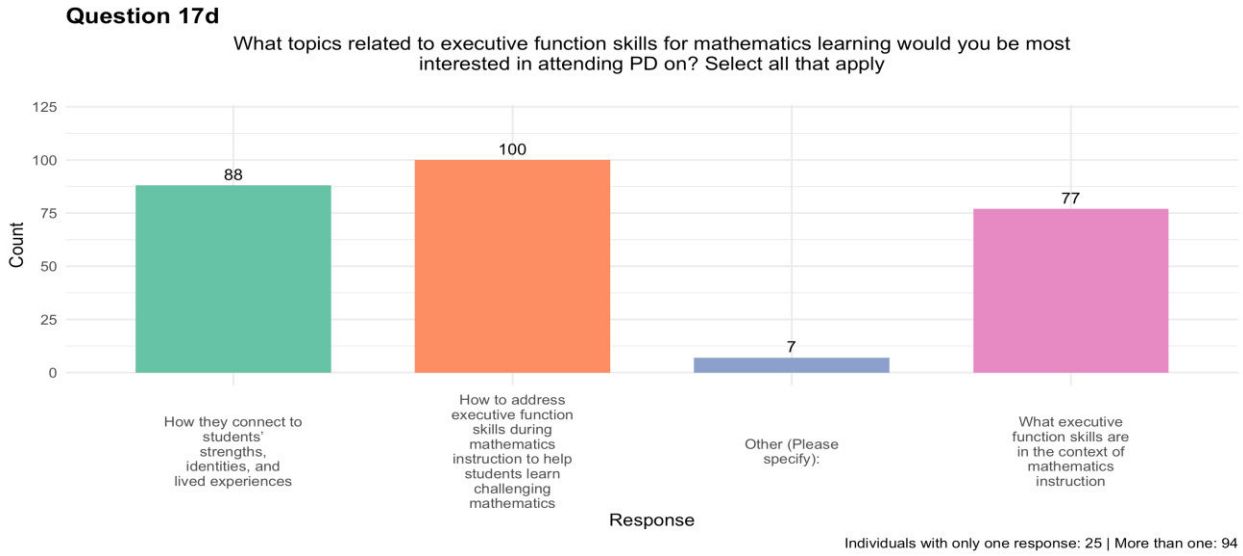
The majority of teacher survey respondents (62%) said they were very interested in PD on how to help all of their students develop the executive function skills that will help them learn challenging mathematics (see Figure 26). Another 26% were moderately interested. In contrast, only 2 teacher respondents were not at all interested in this PD.

Figure 26: Teachers' Interest in PD on How to Support All Students' EF Skills for Math

Preferred Topics for PD on Supporting EF Skills for Math Learning

When asked what topics they would like the PD to address, most teachers selected more than one of the options presented (see Figure 27). A full 84% would like to attend PD on how to address executive function skills during mathematics instruction to help students learn challenging mathematics. Seventy-three percent indicated an interest in PD on how to connect EF skills to students' strengths, identities, and lived experiences. Sixty-four percent selected the option of PD focused on what EF skills are in the context of mathematics instruction. These percentages align with focus group participant responses regarding specific topics on which they would like to receive PD.

Figure 27: Preferred Topics for PD on Supporting EF Skills for Math Learning



Across all three focus groups, teachers indicated a strong preference for PD on EF skills for mathematics learning to focus on practical strategies for goal setting and immediate implementation in the classroom. They suggested that such PD should briefly define EF skills and that the majority of the PD time should be spent learning actionable strategies that teachers could use right away in their classrooms, as soon as the very next day. Teachers suggested the training should focus on helping them to better support student risk-taking and participation in class discussions. Teacher comments highlighted a preference for building on existing teaching methods rather than starting from scratch; for example, PD could focus on integrating EF skills support into familiar strategies like productive struggle and "I do, we do, you do" modeling. They also suggested that professional development should connect to their existing curriculum and highlight strategies from that curriculum that support EF, making them explicit for easier adoption. Another request was that the PD focus on how to incorporate EFs into mathematics in a simple and streamlined way, without requiring pulling in pieces from other places.

In open-ended survey comments, teachers suggested that PD on how to support executive functions skills for mathematics should focus on topics including 1) how teachers can best assess the effectiveness of executive function skills in student achievement and growth, 2) how to identify deficits in EF skills, and 3) how to differentiate supports for EF skills for mathematics learning for students with learning differences and students on the autism spectrum.

Preferred Formats for PD on Supporting EF Skills for Math Learning

When asked about their preferred formats for PD to support EF skills for mathematics learning (see Figure 28), most teachers chose more than one option. The most popular options included ongoing PD sessions throughout the school year (65%) and a virtual class or workshop completed on teachers' own time (62%). The next largest group of teachers (39%) indicated a preference for a single workshop offered during the school day. Only 21% of teachers said they would like to attend an in-person class or workshop on their own time; this is not surprising, given the prevalence of virtual learning options.

Teachers elaborated on these preferences in focus group comments. They expressed a preference for a series of PD sessions (perhaps including at least one session per EF skill) to allow for time to discuss issues with other teachers and hear what's happening in other classrooms. This type of ongoing PD was especially encouraged for new teachers. A key suggestion was a format that brings experienced teachers together to support new teachers and each other, such as a professional learning community. It was noted that this type of PD experience can be hopeful and empowering for teachers, and especially so for new teachers, who always need mentoring.

In terms of timing and logistics, focus group participants suggested a length of 30 to 45 minutes per PD session. One noted, "…depending on what kind of school you're in, you all probably do several PD a month, and we already have so much to do as teachers. I would say nothing longer than 45 minutes. I mean short, sweet, to the point." It was also suggested that the PD should begin before the school year begins.

Figure 28: Preferred Formats for PD on Supporting EF Skills for Math Learning

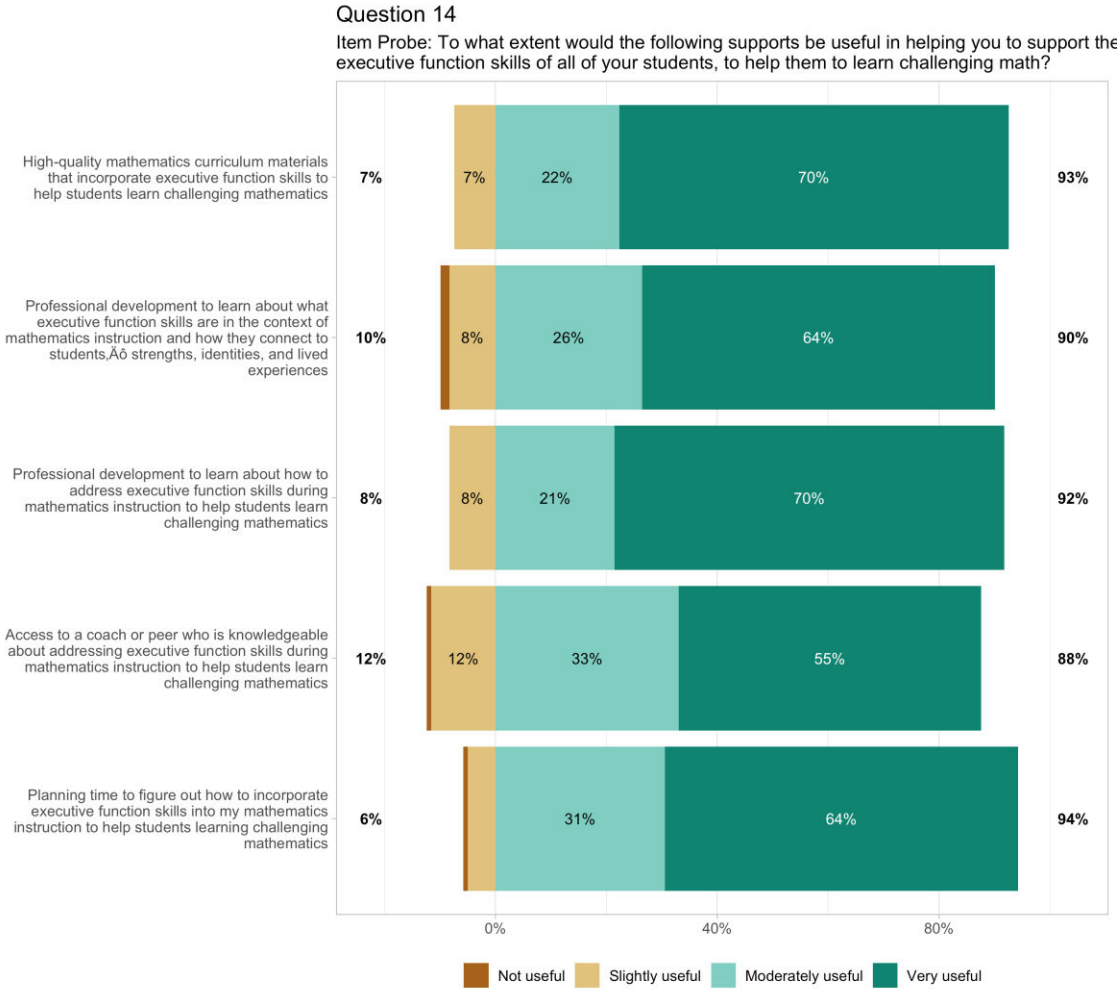
7. What supports do teachers need to incorporate EF skills into classroom practice?

When asked in the survey how much each of five supports would help them to develop the EF skills of their students (see Figure 29) to help them learn challenging mathematics, the majority (88%-94%) of teacher survey respondents indicated each of the five supports would be moderately or very useful. Supports rated as very useful by the largest proportion of teacher survey respondents (70%) included 1) high-quality mathematics materials that incorporate EF skills and 2) professional development to learn about how to address EF skills during mathematics instruction.

In focus groups teachers elaborated on what supports would most help them to support student EF skills for challenging mathematics learning, echoing many of their comments related to their preferences for PD on EF skills for mathematics. They emphasized the importance of explicit training on specific moves to aid students' EF skills, along with practical modeling and practice sessions. Teachers would find it helpful to share strategies with one another. They would also like to

receive periodic PD refreshers throughout the year, ideally packaged in an easy-to-deliver format, especially around test-taking periods.

Figure 29: Teachers' Perceptions of the Usefulness of Supports for EF Skills for Math



8. To what extent would teachers be more interested in using a mathematics learning product/approach in their classroom if it supported students' EF skills?

Key Takeaways:

Most teachers indicated a strong interest in supplemental programs supporting EF skills alongside mathematics skills.

Teachers would be more interested in such programs if they were easy and not time consuming to implement, aligned to state standards and tests, and worked well with their mathematics curricula.

They were interested in programs that gamified mathematics learning either in an online, video-game like experience or in a live play and movement based experience.

Factors that could increase teachers' interest in a program include the extent to which it supports students' critical thinking skills, the extent to which it's use is supported by district or school leaders, and research evidence and teacher testimonials on its effectiveness for supporting mathematics learning.

Survey results highlight that the majority of teachers (66%) are very interested in using a mathematics learning product or approach that also supports students' EF skills. Another 26% indicated they are moderately interested in such a product or approach (see Figure 30). Most teachers (70-77%) indicated a strong interest in supplemental programs supporting EF skills alongside mathematics skills.

In the three focus groups, we briefly described three examples of supplemental mathematics programs designed to support students' EF skills. The examples included 1) a program that helps grades 4-5 students learn fractions and engage their executive function skills through play and movement-based activities, 2) an online program that helps grades 4-5 students simultaneously strengthen their mathematics fact fluency and executive function skills through a series of games, and 3) an online program that helps guide students through the mathematics problem-solving process with built-in executive function and metacognition supports, and also creates a collaborative space for students to share their thinking. We then asked the teacher focus group participants what would lead them to be more interested in using a product like these examples, that also supports EF skills, and what they would want to know about the products to inform their decision. Finally, we asked them how purchasing decisions are made in their school or district for supplemental mathematics products or programs.

The teachers explained that they would be more interested in using a supplemental mathematics learning product or approach in their classroom if it was easy and not time consuming to implement. They also emphasized the importance of the program being aligned to state standards and state tests, because the reality is they must focus on preparing students for the tests. One teacher explained, *"I think the timing it takes to utilize that would honestly be the thing that attracts me to one program over another. If it was an easier lift to use and not so difficult to get started with and won't take up so much time because you still have to teach standards for your grade, but still being able to work on those executive functioning skills for students as well."* Some teachers would like any program or product they use to include the ability to track growth in students' EF skills.

Several teachers expressed interest in play- and movement-based products, and others agreed with them, noting concerns about excessive screen time and a belief that students learn and develop skills better through play and movement. They also noted that students may be more willing to take risks and develop related skills if the activity involves play and movement. They liked the idea of getting students out of their classrooms. Teachers also mentioned that this kind of program would allow them to see what they're doing, unlike in an online environment. However, logistical challenges such as the need for large spaces could pose a challenge to using play- and movement-based products.

Other teachers expressed interest in the online programs briefly described to them. They liked the gamification of mathematics learning and thought this would make the programs engaging for students. Options to track and get feedback on student learning would be particularly appealing to some teachers. It was also noted that they would generally prefer students to compete against themselves rather than each other if competition is involved. One middle school teacher said she would like to use the online program for grades 6-8 students a few times a week *"maybe 10-15 minutes during a center while I'm working with other students."* She expressed concerns about using it daily related to the challenge of monitoring students' online activity while working with another small group of students, *noting "These kids are so fast, they're going to click right out and go to some other site. Even though we have monitoring, but it's difficult to monitor students when they're online, if you're working with other students directly."*

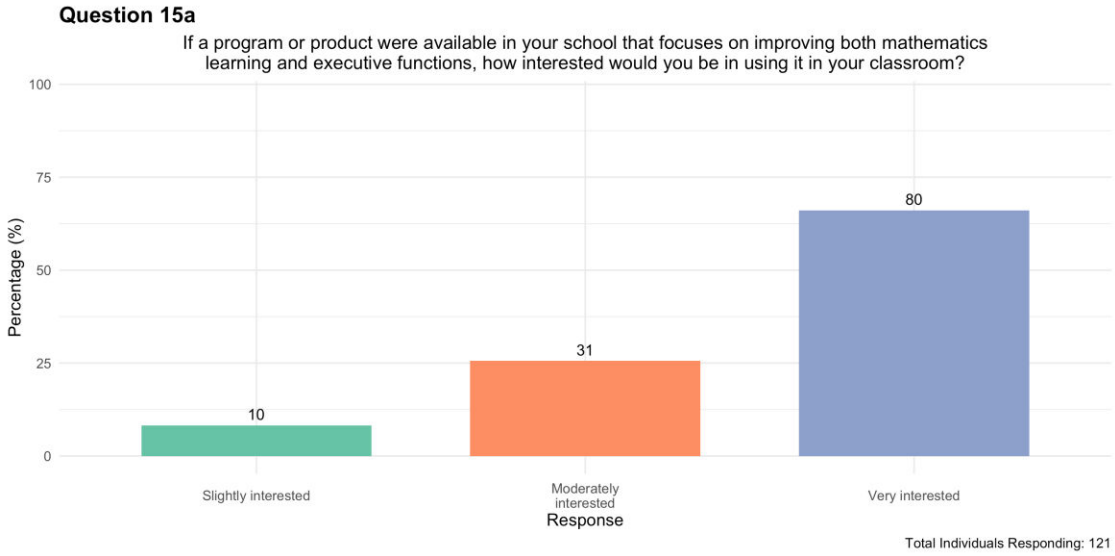
Other teachers across all three focus groups echoed these concerns about an online program requiring very close monitoring to ensure students are using it rather than finding ways to play their favorite games and videos. One noted, *"It's like the options that they have in the real world are just way too stimulating and too attractive. Like nobody at this point can develop a game that's gonna compete with their video games or with YouTube."*

A few teachers described using the online IXL program to give students additional mathematics practice during the school day but seeing through the program monitoring function that students are idle and not using IXL, presumably having navigated to another webpage in another tab. Teachers liked that they are able to monitor student engagement and redirect students to use the program, and also lamented how difficult it is to monitor students using online programs. They would prefer an online program that incorporates supports for EF skills, but first and foremost that program should have ways to monitor student engagement and block access to everything else online. Among middle school teachers already using online tools, a collaborative space for student interaction was viewed as beneficial.

In terms of who makes purchasing decisions, teachers largely said decisions are made by school or district administrators and that *"good administrators always get input from teachers. But that may not always happen."* In large districts school principals may be the ones making these decisions, whereas in small school districts such decisions may be made by district administrators. Some administrators may survey teachers to gather their suggestions and preferences for new supplemental mathematics learning products. A few teachers in small schools and teachers of students with disabilities said they are able to choose supplemental mathematics programs and administrators must approve their use. Teachers explained that they would be more likely to be approved by administrators to use a new program if it was backed by research demonstrating effectiveness, particularly in improving test scores, and if it aligned with state standards and, accordingly, the state assessment. One teacher noted, *"I'm constantly asked how does that align to the state standards? How does that align to the curriculum? How do you know that the rigor is the same? How do you know that it's gonna align with what they see on state testing? So as long as I can prove that it is aligning then I get the green light."* Cost is also a factor in all cases, and even teachers with leeway to choose their own supplemental mathematics products or programs are far more likely to be able to use a program if it is free for teachers.

Focus group participants also suggested making brief presentations to garner buy-in from school and district administrators by helping them understand how the program or product would directly benefit their students and teachers. They noted that the opportunity to try a program or see it in action could increase their buy-in, as would data on how the product compares to those already in use by teachers. One teacher said teachers and administrators need to know *"how does it compare to other tools that teachers use already. Some teachers use IXL, some curriculums have an online component built in. What's different or what's the same?"* One teacher who also supports other teachers in their instruction expressed skepticism, noting *"Executive function skills would be something nice, but it's also something we can just add on ourselves through professional development. As long as we have that knowledge base."* He also noted that his school already uses supplemental mathematics programs (iReady and Reflex) that "hit on all the topics and standards that are important to the standardized tests at the end of the year." Teachers also noted that districts are keen on tracking student growth and are more likely to be convinced to invest in a new program by research data demonstrating the program's effectiveness, particularly if it leads to positive test score outcomes.

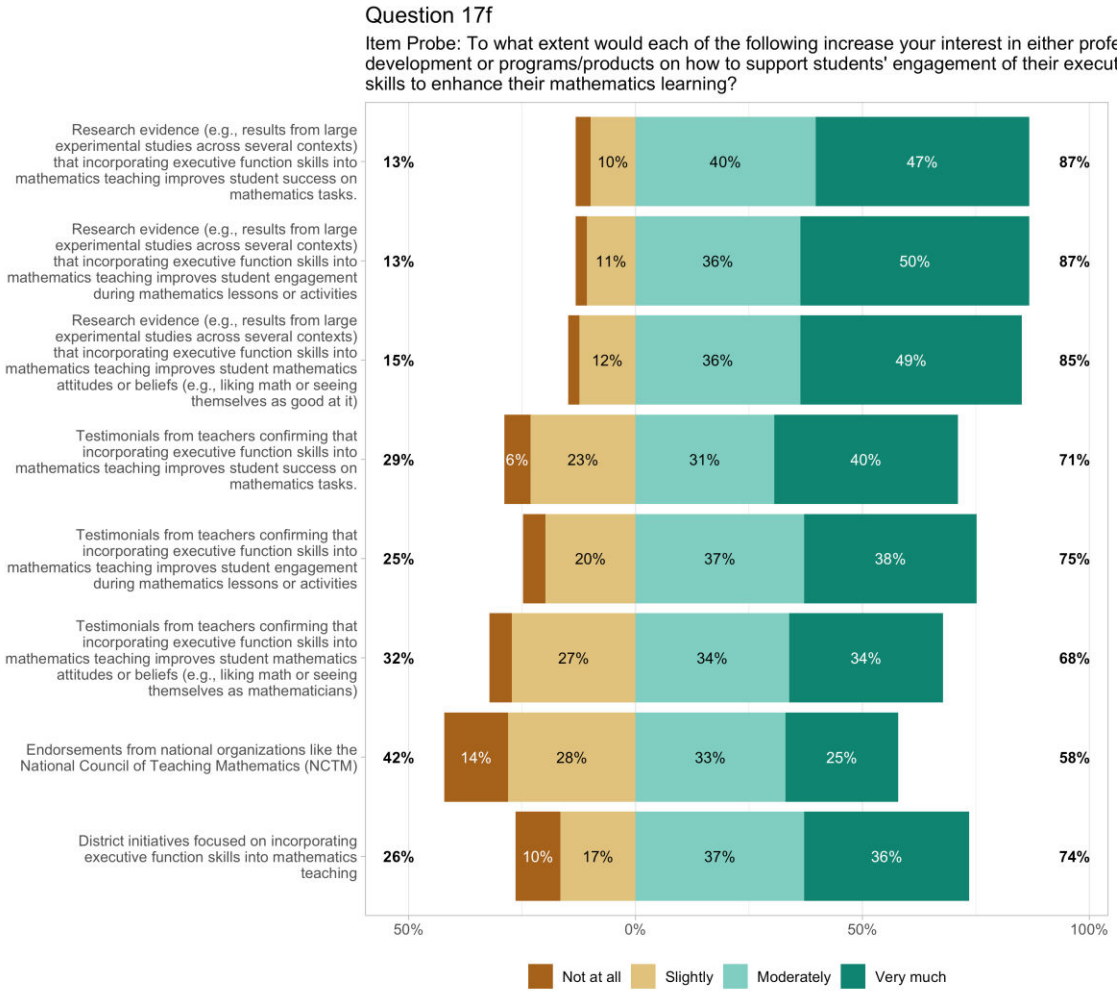
Figure 30: Teachers' Interest in a Product or Program to Improve both Math and EF Skills



What would increase teacher's interest in PD or programs/products that focus on EFs and mathematics?

When given a list of things that might increase their interest in PD or programs/products that focus on EF skills for mathematics learning, most teachers indicated that everything on the list could increase their interest moderately or very much (see Figure 31). The largest percentages of teachers responded that research evidence that incorporating EF skills into mathematics teaching supports student engagement (50%), students' mathematics attitudes or beliefs (49%), or student mathematics success (47%) would very much increase their interest in PD on how to incorporate EFs into mathematics learning. NCTM endorsement of EF skills for mathematics learning and teacher testimonials on the helpfulness of incorporating EF skills into mathematics learning were rated as likely to increase interest by the smallest percentages of teachers.

Figure 31: Extent to Which Various Factors Would Increase Teacher Interest in PD or Program to Support EF Skills for Math



In open-ended comments, fifty (*N* = 50) respondents identified several factors that would increase their interest in professional development (PD) or programs/products on executive function skills for mathematics learning. Factors included external recommendations for incorporating EF skill products or strategies in the classroom, incentives for participating in an EF professional development, and the PD focusing on them applying the content in their classrooms.

Many comments suggested that teachers would be more likely to be interested in an EF skill-supporting product or PD if it was supported by evidence or if teachers knew their district leaders supported teachers using it. Comments primarily focused on evidence of effectiveness, whether this be from research or testimonial evidence from students or teachers. District support was also mentioned as an important factor, including district-level buy-in and whether the district evaluated the teacher on EF skill application in the classroom.

> *"Student testimonials about how learning different EF skills changed their perspective and/or positively impacted their mathematics understanding and performance."*
> *"Proven results from real teachers as well as real life examples on how to incorporate it and how it works in classrooms."*

"Evidence on how EF instruction has improved mathematics achievement in specific schools."

Comments on EF skills PD tended to suggest options for gaining teacher buy-in, including flexible scheduling options like multiple and online session offerings and online support following the PD. It was also emphasized that teachers would need time to incorporate the PD lessons into their teaching, with one teacher suggesting a summer PD. Compensation for attending the PD was also recommended to increase teacher interest, and one teacher suggested offering specific content to support new teachers.

"Allowing for virtual sessions makes it much more likely and easier on me with a hectic schedule. Means of access is what comes to mind the most. If it's easy for me to access and or attend I am more than willing to make it work."

"It would be great to offer these programs with multiple date options. Often I find a professional development offering, but due to scheduling can not attend. Having multiple day and time offerings would allow me to pick a time that works best for me. Also, it would be great to see it in action. Perhaps including a video of teaching executive functioning skills in action may be beneficial to see."

"Honestly, offer them during the Summer if on personal time so I can implement when I return to school in the Fall. During the year or on my own time during the year is exceptionally challenging."

"Some teachers wouldn't participate without a pay incentive."

While one teacher suggested an online product for students to support EF skills, most comments discussed teachers' interests in incorporating EF skills into their existing teaching practices. Respondents strongly favored PD content that offered simple strategies and quick/easy application of EF strategies in their classrooms. Additionally, many suggested that learning such content should be accompanied by practical examples to see the strategies in action, with one teacher suggesting peer-feedback support. Teachers called out their interest in applying EF skill strategies in various subject areas in addition to mathematics. Using EF skills to support ELL students and to help bring students up to grade-level were also noted as important possible focuses of PD.

"Simplify the process, give easy tasks and activities to incorporate."

"Including resources that allow for less planning and prep for teacher."

"I think what will increase my interest is a tailored content that teaches mathematics with personalized cultural experiences that address the vast population of ELL students in my district."

"The biggest thing PD needs to have is explicit instruction and examples. Just explaining what a topic is and what students may or may not have in relation, will not be beneficial to teachers in our classrooms."

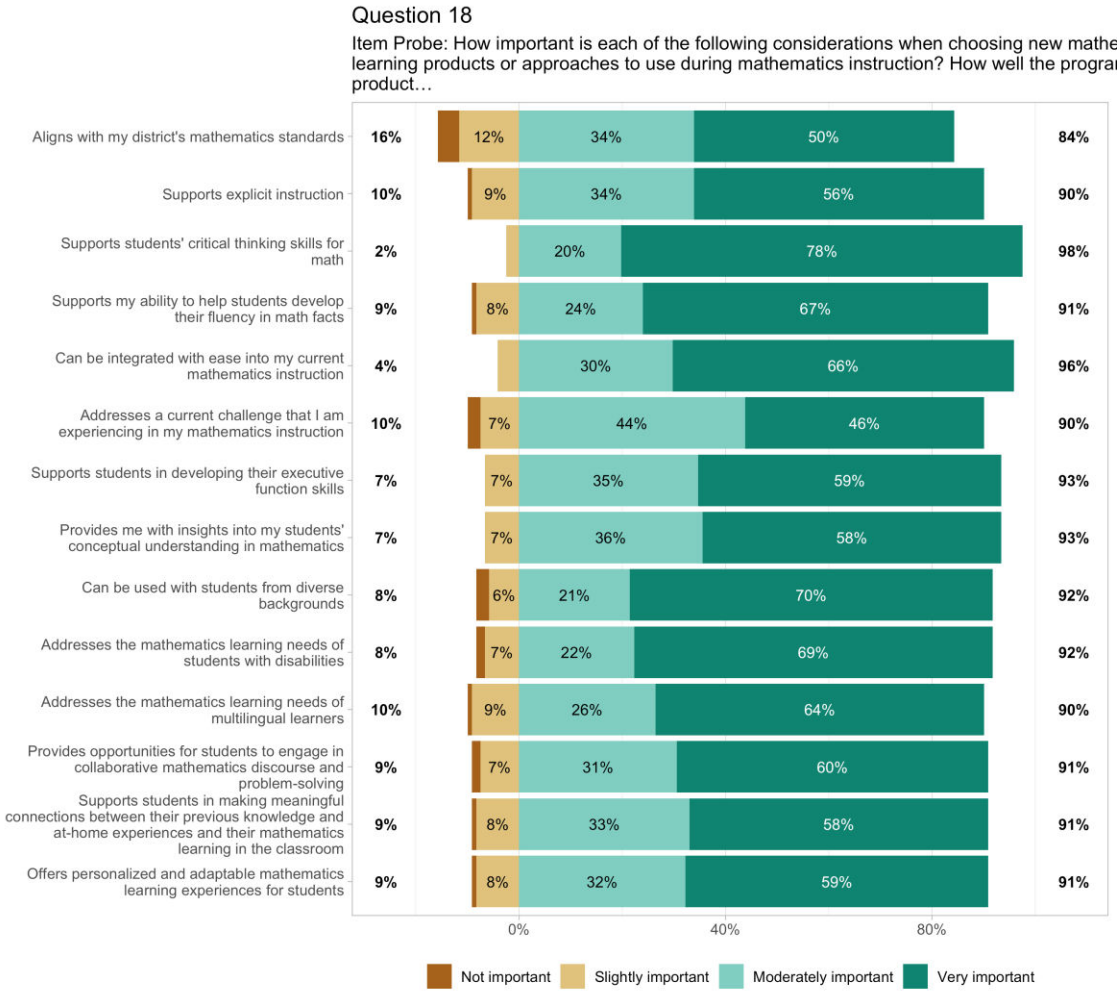
"I would like to have a PD on how we can back fill gaps from previous school years while in the same content as now."

What priority would teachers place on EFs, knowing they have lots of goals and considerations when choosing mathematics products?

On the survey the largest groups of teachers rated support for students' critical thinking skills (78%), usability with students from diverse backgrounds (70%), and addressing the learning needs of student disabilities (69%) as "very important" priorities when choosing a new mathematics

learning product or approach (see Figure 32). Other considerations rated as very important by large proportions of teacher respondents included supporting student mathematics fact fluency (67%), ease of integration with current mathematics instruction (66%), and addressing the mathematics learning needs of multilingual learners (64%).

Figure 32: Teachers' Considerations When Choosing a New Math learning Product or Approach



Conclusions & Recommendations

The survey and focus group findings point to several themes and conclusions addressing the key questions guiding the study. We extrapolate from these recommendations on how best to assist priority teachers so that they can support their students' EF skills for mathematics learning.

1. What do teachers in our priority teacher population know and believe about executive function (EF) skills for mathematics learning?

Priority teachers indicated familiarity with the concept of EF skills and generally agreed that supporting these skills helps all students engage in challenging mathematics. At the same time, teachers may not deeply understand some EF skills and may conflate them with general

behaviors and attitudes that support mathematics learning. This makes sense, given that teachers must focus their time and energy on the student behaviors that directly support learning.

On the survey, priority teachers indicated that they view EF skills as something students can develop and improve upon, rather than a fixed set of skills. They also indicated a preference for approaches to supporting EF skills for mathematics embedded within mathematics instruction and connected to students' cultural perspectives.

Based on the data, our recommendation is that designers of teacher PD on EF skills for mathematics should carefully consider what and how much knowledge about EF skills is necessary for teachers to successfully enact instructional strategies that support EF skills development to enable challenging mathematics learning. For example, is it sufficient for teachers to hold a very 'general cognitive skills' view of EF and see its value? Or is it more helpful, or even necessary, for teachers to deeply understand EFs such as Working Memory, Cognitive Flexibility, and Response Inhibition in order to use and see value in programs to support EF skills? Future research could also address these questions. Regardless of how deeply teachers must understand EFs in order to successfully support EF skills for mathematics, many teachers may still need to learn more about the importance of EF skills for mathematics learning.

2. How do they approach EF skills in their teaching practice?

The survey and focus group data indicate that many priority teachers are already using some strategies that support students' EF skills for mathematics learning, or support behaviors related to EF skills. Moreover, most teachers are not assessing students EF skills. Based on these findings, our recommendation is for designers of teacher PD on EF skills for mathematics learning to take a close look at instructional strategies teachers are already using that implicitly or explicitly support their students EF skills for mathematics learning. Such an approach values and builds upon teachers' expertise. Efforts to help teachers support EF skills for mathematics learning may need to incorporate assessments of students' EF skills within the context of mathematics.

The study findings suggest that many priority teachers who are familiar with EF skills may have primarily viewed EF skills for mathematics from a deficit perspective. This may be related to the fact that, in many cases, teachers' knowledge of EF skills is related to their work with students with special needs or disabilities, who tend to be approached from the perspective of deficits in need of support. Our recommendation is to incorporate into EF skills PD and supports opportunities to discuss and practice asset-based framing of student skills and needs.

3. How interested are they in professional development to help them support students EF skills to enable them to learn and engage in challenging mathematics, and what would they prefer it look like?

The study findings suggest that priority teachers are highly interested in PD on how to support students' EF skills for mathematics learning, and that such PD would ideally focus most on building skills through practice and take the form of an ongoing series of brief sessions involving peer teachers (similar to a professional learning community (PLC)). Each session could focus on helping teachers understand, observe, and practice a specific EF skill and the strategies and moves necessary to support it with students with a range of prior experiences and strengths. In focus

groups, priority teachers noted a preference for opportunities to observe other teachers successfully implementing techniques or strategies to support students' EF skills for mathematics learning. They felt that, while such PD could include time for learning *about* EF skills for mathematics learning, the bulk of the PD time should focus on *how* to support students' EF skills for mathematics. Focus group participants also suggested tailoring the design of each EF in mathematics-focused PLC to build upon and integrate with the mathematics curricula in use by teachers.

In summary, the study findings point to a need for opportunities for teachers to try out and practice the work of supporting students' EF skills in mathematics, but in risk-free environments, such as through peer rehearsals or digital teaching simulations. They also suggest a preference for PD on supporting students' EF skills in the context of students' culture, identities, and strengths.

4. How interested are the priority teachers in using a mathematics learning product/approach that supports students' EF skills, and what would these products or approaches ideally look like?

Priority teachers reported a desire for actionable strategies to support students' EF skills in mathematics, aligned with their existing curricula and standards. They also reported interest in supplemental mathematics programs or products to support students' EF skills. Data suggest that teachers' interest in PD, programs, or products to support EF skills for mathematics would be bolstered by research evidence and testimonials documenting improvements in students' mathematics success, attitudes toward mathematics, and/or engagement in mathematics lessons. Teachers' interest would likely also be bolstered by evidence that a supplemental mathematics program or product that supports EF skills for mathematics learning may be more effective than a supplemental mathematics program that does not support EF skills. Finally, the study results suggest that interest could also be increased through demonstrations giving teachers and school and district leaders opportunities to experience the supplemental mathematics program or product.

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Appendix A. Methodology

Study Sample

Teachers of the priority student population—grades 3-8 Black and Latino students and students experiencing poverty—who teach mathematics were recruited for the study from the ETS Educator Insights Panel (EIP). The EIP includes about 8,000 teachers from across the U.S. who have agreed to participate in research projects focused on feedback and insights from educators. The EIP teachers teach across all grade levels, subjects, and school locations, including in urban, rural, and suburban schools. The EIP database includes 1,056 grades 3-8 teachers of mathematics who indicated they teach in a Title I school, which is a proxy for teaching the priority student population. This is because schools receive Title I funds when the majority of their students are from families living in poverty (Kainz, 2019) and Black and Latino students make up a large proportion of students experiencing poverty. These 1,056 teachers were approximately equally distributed across urban (N=377 or 36%), suburban (N=330, or 33%), and rural locations (N=349, or 31%). More of them indicated teaching across elementary (N=746, or 71%) than middle (N=536, or 51%) grades[1]. They were located across all 50 U.S. states (N=1,038), the District of Columbia (N=16), and American Samoa (N=2).

Study invitations were emailed to the 1,056 EIP teachers, inviting them to complete a survey on the Alchemer platform beginning with screener items on the study eligibility criteria. Respondents were deemed eligible for the study if they indicated that they teach mathematics to students in any of grades 3-8 and they primarily teach Black or Latino students. They were also asked if they primarily teach students experiencing poverty, but this information was used only to describe the sample and not to determine eligibility for the survey. To ensure roughly equal representation of elementary and middle school teachers, quotas were used to limit the number of each to 65 maximum. Eligible teachers were then invited to review and sign the study consent form and, subsequently, to complete the survey, which had an estimated completion time of 30-40 minutes. A total of 124 eligible teachers completed the survey; three were excluded from analyses because they failed items included to check respondent engagement and attention. Thus, the final survey sample included 121 teachers of our priority student population (see Figure 33). As promised in the recruitment email, respondents were provided with a $50 incentive payment for completion of the survey.

All survey respondents were asked to indicate their interest in a 90-minute focus group addressing the same topics as the survey, and 107 survey respondents indicated they would be interested in attending a focus group. Of these 107, we invited 21 to participate in one of three 90-minute focus groups. They were selected to represent an approximately equal proportions of grades taught, years of teaching experience, and urban, rural, or suburban locations. The final focus group participant sample included 16 teachers teaching grades 3-8 mathematics across various locations, primarily in public schools and in general education or inclusion classrooms serving students with disabilities alongside their peers. All but one of the participants opted to receive the $150 incentive payment for participating.

[1] Teachers could select multiple grades, so totals do not sum to 100%

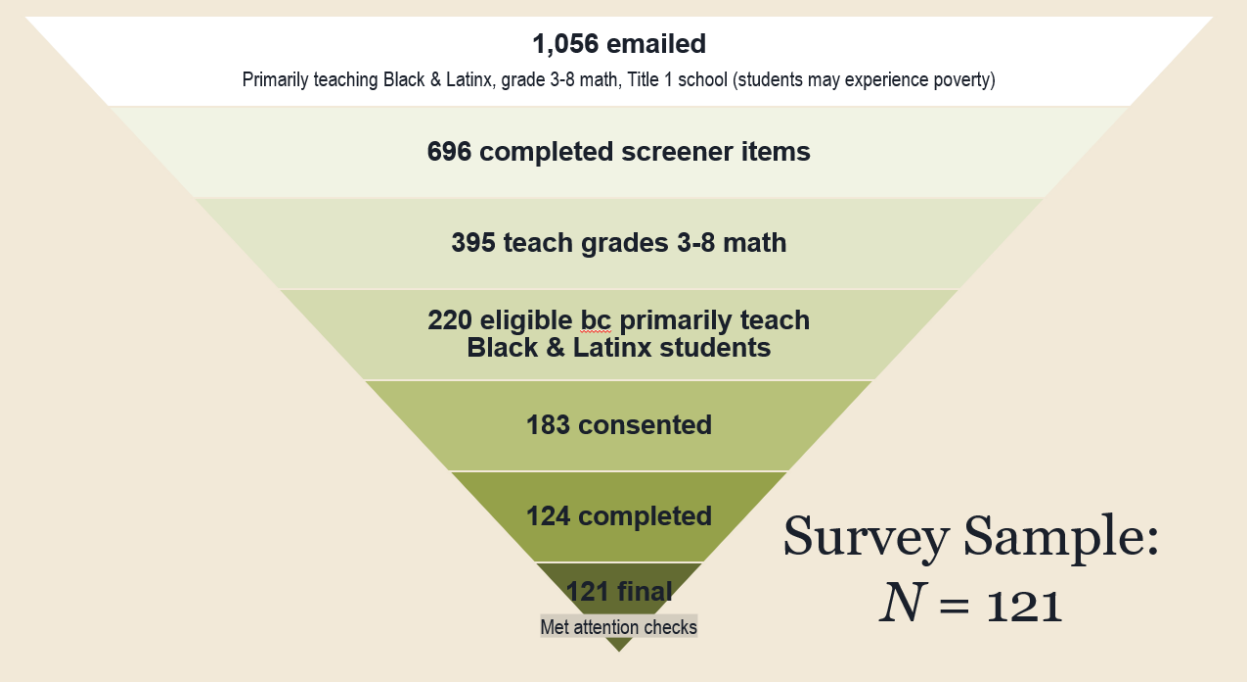


Figure 33. Teacher Recruitment via the ETS Educator Insights Panel

The final teacher survey sample included teachers reporting a range of characteristics and teaching assignments (see Table 4). Teachers reported a range of years of experience; 44% had less than 10 years and 36% had 10-20 years of classroom experience (average=12.2 years). While all teachers had indicated they primarily teach Black and Latino students, 96% indicated they teach students experiencing poverty. Almost all (95%) had taught students with Individualized Education Plans or 504 plans. The vast majority (88%) indicated they taught in Title 1 schools or schools where more than 50% of students qualify for Title I supplemental funding. Not surprisingly then, 78% taught in public schools and another 16% taught in charter schools. In terms of location, just over half taught in urban schools and another 35% taught in suburban schools. Just under half of respondents indicated that they taught elementary school, 41% indicated teaching only middle school, and 10% indicated they teach in both settings.

Table 4. Teacher Characteristics

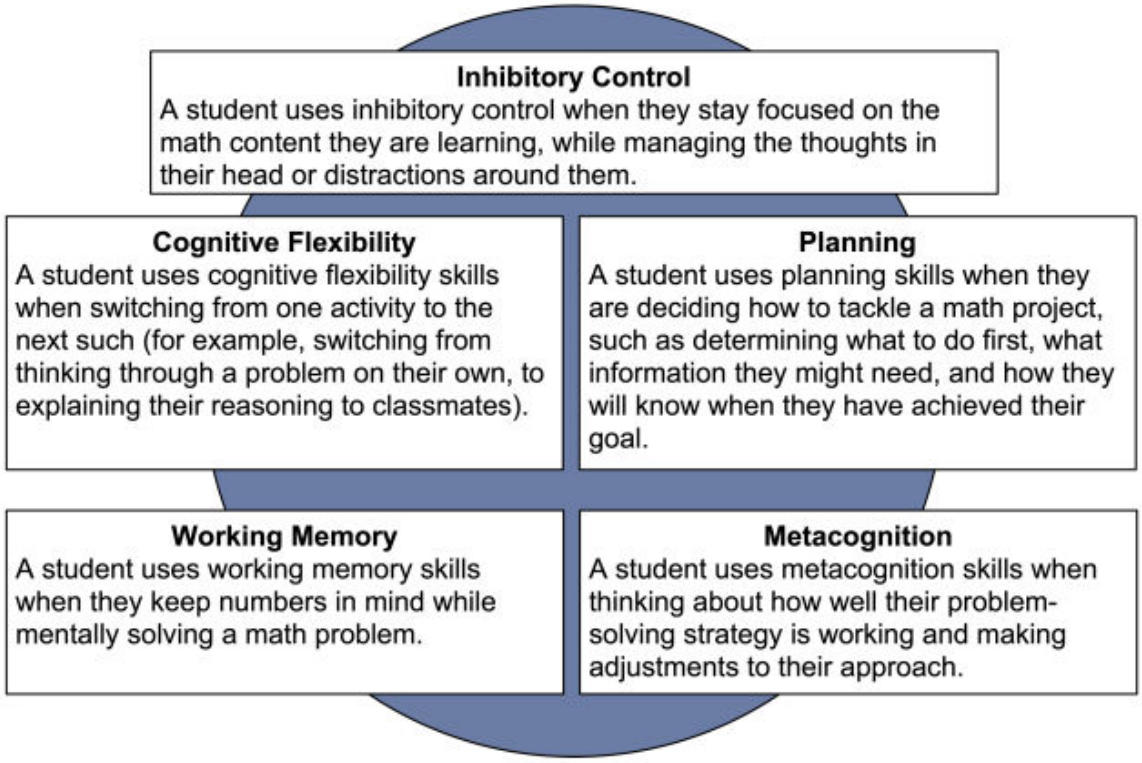
Years Teaching			**Grade level taught**			**Classroom type**		
Category	N	%	**Category**	N	%	**Category**	N	%
<5 years	22	18%	Both elementary & middle	12	10%	Inclusion & general education (GenEd)	38	31%
5-9 years	32	26%	Only elementary	58	48%	GenEd class	44	36%
10-20 years	43	36%	Only middle	50	41%	Inclusion class	24	20%
>20 years	23	19%				Other class only	14	12%

Instrument development

Research suggests that the EF skills of cognitive flexibility, working memory, and inhibitory control are important for mathematics learning (Bull & Lee, 2014; Cragg & Gilmore, 2014). To inform development of the study instruments, we reviewed this research along with existing surveys of teachers' perceptions of EF skills for teaching across multiple subjects and in general developed by Biecheler (2019) and a survey of teaching practices and teacher beliefs developed for a study by Rapoport and colleagues (Rapoport et al, 2016). We also reviewed published research on the cultural relevance and context-specific nature of EFs for mathematics learning (Doebel, 2020; Miller-Cotto et al, 2022).

Using the research questions to frame the survey items, we began by including sets of items from prior surveys and developing new items as needed to address the study research questions and goals. In addition to groups of close-ended, likert-scaled items measuring the focal constructs, the survey includes many open-ended items to gather data on the reasons for responses. We included in the survey a definition of EF skills for mathematics learning to ensure all survey participants had the same understanding of the general concept of EF skills and the five skills specifically of interest for this study. The definition and an accompanying graphic were developed into a flyer linked to in the survey and also shared during the focus group sessions (see Figure 34 below).

Figure 34. Focal Executive Function Skills and Math-Focused Examples of their Use



The survey questions and EF skills definition and examples were refined in collaboration with EF+Math program staff and several members of their educator advisor team, comprised of current and former educators. In addition, we obtained feedback on the survey items from ten current

grades 3-8 mathematics teachers from the target population to confirm content validity and ensure the survey language was clear and accessible. The focus group protocol was also developed iteratively and collaboratively with EF+Math program staff to gather examples and insights into what the priority population teachers know about EF skills, how they view them and incorporate them into teaching, and their professional development needs and interests around EFs for mathematics learning. Some topics were more deeply covered in the survey rather than the focus group protocol, and vice versa.

Data Collection & Analysis

The online survey was open for approximately one week, during which two reminder emails were sent to survey invitees. As survey data were received, they were reviewed in batches for completeness and to determine if respondents were engaging fully and passing attention checks included in three item blocks. After the survey was launched and prior to the focus groups, survey responses were reviewed to determine if any additional focus group questions were needed to clarify the "how" and "why" behind the close-ended survey responses.

Survey data were analyzed to produce response frequencies for the full sample overall and by several teacher characteristics (see separate results appendix document). Making all close-ended items required prevented any item-level missing data, resulting in one sample size. Teacher characteristics variables were derived from responses to the three Question 19 sub-items addressing grades taught, years of teaching experience, and type of classroom (see categories in Table 4). Note that disaggregation of survey responses by whether teachers taught in a Title I school was not possible, as 88% indicated that they taught in Title I schools. The separate results appendix presents survey responses disaggregated by the three Question 19 sub-items. However, these results should be interpreted with caution given that some cell sizes/groups are quite small.

We thematically coded (Clarke & Braun, 2017) the focus group transcripts and open-ended survey items with codes aligned with the focus group questions and research questions, as well as codes emerging from the data. The coding process involved a lead coder identifying and applying an initial set of codes followed by a second coder reviewing the coding and discussing points of clarification and additional codes needed. Coding themes were summarized across all data sources addressing a given topic. Coding themes were triangulated with close-ended survey item results to connect examples of the trends identified by the item responses.

Appendix B. Influence of Training on Practice

We explored the possibility of conducting additional analyses to explore the extent to which EF training and resources (Q5 and Q6) may influence teacher practices around incorporating EF skills in mathematics teaching (Q10 and Q11). However, the survey data are cross-sectional and, thus, will not support causal claims regarding the extent to which teachers' reported prior EF skills training experiences influenced their reported teacher practices. We opted, instead, to explore differences between teachers who indicated that they participated in PD focused on EF skills specifically in mathematics with those attending PD focused on EF skills generally or in other contexts (Q6a).

Both Q5 and Q6 are 'select all that apply' questions and most teachers selected multiple responses. This complicates our ability to compare one group to another group, since in many cases the same individual is in both groups. Thus, we suggest running separate comparisons between those individuals who select a group and those who do not. Additionally, we can provide a frequency table for the groups showing where there are especially high occurrences of both groups being selected by the same individual.

Q5 Binary categories created:

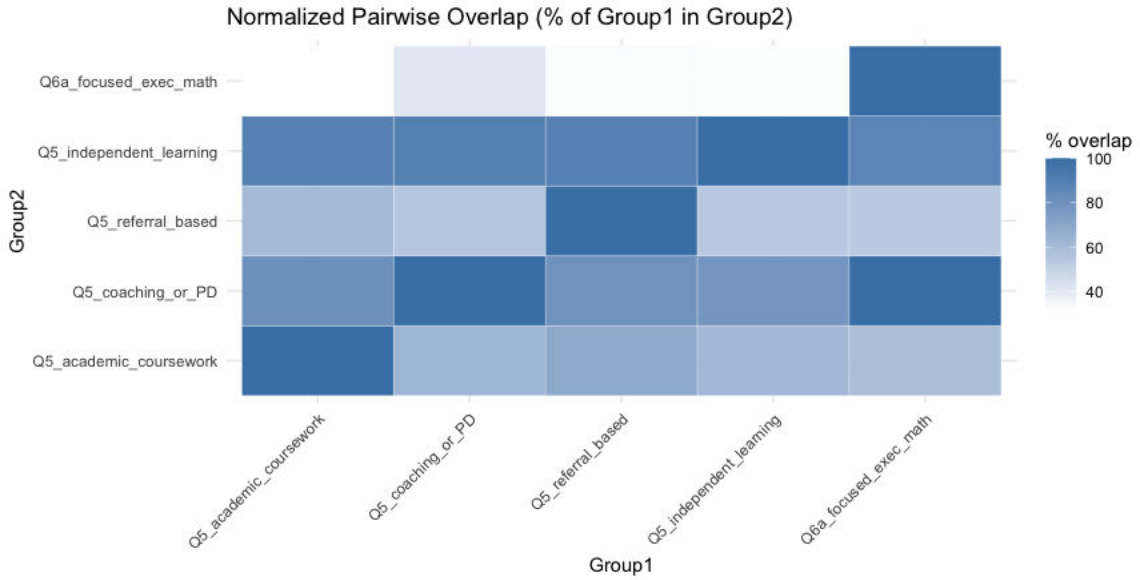
1. Academic course work: **74** out of 121
2. Professional development OR coaching: **94** out of 121
3. Independent learning OR observations: **107** out of 121
4. Referrals or IEPS: **65** out of 121
5. *We did NOT create an NA group since this group only contained 3 individuals.*

Q6a Binary categories created:

1. Focused on EF skills specifically in mathematics or not: **39** out of 94

We used a normalized pairwise overlap graph (see Figure 35) to view the overlap of responses across each grouping variable. The graph suggests two trends. First, all 39 teachers who received PD focused on EF in the context of mathematics responded that PD contributed to their awareness on Q5. Second, there is generally a very high co-occurrence of the 'independent learning' response alongside all other response options (87-89%), as well as high co-occurrence of coaching/PD with other responses (78-81%). This seems likely due in part to the fact that the majority of respondents selected these categories, which makes it challenging to draw many conclusions about the few people who did not select these options.

Figure 35. Teachers' Reported Prior PD Experiences by Their Focus on EF Skills for Mathematics



Appendix C. Understanding Teacher Perspectives on EFs for Mathematics Survey

Awareness of Executive Function Skills

The first part of the survey will ask about your prior knowledge and awareness of Executive Function (EF) skills. Please do your best to answer these questions.

1. Are you aware of what executive function skills are?

- □ I know a lot about these skills and what they are.
- □ I know about these skills, and I know something about what they are.
- □ I have heard of these skills, but I am not sure what they are.
- □ I have not heard of these skills.

2a. What do you believe executive function skills are?

2b. How, if at all, do you believe EF skills influence students' learning or participation in mathematics classrooms? If you can, we encourage you to use an example from your experiences as a mathematics teacher or your own mathematical practice to explain your thinking.

3. Below are terms related to executive function skills that are often used in educational contexts. For each term, please rate your familiarity based on your understanding of how each one is related to teaching and/or learning.

	Unfamiliar	Somewhat familiar	Familiar	Very familiar
Working memory				
Inhibitory control				
Cognitive flexibility				
Metacognition				
Planning				
Persistence				
Emotional regulation				

Introducing Executive Function Skills

Now we are providing a definition of executive function skills to ensure all survey participants have the same understanding of the concept.

Executive function skills are a set of cognitive abilities that every student possesses, enabling them to manage and direct their learning process. These skills include the ability to maintain and manipulate information in the mind, focus attention based on personal priorities, and flexibly adapt thinking strategies as needed. Through executive function skills, students exercise agency over their attention, emotions, and actions to facilitate, their own paths towards their goals. In formalized learning environments, they also use executive function skills to plan out how they will approach an assignment, and to reflect on how well their chosen strategies are working to support their learning and engagement in class.

Now that we have provided a definition of executive function skills, we'd like to revisit the earlier question to see if your perspective on your awareness of these skills has changed.

4. After reading the definition, I would now describe my awareness of executive function skills as:

- □ I know a lot about these skills and what they are, and I use them regularly when designing and enacting instruction and making decisions about assessments.
- □ I know a lot about these skills and what they are, but I do not use them regularly when designing and enacting instruction and making decisions about assessments.
- □ I know about these skills, and I know something about what they are and how they are related to teaching and learning.
- □ I had not heard of these skills before, but I recognize the skills described in the definition from my experience teaching.
- □ I had not heard of these skills before, and after reading the definition, I am still unsure how they relate to teaching and learning.

5. Which of the following sources has contributed to your awareness of executive functions skills in an educational setting? Select all that apply.

- □ Not Applicable: The concept of 'executive functions skills' was new to me.
- □ Academic coursework during my education
- □ Professional development programs or workshops
- □ Coaching or mentoring by colleagues or educational experts
- □ Independent learning, including books, podcasts, or online resources
- □ My own observations of students using executive functions skills in my class or lab classrooms
- □ Through referrals, IEPs, or interaction with staff who provide individualized student supports for students with IEPs or 504 plans
- □ Other: _____

[Survey logic – if selects options 3 or 4 in response to Q5]----------

6a. The professional development session(s) I attended or coaching I received regarding executive functions skills in an educational setting (select all that apply):

- □ Focused on executive function skills generally
- □ Focused on executive function skills, specifically in the context of mathematics learning
- □ Focused on executive function skills, specifically in the context of another subject
    - Please specify which subject:_____
- □ Focused on other topics, but covered executive function skills (either implicitly or explicitly)
    - Please specify which topic:_____

6b. This professional development or coaching was (select all that apply):

- □ Provided by my current school or district
- □ Provided by another school or district
- □ Not provided by a school or district:
    - □ Please specify who provided the opportunity: _____

6c. This professional development or coaching was (select all that apply):

- □ Provided virtually/online
- □ Provided in-person
- □ Provided as a one-time training
- □ Provided as a series of sessions

6d. Please indicate to what extent you felt that participating in this professional development or coaching improved your understanding of executive function skills.

- □ Not at all
- □ Slightly
- □ Moderately
- □ Substantially

6e. Please indicate to what extent you felt that participating in this professional development or coaching led you to change your teaching practices, with respect to how you attend to executive functions in your instruction.

- □ Not at all
- □ Slightly
- □ Moderately
- □ Substantially

[End of survey logic – if selects options 3 or 4 in response to Q5] ----------

Executive Function Skills and Mathematics

Now that you've read the definition of EF and been provided examples, we are interested in your beliefs and experiences related to executive function skills within the context of teaching and learning mathematics. For the following questions we encourage you to reflect on your own experiences as a mathematics educator.

7a. How valuable do you think it is for elementary and middle school mathematics teachers to address executive function skills in the context of mathematics instruction?

- □ Not valuable
- □ Slightly valuable
- □ Moderately valuable
- □ Very valuable

7b. To what extent do you think each of the following student actions or activities can affect your students' academic success in mathematics?

	Not at all	Slightly	Moderately	Very much
Students working with information in their minds, without needing to write things down, like recalling details within a problem.				
Students flexibly shifting from one problem solving strategy to another strategy as needed to reach a solution				
Students sustaining their attention long enough to complete the task at hand				
Students reflecting on their own thought processes, either within a problem or over time, to identify their strengths and areas where they may need more support				
Students making a plan to achieve a goal, whether solving a problem or completing a project				
Students adapting across various languages or dialects in different contexts to communicate effectively in a given situation (e.g., code switching)				
Students using self-explanation and reasoning (e.g., aloud or in writing) to clarify and reinforce learning				

	Not at all	Slightly	Moderately	Very much
Students seeking assistance and effectively using support when needed				
Students listening to and remembering the ideas and strategies of their peers in order to synthesize them into a cohesive argument				
Students integrating personal experiences and backgrounds into the learning process to deepen their own understanding and make the content more relevant to their lives				

The following questions focus on your beliefs about executive function skills. There are no right or wrong answers. We are interested in your ideas about how students use certain executive function skills.

8. Using the scale provided, please indicate the extent to which you agree or disagree with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree
Students' executive function skills are something innate to them and, as their teacher, I don't have much ability to change them.				
Students can learn new things, but they can't really change their executive function skills.				
In academic settings, there are some students who are better at using their executive function skills than others, based on innate characteristics.				
There are many ways a student can use their executive function skills to help them learn.				
There are many ways a teacher can support students with using their executive function skills to help them				

	Strongly disagree	Disagree	Agree	Strongly agree
learn, even as their needs vary day to day.				

9. Please indicate your agreement with the following statements regarding the relationship between executive function skills, cultural diversity among students, and educational context.

	Strongly disagree	Disagree	Agree	Strongly agree
Students' prior experiences in and outside of school can productively influence their use of executive function skills in mathematics.				
Students' cultural perspectives can influence the ways they engage their executive function skills in mathematics learning.				
A student's personal goals and prior experiences are critical factors that affect how they use executive function skills when doing mathematics.				
Teaching executive function skills as part of mathematics instruction is or could be more effective than teaching these skills on their own (without connection to an academic subject).				
Teaching executive function skills as part of mathematics instruction connected to students' lived experiences and cultural assets is more effective than teaching these skills on their own (without connection to students' identities and strengths).				

10a. Please indicate how often you usually do the following things related to executive function skills and mathematics instruction.

	Never	Once or twice a quarter/ semester	Once or twice a month	At least once a week	In every mathematics lesson

Explicitly discuss executive function skills when teaching mathematics.					
Incorporate supports for executive function skills when *planning* mathematics lessons, whether implicitly or explicitly.					
Incorporate strategies and supports for executive function skills when *teaching* mathematics, whether implicitly or explicitly.					

10b. Please select all the methods you use to incorporate executive function skills in your mathematics class planning and instruction. *Select all that apply.*

- □ I explicitly teach students about executive function skills through whole-class lessons.
- □ I explicitly teach students about executive function skills through small-group lessons.
- □ I design mathematics activities that require students to use executive function skills, like multi-step problems that involve planning and task switching to help them build these skills.
- □ I provide opportunities for students to discuss how executive function skills support our ability to learn and engage with mathematics.
- □ *I support* students in setting goals for their use of executive function skills in mathematics learning.
- □ I provide tools and resources for students to support the development of executive function skills, such as curriculum resources, digital learning resources, games, and planning tools.
- □ None: I do not specifically focus on executive function skills in my mathematics instruction.
- □ Other: _____

10c. Please provide an example illustrating how you have incorporated executive function skills in your mathematics teaching (please write "N/A" if you selected "None" in the previous question):

_____

11a. Please indicate how often you teach each of the following executive function skills to students in your mathematics class(es). *Note that these items intentionally include a set of items you previously saw in this survey, but this time we are asking how often you teach them*.

	Never	Once or twice a quarter/ semester	Once or twice a month	Weekly	In every mathematics lesson
Work with information in their minds, without needing to write things down, like recalling details within a problem.					
Flexibly shift from one problem solving strategy to another strategy as needed to reach a solution					
Sustain their attention long enough to complete the task at hand					
Reflect on their own thought processes, either within a problem or over time, to identify their strengths and areas where they may need more support					
Make a plan to achieve a goal, whether solving a problem or completing a project					
Choose "weekly" for this response (attention check)					
Adapt across various languages or dialects in different contexts to communicate effectively in a given situation (e.g., code switching)					
Use self-explanation and reasoning (e.g., aloud or in writing) to clarify and reinforce learning					
Seek assistance and effectively use support when needed					
Listen to and remember the idea and strategies of their peers in order to synthesize them into a cohesive argument					
Students integrating personal experiences and backgrounds into the learning process to deepen their own understanding and make the content more relevant to their lives					

*[Survey Logic - If any response **except for 'Never'** is given to any item on question 11]*

12a. Please indicate your response to the questions below.

	Not at all	*Slightly*	*Moderately*	*Very much*	*Not Applicable*
To what extent does incorporating executive function skills into your mathematics teaching improve your students' *success* on mathematics tasks?					
To what extent has incorporating executive function skills into your mathematics teaching increased your students' *engagement* during mathematics lessons or activities?					
To what extent has incorporating executive function skills into your mathematics teaching improved your students' mathematics *attitudes or beliefs* (e.g., liking mathematics or seeing themselves as mathematicians)?					

12b. Please provide an example of how students respond or what you have observed when you incorporate executive function skills in your mathematics teaching:

12c. Please provide an example, if any, of how students improved in reaching mathematics objectives when you incorporate executive function skills in your mathematics teaching:

[*End of survey logic – If any response* ***except for 'Never'*** *is given to any item on question 11]* ----------

[Survey Logic - If a response ***of 'Never'*** *is given to all items on question 11]*

12d. Please indicate your response to the questions below.

	Not at all	*Slightly*	*Moderately*	*Very much*	*Not Applicable*
To what extent does it seem likely that incorporating executive function skills into your mathematics					

teaching will improve your students' success on mathematics tasks?					
To what extent does it seem likely that incorporating executive function skills into your mathematics teaching will increase your students' engagement during mathematics lessons or activities?					
To what extent does it seem likely that incorporating executive function skills into your mathematics teaching will improve your students' mathematics attitudes or beliefs (e.g., liking mathematics or seeing themselves as good at it)?					

[*End of survey logic – If a response **of 'Never'** is given to all items on question 11]* ----------

13. Please indicate the degree to which each of the following factors represents a barrier to teaching executive function skills in your mathematics class.

	Not at all	Slightly	Moderately	Very much
Curriculum prioritizes time on the content rather than on building executive function skills.				
Balancing the importance of teaching executive function skills with other educational priorities.				
Uncertainty or lack of clarity about the evidence supporting the impact of executive function skills on student learning and outcomes, making it difficult to justify integration into mathematics instruction.				
Choose "not at all" for this response (attention check).				
Lack of training on how to teach executive function skills.				

	Not at all	Slightly	Moderately	Very much
Lack of support for providing rigorous instruction to all students, regardless of skills or background.				
Insufficient resources that target executive function skills in a mathematics context (e.g., instructional materials, tools).				
Difficulty knowing how to integrate executive function skills within a mathematics context.				
Lack of support or emphasis at the school/district level.				
Student resistance or lack of engagement				
Classroom management challenges				
Other challenges *(describe below)*				

Other challenges: _____

14. To what extent would the following supports be useful in helping you to support the executive function skills of all of your students, to help them to learn challenging mathematics?

	Not useful	Slightly useful	Moderately useful	Very useful
High-quality mathematics curriculum materials that incorporate executive function skills to help students learn challenging mathematics				
Professional development to learn about what executive function skills are in the context of mathematics instruction and how they connect to students' strengths, identities, and lived experiences				
Professional development to learn about how to address executive function skills during				

	Not useful	Slightly useful	Moderately useful	Very useful
mathematics instruction to help students learn challenging mathematics				
Access to a coach or peer who is knowledgeable about addressing executive function skills during mathematics instruction to help students learn challenging mathematics				
Planning time to figure out how to incorporate executive function skills into my mathematics instruction to help students learn challenging mathematics				

Now we have some questions for you about your interest in programs or products that focus on improving both mathematics learning and executive functions.

15a. If a program or product were available in your school that focuses on improving both mathematics learning and executive functions, how interested would you be in using it in your classroom?

- □ Not interested
- □ Slightly interested
- □ Moderately interested
- □ Very interested

15b: [Elementary grades teachers only] If a program were available in your school that helps students learn fractions and engage their executive function skills through play and movement-based activities, how interested would you be in using it in your classroom?

- □ Not interested
- □ Slightly interested
- □ Moderately interested
- □ Very interested

15c: [Elementary grades teachers only] If an online program were available in your school that helps students simultaneously strengthen their mathematics fact fluency and executive function skills through a series of games, how interested would you be in using it in your classroom?

- □ Not interested
- □ Slightly interested
- □ Moderately interested
- □ Very interested

15d: [Middle school teachers only] If an online program were available in your school that helps guide students through the mathematics problem-solving process with built-in executive function and metacognition supports, and also creates a collaborative space for students to share their thinking, how interested would you be in using it in your classroom?

- □ Not interested
- □ Slightly interested
- □ Moderately interested
- □ Very interested

Next, we have some questions for you regarding assessments and executive function skills.

16a. Do your students take assessments that directly gather information on their executive function skills (e.g., how well they planned out their work, maintained information in working memory, shifted between strategies, were able to sustain their attention)?

- □ Yes, and this is the case for all students.
- □ Yes, and this is the case only for selected students based on specific needs or challenges.
- □ No

[Survey logic - If a "Yes" response is given to 16 a] ---------- ----------

16b. How are your students' executive function skills typically assessed? *Select all that apply.*

- □ Formally, as part of the regular curriculum
- □ Informally, through your observations of your students during classroom activities
- □ Through individualized student supports (e.g., to inform development of IEPs, 504 plans, or other interventions)
- □ Other (Please specify: _____)

16c. How often are your students' executive function skills ***formally*** assessed?

- o Never
- o Fall, winter, and spring
- o Once or twice a quarter/semester
- o Once or twice a month
- o Weekly
- o Every day
- o Not applicable

16d. How often are your students' executive function skills ***informally*** assessed?

- □ Never
- □ Fall, winter, and spring
- □ Once or twice a quarter/semester
- □ Once or twice a month

- □ Weekly
- □ Every day
- □ Not applicable

16e. How often are these assessment results shared with you?

- □ Never
- □ Sometimes
- □ Always

16f. How do you use the information from these assessments? Select all that apply.

- □ To inform my teaching
- □ To diagnose student needs
- □ To identify formal supports to address student needs
- □ For conferencing with parents and students
- □ N/A, the assessment results are not shared with me
- □ Other (Please specify: _____)

16g. How do you track changes or progress in executive function skills over time? *Select all that apply*.

- □ Tracking is handled by special education/related services or other specialized staff.
- □ I maintain notes or records as part of student evaluations.
- □ I use specific tools or software designed to track these skills.
- □ Student uses this information to track their own progress.
- □ Student progress in executive function skills is not tracked.
- □ Other (Please specify: _____)

[*End of survey logic – if 'yes' response given to 16a*] ---------- ----------

Now we have some questions for you about teacher professional development focused on improving both mathematics learning and executive functions.

17a. How important do you think it is for elementary school mathematics teachers to learn how to support students in developing and using executive function skills as part of learning challenging mathematics?

- □ Not important
- □ Slightly important
- □ Moderately important
- □ Very important

17b. How important do you think it is for middle school mathematics teachers to learn how to support students in developing and using executive function skills as part of learning challenging mathematics?

- □ Not important
- □ Slightly important
- □ Moderately important
- □ Very important

17c. How interested would you be in participating in professional development to learn about how you can help all of your students, regardless of their current mathematics skills and backgrounds, develop the executive function skills that will help them to learn challenging mathematics?

- □ Not interested
- □ Slightly interested
- □ Moderately interested
- □ Very interested

[Survey logic - If a response other than "Not interested" is given to 17c] ----------

17d. What topics related to executive function skills for mathematics learning would you be most interested in attending PD on? *Select all that apply*.

- □ What executive function skills are in the context of mathematics instruction
- □ How they connect to students' strengths, identities, and lived experiences
- □ How to address executive function skills during mathematics instruction to help students learn challenging mathematics
- □ Other (Please specify: _____)

17e. What would be the ideal format for professional learning activities on executive function skills for mathematics learning would you be most interested in? *Select all that apply*.

- □ A single professional development workshop lasting up to two hours during the school day
- □ Ongoing professional development sessions throughout the school year
- □ An in-person class or workshop that you take during your own/personal time
- □ A virtual class or workshop that you take during your own/personal time

[*End of survey logic – If a response other than "Not interested" is given to 17c*] ----------

17f. To what extent would each of the following increase your interest in either **professional development** or **programs/products** on how to support students' engagement of their executive function skills to enhance their mathematics learning?

	Not at all	Slightly	Moderately	Very much
Research evidence (e.g., results from large experimental studies across several contexts) that incorporating executive function skills into mathematics teaching				

	Not at all	Slightly	Moderately	Very much
improves student success on mathematics tasks				
Research evidence (e.g., results from large experimental studies across several contexts) that incorporating executive function skills into mathematics teaching improves student engagement during mathematics lessons or activities				
Research evidence (e.g., results from large experimental studies across several contexts) that incorporating executive function skills into mathematics teaching improves student mathematics attitudes or beliefs (e.g., liking mathematics or seeing themselves as mathematicians)				
Testimonials from teachers confirming that incorporating executive function skills into mathematics teaching improves student success on mathematics tasks.				
Testimonials from teachers confirming that incorporating executive function skills into mathematics teaching improves student engagement during mathematics lessons or activities				
Testimonials from teachers confirming that incorporating executive function skills into mathematics teaching improves student mathematics attitudes or beliefs (e.g., liking mathematics or seeing themselves as mathematicians)				
Endorsements from national organizations like the National Council of Teaching Mathematics (NCTM)				

	Not at all	Slightly	Moderately	Very much
District initiatives focused on incorporating executive function skills into mathematics teaching				

17g. Is there anything else that would increase your interest in **professional development** or **programs/products** on executive function skills for mathematics learning?

Open Response: _____

18. How important is each of the following considerations when choosing new mathematics learning products or approaches to use during mathematics instruction?

How well the product or approach…

	Not important	Slightly important	Moderately important	Very important
Aligns with my district's mathematics standards				
Supports explicit instruction				
Supports students' critical thinking skills for mathematics				
Supports my ability to help students develop their fluency in mathematics facts				
Can be integrated with ease into my current mathematics instruction				
Choose "slightly important" for this response (attention check)				
Addresses a current challenge that I am experiencing in my mathematics instruction				
Supports students in developing their executive function skills				

	Not important	Slightly important	Moderately important	Very important
Provides me with insights into my students' conceptual understanding in mathematics				
Can be used with students from diverse backgrounds				
Addresses the mathematics learning needs of students with disabilities				
Addresses the mathematics learning needs of multilingual learners				
Provides opportunities for students to engage in collaborative mathematics discourse and problem-solving				
Supports students in making meaningful connections between their previous knowledge and at-home experiences and their mathematics learning in the classroom				
Offers personalized and adaptable mathematics learning experiences for students				

Now we have some questions about you and your teaching experience.

19a. Please indicate the specific grade(s) you teach:

☐ Third (3rd) Grade

☐ Fourth (4th) Grade

☐ Fifth (5th) Grade

☐ Sixth (6th) Grade

☐ Seventh (7th) Grade

☐ Eighth (8th) Grade

19b. Do you currently or have you previously taught students with disabilities (e.g., students that have IEPs or 504 plans)?

___ No

___ Yes

19c. Please indicate the type of classroom you currently teach in. Select all that apply. *

- □ General education classroom
- □ Inclusion or integrated classroom (with a special education co-teacher or other teaching aid/assistant)
- □ English language learner (ELL) classroom, or primarily teach ELLs
- □ Other - Write In (Required)

19d. Including the 2024- 2025 school year, how many years have you worked as a teacher?

19e. Including the 2024-2025 school year, how many years of experience do you have teaching mathematics at the elementary or middle school level?

Please describe your current or most recent school.

19f. School location

- □ Urban
- □ Suburban
- □ Rural

19g. School type

- □ Public
- □ Private
- □ Charter
- □ Other (write out)

19h. Title 1 status

- □ Schoolwide Title 1 designation
- □ Greater than 50% of students qualify
- □ Less than 50% of students qualify
- □ Unknown
- □ Not applicable

Thank you for taking the time to complete this survey!

END OF SURVEY

aerdf
Advanced Education Research and Development Fund

EF+Math Program

EF + Math is a flagship program of AERDF that dramatically improves mathematics outcomes for students in grades 3–8—especially Black, Latinx, and students in poverty—by strengthening their foundational executive function (EF) skills.

The initiative supports diverse teams of educators, researchers, and developers to co-design mathematics learning innovations using inclusive
R&D processes.

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