

Evidence of the Need to Prepare Prospective Teachers to Engage in Mathematics Consultations

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The mathematics consultation represents a powerful opportunity for mathematics teachers to leverage the knowledge base of special education professionals to advance equity for students with special education needs. Yet, most teacher preparation programs do not specifically prepare prospective teachers to engage in mathematics-specific consultations. We provided an opportunity for prospective elementary teachers of mathematics and prospective special education teachers to engage in a written consultation about the mathematics learning of a student with special education needs. We analysed the characteristics of these consultations and found that the prospective teachers' questions and responses lacked focus on the mathematics context and largely ignored student engagement in mathematical practices. Based on the evidence from this baseline study, we provide recommendations for how mathematics teacher educators might more effectively prepare prospective teachers for the questioning and answering stages of mathematics consultations.

Keywords · teacher preparation · special education · equity · learning disabilities · mathematical practices · consultation · collaboration · inclusion

Introduction

Over the past two decades, international educational organisations have expressed strong commitment to advancing equitable education for students with special education needs (SEN). This widespread support can be seen in documents such as: the United Nations Convention on the Rights of Persons with Disabilities (2006), United Nations Educational, Scientific and Cultural Organisation (UNESCO)'s Defining an Inclusive Education Agenda (2009), the Australian Government's Disability Discrimination Act (1992), the United States' Individuals with Disability Education Act (IDEA, 2004), and the European Union's Charter of Fundamental Rights of the European Union (Article 26, European Communities, 2000). Although the commitment to increase equity is clear and straightforward, the path to achieving this goal has been neither clear nor straightforward, as evidenced by the fact that students with SEN continue to experience a lack of opportunity and outcomes in mathematics (EURYDICE, 2011; National Center for Education Statistics, 2013). The purpose of this paper is to consider how the avenue of teacher preparation can contribute to the overall goal of advancing equity in mathematics education for

students with SEN. Before we report on our research, we define two key terms: *students with SEN* and *inclusive education*.

The definition of *SEN* has varied greatly across countries and across time (Organisation for Economic Cooperation and Development (OECD), 2012; D'Alessio & Cowan, 2013; D'Alessio & Watkins, 2009). In 1997, the International Standard Classification of Education (ISCED) broadly defined the education of children with SEN as extending "beyond those who may be included in handicapped categories to cover those who are failing in school for a wide variety of other reasons that are known to be likely to impede a child's optimal progress (UNESCO, 1997, as cited in OECD, 2007)." The most recent version of the ISCED (2011) further articulated education for students with SEN as:

Education designed to facilitate the learning of individuals who, for a wide variety of reasons, require additional support and adaptive pedagogical methods in order to participate and meet the learning objectives in an educational programme. Reasons may include (but are not limited to) disadvantages in physical, behavioural, intellectual, emotional and social capacities (UNESCO, 2011, p. 81).

Our use of *SEN* in this paper is consistent with this broad understanding of the term such that it applies to students with disabilities, difficulties, and disadvantages (D'Alessio & Cowan, 2013; OECD, 2004). Whereas this term is useful in identifying the broad group of students who need additional educational supports, we also use more specific terms and diagnoses, such as auditory processing disorder, when discussing how to meet the needs of specific students.

Education that is *inclusive* is a critical aspect to advancing equitable education for students with SEN. The term inclusion is multifaceted in its intent and meaning as it has both social and academic implications. From a social perspective, inclusion has to do with ensuring that students with SEN are not segregated from their peers without special education needs with respect to where students with SEN are educated. From an academic perspective, inclusion has to do with ensuring students with SEN have access to the same learning opportunities as their peers without disabilities, namely having access to the same curriculum. Bryant, Smith, and Bryant (2008) provide a definition of inclusion that reflects the multifaceted intent and meaning of the term as "an educational setting in which students with disabilities have access to the general education curriculum, participate in school activities alongside students without disabilities, and attend their neighbourhood school" (p. 605). Inclusion has been promoted in policy documents from Australia (Australian Government, 2005), the United States (IDEA, 2004), and the European Union (European Commission, 2010), among other countries.

Inclusion and Teacher Preparation

The commitment to inclusion has profound implications for teacher preparation. The sharp and rapid rise of students with SEN in general education classrooms (Loiacono & Valenti, 2010) means that general education teachers as well as special education teachers must be adequately prepared to meet the needs of students with SEN. Yet, on the Teaching and Learning International Survey (TALIS), teachers across 18 countries reported that "teaching special needs students" was the aspect of their work most in need of development (Schleicher, 2012). Consequently, there is an urgent need for immediate improvement in the ways in which both general education and special education teachers are prepared to meet the needs of students with SEN. As the European Agency for Development in Special Needs Education explained,

One of the key priorities for teacher education . . . [is] to review the structure to improve teacher education for inclusion and to merge the education of mainstream and special education teachers. The changing role of teachers is increasingly acknowledged, emphasizing the need for significant

changes in the way teachers are prepared for their professional roles and responsibilities. (2011, p. 18)

Internationally, standards related to teaching and teacher preparation have reflected the expectation that general and special education teachers ought to be prepared to collaborate with each other to meet the needs of students with SEN in inclusive settings. For example, Standard 1.6 of the Australian Professional Standards for Teachers (Australian Institute for Teaching and School Leadership, 2011) states that teachers will utilise “strategies to support full participation of students with disabilities” and that to be highly accomplished in this standard teachers will “work with colleagues to access specialist knowledge . . . [to] support the participation and learning of students with disability” (p. 11). In the United States, performance standard 2f of the Interstate Teacher Assessment and Support Consortium (InTASC) Model Core Teaching Standards (Council of Chief State School Officers, 2011) states, “the teacher accesses resources, supports, and specialized assistance and services to meet particular learning differences or needs” (p. 11). Similarly, the European Agency for Development in Special Needs Education (2014a, 2014b) provided a framework for initial teacher education in which inclusive education was viewed as a collective task, and collaboration between general and special education teachers was an essential approach to inclusive teaching. Likewise, Standard 7 of the American Council for Exceptional Children Initial Level Special Educator Preparation Standards focuses squarely on collaboration between general and special education teachers and the key role collaboration has in meeting the needs of students with SEN (2012, p. 9-10).

Preparing Prospective Teachers for Collaboration

Although standards and policy documents have established the expectation that initial teacher education will “merge” the preparation of general and special education teachers such that prospective teachers (PTs) will be prepared to collaborate with each other in inclusive classroom settings, it is not clear how this merged preparation can be best accomplished (McKenzie, 2009). Based on a synthesis of the literature, Blanton, Pugach, and Boveda (2014) offer five action steps for redesigning general education and special education preparation for inclusive practices in schools. Among the recommendations is that teacher education should be a collaborative enterprise between general and special education faculty, as well as faculty in the arts and sciences.

What learning experiences can general and special education teacher educators collaboratively provide so that PTs will be prepared for effective collaborations? In order to answer this question, teacher educators must clearly explicate *collaboration*. One avenue for collaboration is co-teaching (Bessette, 2008; Friend & Cook, 2003; Mastropieri et al., 2005; Nowacek & Blanton, 1996; Van Laarhoven, Munk, Lynch, Bosma, & Rouse, 2007; Weiss, Pellegrino, Regan, & Mann, 2015). Co-teaching can take on different forms. Friend and Bursuck (2009) and then Sileo (2011) described six different structures within which co-teaching can occur, including: one teach and one observe, parallel teaching, station teaching, alternative teaching, one teach and one assist, and team teaching. For the purposes of this paper, we understand co-teaching to occur when a special education teacher and a general education teacher assume instructional roles in the classroom at the same time to assist each other in providing inclusive education for students with SEN. Certainly this type of collaboration ought to be addressed in teacher preparation, but there are other forms of collaboration among general education and special education teachers that support inclusion and in which PTs should be prepared to engage.

In many schools there are simply not enough special education teachers for co-teaching to occur in every inclusion classroom (e.g., McLeskey, Tyler, & Flippin, 2004). Consultation between a general education teacher and a special education professional is another form of collaboration

that can support inclusion. Although there is less research on preparing PTs to engage in consultation than research on preparation for co-teaching, there is still a body of literature that teacher educators can draw from when designing consultation learning experiences for PTs (e.g., Cummings, 2002; Gravois, Knotec, & Babinski, 2002; Pugash, Johnson, Drame, & Williamson, 2012; Truscott et al., 2012). Wesley and Buysse (2004) provided a framework for a step-by-step understanding of the consultation process. Arthaud, Aram, Breck, Doelling, and Bushrow (2007) reported on the design of a teacher education seminar that scaffolded a consultation-like process for both general and special education PTs, and Richards, Hunley, Weaver, and Landers (2003) created a consultation project that was broken down into ten steps that effectively defined a consultation cycle. Although there are differences among consultation models in the literature, there also are common components among them (e.g., establishing rapport; identifying the problem; collecting data/information; developing, implementing, and evaluating the plan). Figure 1 shows a model that synthesises these common components. Although there is a growing literature base about the need to prepare PTs for consultations in general, as the next section describes, there is a gap in the literature related to preparing PTs for *mathematics* consultations.

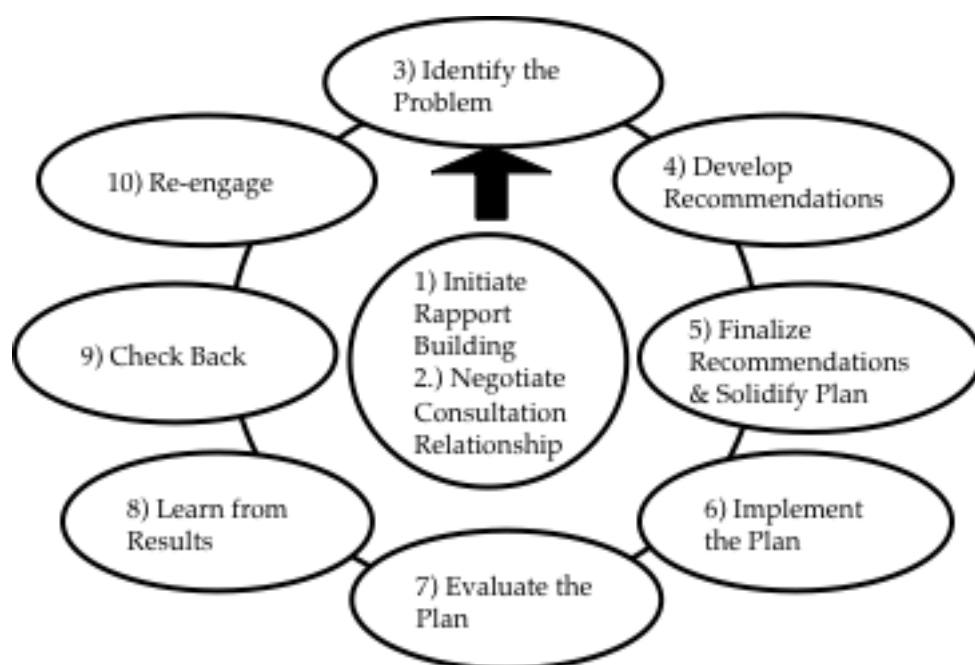


Figure 1. Model of a general consultation process. The Need to Prepare PTs for Mathematics Consultation

There is a pressing need for strategies to improve learning opportunities and outcomes in the context of inclusive *mathematics* education. Students with SEN are often classified as low achieving in mathematics and science (LAMS) (European Commission's Thematic Working Group in Mathematics, Science, and Technology, 2013) and their achievement scores on standardised assessments such as the Program for International Student Assessment (PISA) are far below their peers (OECD, 2005). In the United States, the learning outcomes of students with SEN are significantly lower than their peers without SEN. The most recent National Assessment of Educational Performance (NAEP) data highlight this disparity (NAEP, 2013).ⁱ In fourth grade,

45% of students with SEN scored below a basic level of understanding according to NAEP. In contrast, only 14% of general education students did so. With respect to demonstrating mathematical proficiency, a mere 18% of fourth grade students with SEN scored at or above proficient compared to 45% of their general education peers. Outcomes for students with SEN at eighth grade and 12th grade were even worse. Unfortunately, these disparities are not unique to NAEP; the literature is replete with documentation of the historically poor mathematics outcomes for students with SEN (e.g., Judge & Watson, 2011; Klingner, Vaughn, Hughes, Schumm, & Elbaum, 1998; Mazzocco & Räsänen, 2013).

These poor outcomes for students with SEN stand in stark contrast to the equity stance promoted by mathematics education professional organisations such as the Australian Association of Mathematics Teachers (AAMT) (2006) and the National Council of Teachers of Mathematics (NCTM) in the United States (,2000, 2014). In the following passage, Boyd and Bargerhuff (2009) highlighted the potential for collaboration between mathematics teachers and special educators to advance equity in mathematics learning for students with SEN:

“If current mathematics practitioners can engage their students, those with and without disabilities, in the kind of mathematics instruction described by the recommendations of NCTM (1989; 2000) and AAMT (2006) as “best practice;” and if special educators can collaborate with those mathematics practitioners to ensure students with disabilities have any needed supplementary specialised services to which they are entitled by US and Australian law, then many students with disabilities (as well as those without disabilities) in effective inclusive classrooms may achieve the levels of proficiency ascribed to by mandates such as NCLB, IDEA, and the Disability Discrimination Act.” (p. 62)

Boyd and Bargerhuff went on to assert that preparation of mathematics and special education teachers must extend beyond providing opportunities to understand each other’s work to providing a common set of collaborative experiences. In presenting directions for future research, they posed this question: “What other courses and experiences need to be a part of a common preparation program for [preservice teachers] to competently navigate both fields and help all students do significant mathematics”? (p. 65).

The work that we describe in this paper was designed to respond to this pressing question. Although consultations, in general, have been valued for advancing equity for students with SEN, there has been no significant discussion in the literature about content-specific *mathematics* consultations and how teacher preparation programs might equip general education and special education PTs to leverage these consultations to meet the mathematics learning needs of students with SEN.

Study Purpose & Research Questions

The purpose of this study was to understand the characteristics of the questions and responses of PTs who engaged in a mathematics-specific consultation about how to meet the mathematics learning needs of a student with SEN. The context informing this study is one in which most teacher preparation programs, including ours, prepare general education PTs and special education PTs to engage in consultations in general, but do not provide additional support for mathematics-specific consultations. As teacher educators and education researchers we wanted to understand if this general approach to consultation was sufficient to prepare PTs to engage in mathematics-specific consultations. Because this question had not previously been addressed in the literature base, we designed an opportunity for general education PTs and special education (SPED) PTs to engage in a beginning approximation (Grossman, Hammerness, & McDonald, 2009) of a mathematics consultation. Our research questions were:

1. Given the opportunity to engage in a mathematics consultation, what are the mathematics-related characteristics of the questions that elementary PTs ask of their special education (SPED) counterparts?
2. Given the opportunity to engage in a mathematics consultation, what are the mathematics-related characteristics of SPED PT responses to their elementary PT counterparts?

By analysing these characteristics, it was our intention to understand the extent to which PTs could attend to the mathematics-specific nature of the consultation. This baseline information was designed to inform the field of teacher education about the extent to which additional, explicit preparation related to engagement mathematics consultation might or might not be warranted.

Methods

Participants

This article reports on research conducted at a large, public university in the South-eastern region of the United States. The university's Institutional Review Board (IRB) approved the research, and pseudonyms have been used in this article to protect the anonymity of all participants. This research involved two groups of undergraduate PTs who were in their final year of their four-year undergraduate teacher education degrees. The first group included 22 PTs enrolled in an elementary teacher preparation program (general education PTs). The second group included 25 PTs enrolled in a special education preparation program (SPED PTs). PTs from both groups had had extensive experiences in the field (classroom) prior to the semester of this study. During the study semester, both groups were engaged in classroom based internships in which they were regularly working with K-12 students.

Both groups were enrolled in separate sections of the same mathematics methods course, each taught by one of the co-authors. Neither group had taken previous mathematics teaching courses. The same content was covered in both courses. At the point of this study, during the second half of the semester-long course, both groups had considered the following areas of knowledge for mathematics teaching: what is mathematics, what it means to do mathematics, teaching through problem solving, taking an equity stance, assessment, differentiating for diverse learners, number sense, operations, and rational numbers. In addition, both sections of the methods course spent significant time considering how to teach in light of widespread state adoption of the Common Core Mathematics Standards (Council of Chief State School Officers, 2010). These recently adopted state standards included both content standards and process standards. The content standards govern *what* mathematics content K-12 grade students ought to master and the process standards, called Mathematical Practices (MPs), govern *how* students should engage in learning that content. The PTs in both sections completed field-based assignments in which they focused on supporting student engagement in the MPs.

Attending the same methods course, albeit different sections taught by two different instructors, allowed the PTs from both groups to have comparable experiences and to develop similar ideas and vocabulary regarding mathematics teaching. This common background was an important foundation for the consultations in which they engaged.

Mathematics Consultation- A Beginning Approximation of Practice

As part of the methods course, the PTs were asked to complete the Consultation Assignment. The focus of this assignment was to engage both elementary education and special education PTs in two particular components of the general consultation process (illustrated in Figure 1) within the context of mathematics teaching. These two consultation components were Identify the Problem and Develop Recommendations. The decision to break the consultation process down into its components and to look at a beginning approximation of the full consultation process was consistent with McDonald, Kazemi, and Kavanagh's (2013) pedagogical cycle for engaging PTs in authentic and ambitious instructional activities. For this assignment both the elementary and SPED PTs watched video segments of authentic elementary mathematics instruction involving a student with SEN. Specifically the student had been diagnosed with an information processing disorder (e.g., difficulties with memory retrieval and auditory and visual processing difficulties). PTs in both groups were asked to describe how the teacher in the video supported the student's engagement in the first Common Core Standard for Mathematical Practice (CCMP#1)- *make sense of problems and persevere in solving them* (Council of Chief State School Officers, 2010). PTs also described the extent to which the student in the video segments engaged in this practice. At this point the assignment differed for the PTs in each group. The elementary general education PTs were asked to put themselves in the role of the teacher and to write questions they had for the SPED PTs regarding how to support the mathematics learning of this student given his identified disability and related information processing difficulties and, specifically, how to further the student's engagement in CCMP#1. Each SPED PT was then assigned to provide written responses to the questions of two of the elementary PTs (they responded to two because there were more elementary PTs than SPED PTs). The written records of the elementary PTs' questions and the SPED PTs' responses became the data sets for the following analyses.

Data Analysis

We analysed the Consultation Assignment documents for consultation characteristics and specifically focused this analysis on the mathematics-related characteristics of the consultation. Data analysis occurred across four stages. In the first stage of analysis, we read the questions and the matching responses to get an initial sense of the data. For the second stage, in addition to using unrestricted, open coding (Corbin & Strauss, 2008) to identify the characteristics of the questions and responses with respect to the content, context and processes of mathematics, we also used codes based on Ball, Thames, and Phelps' (2008) mathematical knowledge for teaching. Specifically, we looked for examples of the following three types of pedagogical content knowledge (PCK); (1) knowledge about effective teaching moves for the content area of mathematics—or *knowledge of content and teaching* (KCT); (2) in-depth knowledge of the mathematics needed by a teacher—or *specialised content knowledge* (SCT); and (3) knowledge of how students learn mathematics-- or *knowledge of content and students* (KCS). (See Ball, Thames, & Phelps (2008) for further descriptions of each of these categories.) The third stage involved collapsing codes and defining examples and non-examples of each code. In the fourth stage, we independently used the defined codes (See Tables 1 & 2) to code the questions and responses. Then we met to discuss the coding and come to a consensus on the application of the codes (Harry, Sturges, & Klinger, 2005).

Table 1. Codes used to categorise elementary PT's questions.

| PT Questions | Codes Used |
|---|---|
| Is the question about meeting the needs of the specific student in the video? | The question is specific to that student. The question is general, not specific to student. |
| About which aspect of Pedagogical Content Knowledge (PCK) is the question asking? | Knowledge of Content and Teaching (KCT) Knowledge of Content and Students (KCS) Specialized Content Knowledge (SCK) |
| Is the question specific to a math context? | Non-math context Math context |
| Is the question related to Standard for Mathematical Practice #1? | Explicitly related Implicitly related Unrelated |
| Is the question aimed at an SPED expert? | Aimed at a SPED expert Aimed at any educational professional |

Table 2. Codes used to categorise SPED PTs' responses.

| PT Responses | Codes Used |
|---|---|
| Does the SPED PT directly answer the original question? | SPED PT provides a direct answer SPED PT provides an indirect answer SPED PT does not answer the question |
| About which aspect of Pedagogical Content Knowledge is the question asking? | Knowledge of Content and Teaching (KCT) Knowledge of Content and Students (KCS) Specialized Content Knowledge (SCK) |
| Extent to which the response addressed Common Core Mathematical Practice #1 | Explicitly addresses the mathematical practice Implicitly addresses the mathematical practice No attention to the practice |
| Extent to which response explains how student's special education needs relate to math: | Explains how special education need affects learning in general Explains how special education need affects learning in another content area Explains how special education need affects learning in a mathematical context Does not explain how special education need affects learning |
| Extent to which response recommends instructional practices for the mathematics classroom: | Recommends practices for a math context Recommends practices for another content area (e.g., reading) Recommends practices but not contextualised to content area Does not provide recommendations |
| Extent to which response explains why a suggested practice addresses a special education need | Explanation is specific to the student's needs Explanation is general in nature No explanation |
| Extent to which the recommendations are contextualised in a mathematics classroom context: | Recommendations are contextualised to a math classroom Recommendations are contextualised but to teaching in general Recommendations are not contextualised |

Results

Research Question 1- Elementary PTs' Questions

The elementary PTs asked a total of 54 questions, with a range of 1-5 questions asked per PT. Figure 2 provides a summary of the question characteristics. Overall, the questions tended to be general, meaning that they could have applied to all of the students in the classroom or to students in general, as opposed to addressing the specific student with SEN in the video. As an illustration of these differences, we provide an example from Alessandra who asked this general question: "How much support should be provided to students?" and from Tasha who asked a much more student specific question: "If he has problems with auditory/visual processing and memory, should he have been accommodated with the notes from the board at his desk?"

Elementary PTs typically asked about mathematics teaching moves as opposed to questions about how students learn mathematics or questions about the depth of mathematical understanding needed to teach the material. Using terminology from Ball, Thames, and Phelps (2008) this corresponds to asking about knowledge of content and teaching (KCT) as opposed to knowledge of content and student (KCS) or specialised content knowledge (SCK). Here we provide examples of the knowledge of content and teaching questions and knowledge of content and student questions, and note that there was not one question that addressed specialised content knowledge. Tiffany's KCT question was "What can the teacher do to accommodate this type of problem," and Rolland's KCS question was "[Can you] tell me about auditory and visual processing problems, and how they can affect a student's math learning?"

Most often the questions were not contextualised to the math classroom but could have been generated from the teaching of any content area. In addition most questions did not seem to be aimed at someone with SPED expertise but simply aimed at a general education professional. Elementary PT Kelli asked three questions that illustrate these two typical characteristics:

What do you suggest is the best way to group students? How do you assess whether student learning is increasing or decreasing when students are grouped based upon interests? How often do you change the way the content is taught?

In contrast, PT Shawna asked questions that are contextualised to a math classroom and aimed at a SPED expert:

Would modelling the graph on an individual sheet of paper with the student (individualised instruction for each bar) and then allowing them to copy the model be more supportive than correcting the student's graph? What are audio and visual processing difficulties? What effect does it have on the learning process? What are some strategies to incorporate memory/recall strategies during the creation of the bar graph?

Finally, although elementary PTs were specifically asked to consider how to support the student's engagement in the Common Core Mathematical Practice #1 (CCMP#1: make sense of problems and persevere in solving them), their questions rarely explicitly addressed student engagement in that mathematical practice. One elementary PT, Melanie, explicitly referred to the practice when she asked, "What are the different ways to make sure the student is engaged in CCMP#1?" and another student, Kyle, implicitly referred to the practice when he questioned, "If a student has auditory processing difficulties, how can a teacher assess if the student is benefiting from struggle time?" Aside from these examples, most PTs did not address CCMP#1 at all. This was quite surprising to our research team due to the fact that they had been specifically asked to attend to this in their questioning.

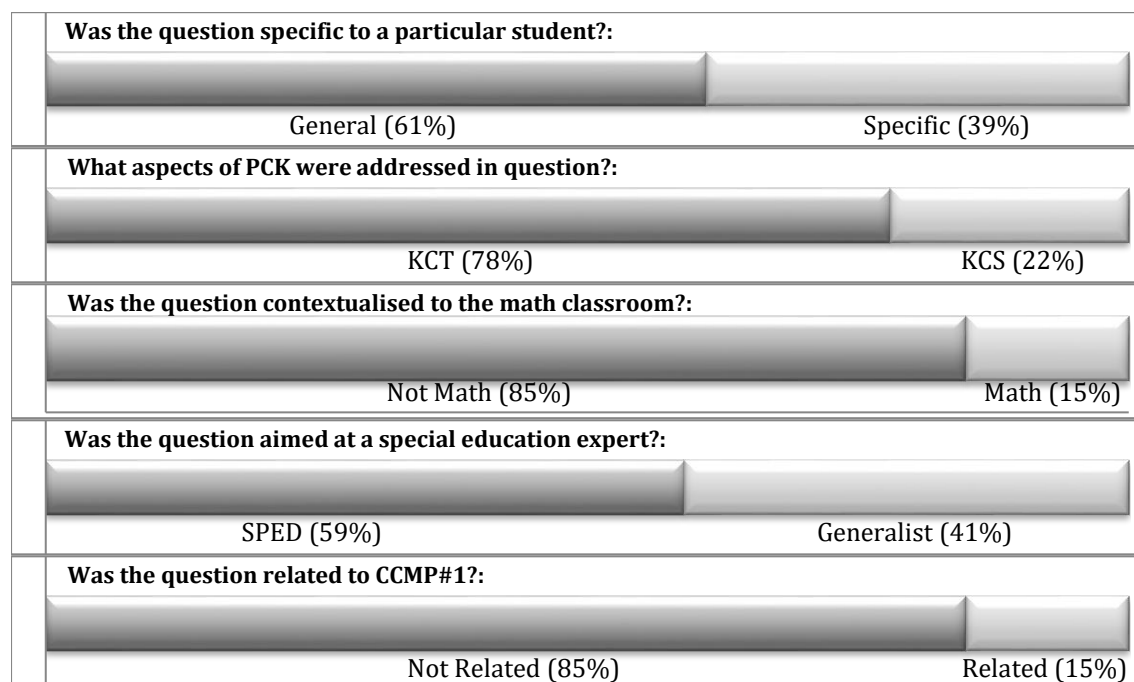


Figure 2. Characteristics of the elementary PTs' questions.

Research Question 2- SPED PTs' Responses

Because the 25 SPED PTs each responded to two elementary PTs' inquiries, there were a total of 50 responses. We first examined the extent to which the SPED responses directly answered the elementary PTs' questions and found that 88% of the elementary PTs' questions were directly answered by the SPED PTs. Figure 3 shows the characteristics of these responses. The majority of responses addressed teaching strategies (KCT). For the elementary inquiries that *did* ask about supporting the student's engagement in CCMP#1, most of the SPED responses did not attend to this query. In addition, most of the responses did not explain how the student's learning exceptionality would affect mathematics.

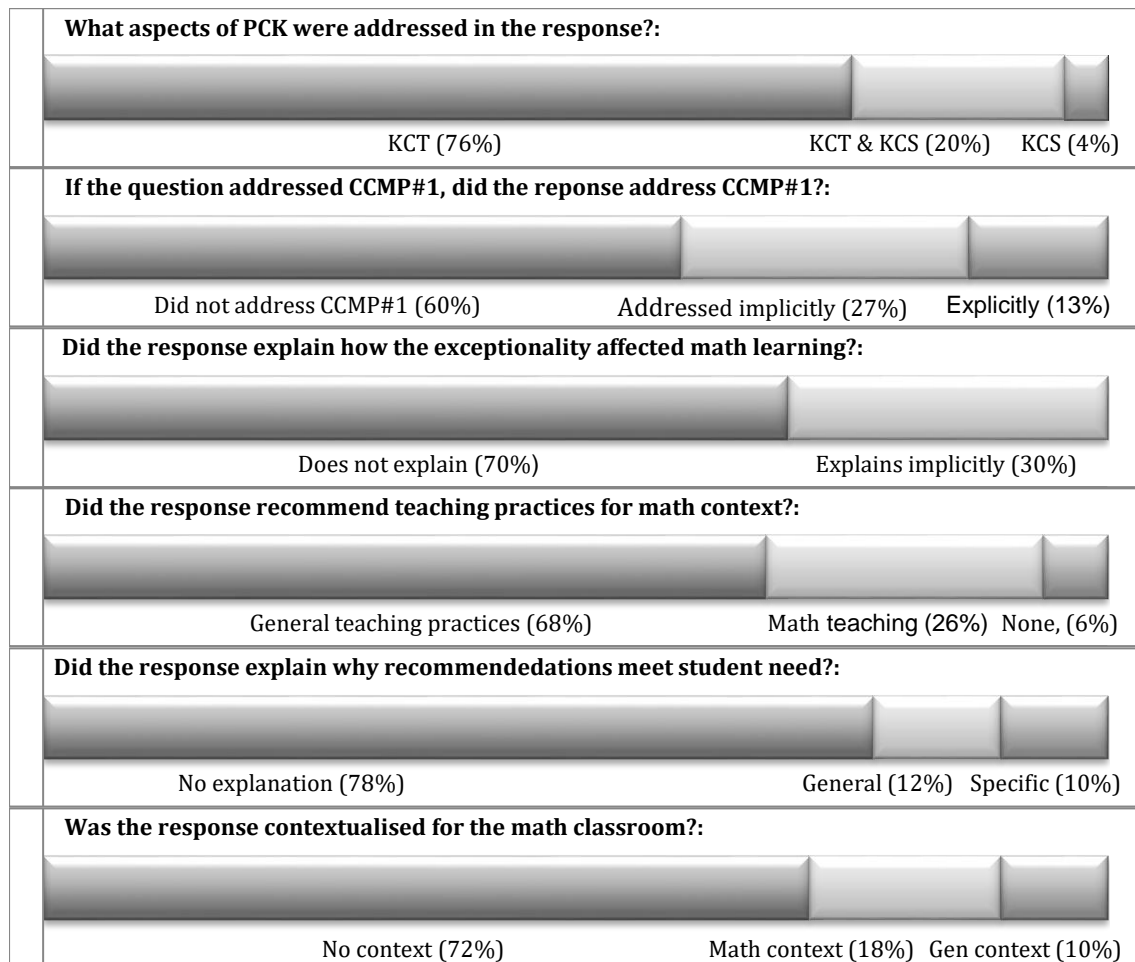


Figure 3. Characteristics of SPED PTs' responses

Most responses made general teaching recommendations as opposed to specific *mathematics* teaching recommendations. The majority of responses also did not explain why recommended practices would meet the student's particular needs as described by the elementary PTs. Finally, most of the SPED PTs did not contextualise their recommendations and explanations to the mathematics classroom. SPED PT Tanya provided a response that was typical of the majority of responses. It is reproduced here along with the elementary PT's original questions.

Elementary PT Wyatt: Should I continue to re-word questions if the student is not understanding or does that confuse them more? What is the best way to engage students that are not on level and struggle to participate? What is the best way to group students that struggle with inattention/distractibility?

SPED PT Tanya: I think that re-wording a question once or twice at the most could help the student to understand. If the student doesn't begin to understand once you have changed the wording then the teacher should try to show the student examples so that the student can see what the teacher wants them to do. . . I

would also help the student one-on-one after class so that the student is not distracted by other classmates or outside noises. The best way to group a student that struggles with inattention/ distractibility is to partner or group them with a student that does not get distracted easily or someone who can keep the student on track. I would also have the student work in the hallway or in a quiet place so that the student does not have as many distractions as they would if they were in a noisy classroom.

As was common among many of the SPED PTs' responses, Tanya's response reflected a lack of consideration for the mathematics context. Her recommendations might have applied equally well to the content area of reading or science as to the content area of mathematics.

Although the data show that there was a general lack of mathematics contextualisation, we wanted to look more closely to see if there were relationships among the contextualised questions and contextualised responses. Figure 4 shows that, if an elementary PT asked a question that was contextualised to the math classroom, then the SPED PT response was 25% more likely to be contextualised to the math classroom than if the question had not been contextualised. However, asking a contextualised question did not ensure a contextualised response.

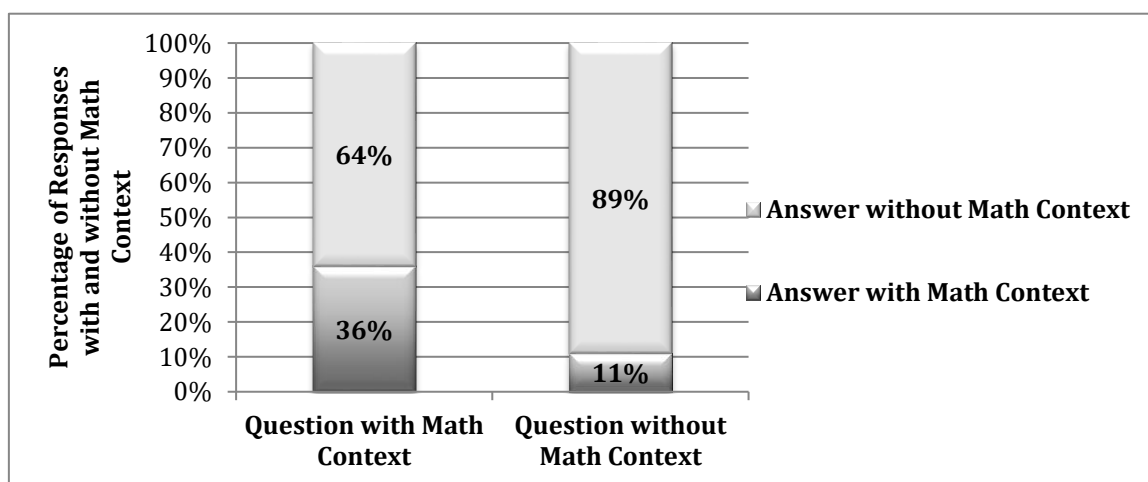


Figure 4. Percentages of SPED PT responses that were contextualised given contextualised and non-contextualised elementary PT Questions.

Discussion

The design of this study allowed us to collect data on steps 3 and 4 of the consultation model: identifying the problem (asking questions) and developing recommendations (providing answers). This data set provided valuable information about the characteristics of the communication between elementary general education PTs and SPED PTs in the absence of specific, explicit preparation for mathematics consultation. Overall, the baseline data revealed that the PTs did not maximise the potential of questioning and responding stages of the consultations. In other words, the elementary PTs, to a large extent, did not tap into the special education expertise of their colleagues. Rarely did the elementary PTs ask about how the SEN affected the mathematics learning. Rarely did the elementary PT attend to either the mathematics content or the student engagement in the mathematical practice. Similarly, the SPED PTs rarely

provided explanations for why their recommendations would address the student's SEN, and rarely did they put their suggestions into the context of a mathematics classroom.

The consultation activity described in this baseline study was a beginning approximation of a mathematics consultation: PTs engaging in written consultation about video cases represented a first step towards engaging in mathematics consultations. This approximation does limit the generalisability of the findings. There is more to learn about how PTs engage in full, face-to-face consultations in school settings. Nevertheless, the baseline data reveal that, in the absence of explicit support for how to engage in mathematics consultation, the majority of this sample of PTs did not contextualise their questions and answers to the mathematics classroom. Their consultations failed to focus in on the mathematics-specific learning of the student with SEN. In the end, we believe the baseline data provide a rationale for developing new ways to prepare PTs to engage in mathematics-specific consultations. In the remainder of this section we discuss implications of the findings. We offer data-informed suggestions as to how mathematics teacher educators might provide support for consultations, and we offer directions for future research.

Lessons from the Data

Two themes that arose from the data were the lack of mathematics context and the lack of attention to the SEN student's engagement in the mathematical practice. In light of these findings, we created specific data-informed suggestions that could guide mathematics teacher educators in supporting greater mathematics specific contextualisation in the *Identify the Problem*, *Develop Recommendations*, and *Finalise the Recommendations/Solidify the Plan* steps of the consultation process (Figure 1). In particular, we developed suggestions for how to support general education PTs in the development of focused questions for the purpose of identifying the problem within the mathematics context. We also developed suggestions to support SPED PTs in the development of recommendations that are relevant to the identified problem and the mathematics context.

Suggestions for *Identify the Problem*:

1. Support the general education PT in providing the SPED PT with information about the mathematics instruction context that will allow the SPED PT to understand the problem.
2. Support the general education PT to frame their questions about the problem in ways that will situate the SPED PT to address knowledge of content and the student (KCS) and knowledge of content and the teacher (KCT).
3. Support the SPED PT to develop an instructional hypothesis that can precisely define the problem with respect to KCS and KCT.

Suggestions for *Develop Recommendations and Finalise the Recommendations/Solidify the Plan*:

1. Support the prospective SPED PT to incorporate information about the student, the mathematics classroom context, and the math practices in their recommendations.
2. Support the general education PT to make sense of the recommendations made by the prospective special education teacher and how they can be contextualised within their mathematics classroom.

In order to actualise these suggestions, we have developed a set of prompts that can be incorporated into teacher preparation when mathematics education and special education teacher educators collaborate to engage PTs in preparation related to mathematics consultations (Table 3). These prompts help the consultants to foreground the mathematics context and to

attend to supporting engagement in the mathematical practices. For example, prompts for the general education PT are meant to encourage the PT to think about the distinction between KCS and KCT and ask questions both about how the exceptionality affects the mathematics learning of the specific student and about teaching strategies for a student with that exceptionality. Table 4 shows the prompts developed to support SPED PTs in developing recommendations that address the learning exceptionality of a student, the math content, and the math practices. For example the prompts for the SPED PT are meant to encourage the PT to think about responding directly to both KCS and KCT questions and giving detailed examples of how suggestions might play out in the mathematics classroom. Both Tables 3 and 4 prompt the consultants to summarise the information they learned from each other in order to promote greater integration of their two domains of knowledge.

Table 3. Recommendations for the Identify the Problem component of mathematics consultation.

| General Education PT | SPED PT |
|---|--|
| 1. Provide SPED consultant with information on the 3 C's: <ol style="list-style-type: none"> a. Child b. Content (Math): Content Standards & Mathematical Practices c. Context (Math Class) | 1. Summarise what you have learned about the 3 C's: <ol style="list-style-type: none"> a. Child b. Content (Math): Content Standards & Mathematical Practices c. Context (Math Class) |
| 2. Ask questions about: <ol style="list-style-type: none"> a. Knowledge of Content and Students <ul style="list-style-type: none"> • How the exceptionality affects the student's learning of this math content • How the exceptionality affects engagement in the mathematical practices b. Knowledge of Content and Teaching <ul style="list-style-type: none"> • What teaching practices are effective for students with this exceptionality? | 2. Create an instructional hypothesis about what the student is able to do and not do in the math class and why this might be the case given the information that was presented. |

Table 4. Recommendations for the Develop Recommendations and Finalise the Recommendations/Solidify the Plan component of mathematics consultation.

| SPED PT | General Education PT |
|---|--|
| <ol style="list-style-type: none"> 1. Explain how the learning exceptionality affects the student's learning of mathematics. 2. Put suggestions into the context of the math classroom. Provide detailed examples of how your suggestions might play out with the math content and in the context of the math classroom that has been presented. 3. Attend to and provide recommendations for supporting student engagement in the mathematical practices. | <ol style="list-style-type: none"> 1. Put the plan into your own words 2. Verify with the SPED consultant that you understand the suggestions and how they would be implemented in the context of your specific classroom and your specific student. |

The prompts depicted in Tables 3 and 4 are intended to provide structure for teacher educators to engage PTs purposefully in math consultations that emphasise the mathematics learning of students with SEN. It is our intention that the results of this study and the suggested prompts in Tables 3 and 4 provide the fields of mathematics education and special education with a starting point for supporting PT engagement in mathematics consultations. We do not assert that these are the only possible suggestions or even the best ones. Our baseline study was not designed to evaluate a mathematics consultation preparation model but to gather data that might inform the need for and development of a future model, starting with key consultation components related to identifying the problem and making recommendations/finalising recommendations and solidifying a plan.

This study is a direct response to Boyd and Bargerhuff's (2009) call for common collaboration experiences during teacher preparation for both general and special education PTs. It is also a response to Karp's (2013) call for greater attention to students with SEN in the context of mathematics methods courses. The data from this study revealed that the consultations lacked mathematics context. Thus the challenge for future research is to design ways in which to prepare both general and SPED PTs for productive mathematics-specific consultations.

Study Limitations and Directions for Future Research

This report has potential to advance the field of mathematics teacher education by spurring dialogue and further research around preparing teachers to leverage mathematics consultations to meet the mathematics learning needs of students with SEN. We have proposed data-informed suggestions for how teacher educators might support general and special education PTs in the consultation steps: *identify the problem* and *develop recommendations*, *finalise recommendations* and *solidify a plan*, and now these suggestions need to be tested empirically. We have also provided recommendations for prompts that collaborative mathematics and special education teacher educators can utilise to structure common opportunities for PTs to engage in mathematics consultations. Central to the consultation process, the suggestions that we have made apply only to three important components of a general consultation model (Figure 1). This is a limitation of our study and additional studies are needed to look at each component of the consultation

process, to explicate the unique characteristics of mathematics-specific consultations for each component, and to determine the most effective means of supporting these components during teacher preparation. Follow up studies could test the recommendations presented in this report, and could also give the PT consultants opportunities to meet face-to-face and to consult about the students with SEN in the classrooms in which they are interning.

Furthermore, additional research is also needed to investigate the effects of mathematics consultations on student learning. Do effective, mathematics-specific consultations lead to improved outcomes for students with SEN? In addition, because of the broad interpretation of the term *SEN*, future research is also needed to determine how mathematics consultations might be tailored depending upon whether the SEN is a disability, difficulty, or disadvantage.

Conclusion

Meeting the mathematics learning needs of students with SEN requires a knowledge base in *both* mathematics education and special education. Lewis (2014) recently demonstrated that students with mathematics learning disabilities have atypical, persistent mathematical understandings that are qualitatively different from students without those disabilities. An implication of this finding is that general education mathematics teachers must find effective ways to address the unique mathematics learning needs of students with SEN. How are mathematics teachers to do this if not through consultation with professionals who have expertise in special education? Yet our study reveals that, without specific preparation on the consultation process, PTs may be unprepared to maximise the consultation opportunity.

Learning to engage in consultation is not automatic, and many other professional fields, such as psychology, social work, nursing, and medicine spend significant time training their practitioners in how to engage in an effective consultation. We believe it is time for the field of mathematics education to do the same. The urgency of this research agenda lies in the fact that the learning needs of many students with SEN are not being adequately met in mathematics classes. The field of mathematics education has long championed the importance of equity for *all* students (NCTM, 2000, 2014). By presenting our emerging research agenda and data-informed suggestions, we hope to encourage greater attention to the potential for the mathematics consultation to advance equity for students with learning exceptionalities.

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ⁱ The NAEP is the largest nationally representative education assessment used in the United States of America. The mathematics portion of the NAEP is administered to students in Grades 4, 8, and 12 (ages 9, 13, and 17) every two years. More information regarding NAEP can be found at the NAEP website (<https://nces.ed.gov/nationsreportcard/>).

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