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# Understanding the Problem Solving Approaches of Special Educators through the Lens of Adaptive Expertise

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UNDERSTANDING THE PROBLEM SOLVING APPROACHES OF SPECIAL EDUCATORS THROUGH THE LENS OF ADAPTIVE EXPERTISE

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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Abstract

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The purpose of this research was to investigate special educators' problem solving approaches through the lens of adaptive expertise. An explanatory sequential mixed methods design was used with participants of varying experience levels and teaching contexts from one Mid-Atlantic state. Participants responded to a researcher-developed survey about their orientations to problem solving ($N = 162$), then a purposive sample completed semi-structured interviews ($N = 8$). Following survey measure refinement and validation, quantitative data were analyzed through descriptive statistics, z-scores, correlation, and chi-square test of independence. Subsequently, qualitative data were analyzed through iterative cycles of hypothesis and open coding. Finally, quantitative and qualitative data were linked through mixed methods analysis.

Results of exploratory factor analysis identified an 18-item, two-factor structure within the survey measure. Survey results indicated most special educators had more adaptive than routine expertise orientations to problem solving; for some these orientations were balanced,

while others had a much stronger orientation to adaptive expertise. Though no statistical relationship was found between teaching experience and participants' degree of adaptive or routine tendencies when problem solving, teachers interviewed spoke of the role of experience in shaping their problem solving approaches. Many also noted that the application of particular approaches were dependent upon characteristics of their teaching contexts. Literature-based indicators of adaptive expertise were evident across examples of problem solving in special educators' narrative data. Together, survey and interview data captured a more comprehensive and nuanced picture of special educators' problem solving in practice than either approach could have alone.

Findings reaffirm the variable and dynamic nature of teaching in special education and the need for understanding what supports teachers' success and longevity in the field. Teacher preparation programs can be designed to set prospective teachers on the trajectory towards adaptive expertise, while in-service teachers can plan for professional growth aligned to a balance between adaptive and routine tendencies as indicators of adaptive expertise. Results inform policy concerning implementation of evidence-based practices and teacher quality in special education.

Chapter I

## Introduction

"Teachers are very important; no other measured aspect of schools is nearly as important in determining student achievement" (Hanushek, 2011, p. 467). In a field defined by the provision of individualized education to meet students' unique learning needs, special education teachers are the driving force, and most important within-school factor behind the positive learning outcomes of students with disabilities (Boe, 2014). Collectively, more than 380,000 special educators (OSEP Data Team, 2014) teach over 13% of enrolled students in the United States (U.S. Department of Education, 2012; Scull & Winkler, 2011). These students may qualify for special education services under one or more of 14 disability categories as delineated by the Individuals with Disabilities Education Act (IDEA, 2004): autism, deaf-blindness, deafness, developmental delay, emotional disturbance, hearing impairment, intellectual disability, multiple disabilities, orthopedic impairment, other health impairment, specific learning disability, speech or language disability, traumatic brain injury, and visual impairment. Although the number of students identified with disabilities and receiving special education services has decreased in recent years (13.1% of enrolled students in 2009-2010) after a peak of 13.8% of the school-age population in 2004-2005, (Scull & Winkler, 2011), the proportions of students identified under the categories of autism and other health impairment have increased (US Department of Education, 2012), as have racial and ethnic diversity among students with disabilities (US Department of Education, 2010b).

Demand for special educators to address the learning needs of this increasingly diverse population of students first began with the influx of students with disabilities into public schools following the enactment of PL 94-142, the Education for All Handicapped Children Act, in 1975 (Brownell, Sindelar, Kiely, & Danielson, 2010). Now, almost 40 years later, demand persists (Boe, 2014; McLeskey, Tyler, & Flippin, 2004) and is complicated by policy and debates regarding teacher quality and accountability standards for student achievement (Sindelar, Wasburn-Moses, Thomas, & Leko, 2014; US Department of Education, 2010a). High quality special educators who possess the knowledge, skills, and dispositions to effectively problem solve in response to challenges associated with the complex nature of individualizing instruction for a diverse student population must be recruited and retained to help ensure positive learning outcomes for students with disabilities (Boe, 2014; De Arment, Reed, & Wetzel, 2013; McLeskey et al., 2004).

**Statement of Problem**

Special education is a field plagued by chronic shortages of qualified personnel (Boe, 2014; Boe & Cook, 2006; McLeskey et al., 2004). Attrition occurs, in part, due to the significant and unique challenges special education teachers face in negotiating their roles and responsibilities in working with students with disabilities (Billingsley, 2004; Boe, 2014; Boe & Cook, 2006; Boyer & Gillespie, 2000; Gersten, Keating, Yovanoff, & Harniss, 2001; McLeskey et al., 2004; Nichols, Bicard, Bicard, & Casey, 2008; Whitaker, 2000). Teacher turnover is especially problematic within the first five years of practice (Fantilli & McDougall, 2009; Gehrke & Murri, 2006). Further, the No Child Left Behind Act (NCLB, 2002) places unprecedented pressure on special educators for the academic performance of their students with disabilities (Kaufman & Blewett, 2012), scrutinizes what it means to be a highly qualified or effective teacher, and emphasizes instruction according to evidence-based practices (NCLB, 2001; U.S. Department of Education, 2010a). Combined with teacher shortages, this focus on quality provokes the need to understand what makes an effective special educator and how pre-service preparation programs and in-service supports can be designed to ensure the development of high quality special educators who persist in the field.

**Rationale for Study of Problem**

Special educators must possess the knowledge, skills, and dispositions to effectively respond to the day-to-day challenges and variability inherent to their teaching positions. Yet, more research is needed that examines the relationship between special educator preparation and the factors that help these teachers find success and thrive once they are on the job (Sindelar, Brownell, & Billingsley, 2010). In the seminal teacher preparation text, *Preparing Teachers for a Changing World: What Teachers Should Learn and Be Able to Do*, Darling-Hammond and colleagues suggest the development of adaptive expertise is essential for teachers working within today's dynamic classroom environments (Darling-Hammond & Bransford, 2005; Hammerness, Darling-Hammond, & Bransford, 2005). Hatano and Inagaki (1986) explained "two courses of expertise": *routine expertise* whereby individuals gain greater efficiency with procedures for solving routine problems, and *adaptive expertise* characterized by flexible problem solving in response to the non-routine. For special educators, being able to flexibly respond to the challenges associated with taking on multiple roles and meeting the individual needs of diverse students with disabilities across various settings and content areas may be critical to their success and longevity in the field (De Arment, Reed, & Wetzel, 2013). Research is needed that examines the application of theoretical understandings of adaptive expertise to special educator development.

Studying how adaptive expertise manifests in the teaching practice of special educators informs the design of supports for in-service special educators' problem solving practices as well as the preparation of special education teacher candidates to ensure their readiness for addressing the real-world challenges of teaching practice. Understanding what experienced and accomplished special educators do to address the challenges they encounter when teaching, and how those approaches may differ from those of beginning special educators, can provide insight into successful strategies to support in in-service special educators and nurture in pre-service special education teacher candidates prior to entering the profession. In turn, well-prepared and supported special educators, who, manifesting the characteristics of adaptive expertise, have the dispositions and skills to be effective problem solvers, may be set on a trajectory for lasting careers in special education.

Studying the problem solving approaches of special educators through the lens of adaptive expertise benefits several audiences. First, this research informs teacher education faculty and special education administrators about the dispositions and skills characteristic of adaptive expertise that enable special educators to effectively problem solve and persist in the challenging field of special education. With this knowledge, faculty can purposefully design preparation program content and field experiences to foster those dispositions and skills. Likewise, special education administrators can orchestrate specific supports that promote adaptive skills and dispositions within in-service professionals. Because this research addresses critical gaps in the literature, results inform other researchers in teacher preparation in special education. In this way, researchers can replicate or extend the work detailed here and further expand the literature base. Finally, this research has implications for educational policy makers and those who work to influence the development of such policy related to teacher quality and evidence-based practices.

**Statement of Purpose**

To be effective, special educators must problem solve when faced with challenges associated with their teaching practice. The overall purpose of this study was to investigate the problem solving approaches of special educators through a lens of adaptive expertise. By studying teachers at several stages of their careers and training across various contexts, more could be understood about how adaptive expertise manifests and is associated with special educators' experience and other characteristics. To address this purpose, first survey data were collected and analyzed to reveal the extent of special educators' more adaptive or more routine approaches to problem solving. Then, based on survey responses, semi-structured follow up interviews were conducted with purposefully selected participants. The goal was to interview participants whose survey responses were of particular interest as illustrative examples of particular orientations to problem solving as identified through quantitative analyses. Interviews yielded descriptive examples of problem solving within special educators' teaching contexts that further explained survey results. Combining quantitative and qualitative methods within a single study allowed for a more complete understanding of special educators' problem solving as a broader range of research questions were able to be examined than if a single method approach was used (Johnson & Onwuegbuzie, 2004). In addition, the weaknesses of one approach were addressed by the strengths of the other. In this research, narrative data added richer meaning to numeric data. Results from this study inform both the literature base on special educator development and the literature base on adaptive expertise.

**Literature/Research Background**

Several critical issues in the field of special education explicate the context of teaching in special education. First, teaching in special education is different from teaching in general education in distinct ways (Sindelar et al., 2014). Special educators have many roles associated with their jobs, teach diverse caseloads of students with disabilities often across content areas and grade levels, and must adhere to legal and paperwork requirements. These characteristics that set special educators apart from their general education colleagues are also the source of many well-documented challenges of practice (Billingsley, 2004; Brunsting, Sreckovic, & Lane, 2014; Gersten et al., 2001), another critical issue. Contextual factors that vary by individual special educator such as availability of materials and resources or demographics of school setting contribute to teachers' perceptions of challenges (Kilgore & Griffin, 1998) and reflect the complexity inherent to special education teaching practice.

Next, in the face of these challenges, special educator turnover is a continual problem and high quality, well-qualified teachers are needed to reduce chronic shortages of special educators (Boe, 2014). To manage challenges, special educators perceive collegial and administrative support as essential (Billingsley et al., 2009), but researchers note some exhibit self-supporting characteristics such as pursuing new learning through professional development (Billingsley, 2004).

A final critical issue pertains implications of policy for special education teaching practice through emphases on teacher quality and implementation of evidence-based practices. Definitions of teacher quality are unclear (Cochran-Smith, Piazza, & Power, 2013). Though some models for teacher quality specific to special education have been offered (Benedict, Brownell, Park, Bettini, & Lauterbach, 2014), more research is needed to understand the characteristics of quality special educators across various measures to inform teacher growth and development as well as recruitment. Further, despite policy emphasis on practices supported by scientific evidence, research-to-practice gaps exist as special educators often rely on personal beliefs over research when making instructional decisions (Boardman, Arguelles, Vaughn, Hughes, & Klingner, 2005; Cook et al., 2009; Kretlow & Blatz, 2011; Kutash, Duchnowski, & Lynn, 2009). Students with disabilities benefit from instructional approaches steeped in an evidence base, however. Therefore special educators need frameworks for understanding how to select and strategically adapt evidence-based practices without compromising fidelity to the approach (Israel, Ribuffo, & Smith, 2014).

Teacher development begins in pre-service preparation and has the potential to continue throughout teachers' careers. Initially, when learning to teach, novices must overcome common barriers to development. These include recognizing the inherent complexity of teaching, challenging pre-existing visions of what good teaching is, and putting research and theory into practice (Hammerness et al., 2005). Studying the practices of expert teachers who embody lifelong learning offers insight into how novice development can be promoted in the face of these barriers (Berliner, 1986, 1994). In turn, overcoming these barriers can support beginning teachers' early steps along the trajectory towards adaptive expertise.

**Conceptual Framework**

Given what is known about the context of teaching in special education and teacher development, adaptive expertise is proposed as a conceptual framework to guide understanding of the nature of special educators' problem solving. Because adaptive expertise is the key construct under study, a full review of the theoretical and empirical literature, particularly in relation to teaching, is presented.

Hatano and Inagaki (1986) conceptualized expertise in terms of two “courses”: routine expertise and adaptive expertise. Routine expertise characterizes individuals who have developed certain skills that they can perform within a stable domain with speed and accuracy. Adaptive expertise describes performance in response to changing, unstable contexts whereby individuals choose to employ an efficient approach or modify their typical approach as warranted by the context. Like routine experts, adaptive experts pursue lifelong learning, but the nature of that learning differs. Whereas routine experts seek knowledge for the purpose of becoming more efficient with a core set of skills, adaptive experts seek to revise and expand their knowledge based on new learning (Bransford, Derry, Berliner, & Hammerness, 2005). As described by the National Research Council (NRC, 2000), adaptive experts “approach new situations flexibly” (p. 48) and pursue new knowledge so that they may do things better, not just more efficiently. Conceived another way, Schwartz, Bransford, and Sears (2005) depict adaptive expertise as the relationship between efficiency and innovation. Whereas a routine expert demonstrates a high degree of efficiency but low innovation, an adaptive expert is equally high in both dimensions (Bransford et al., 2005).

Recently, De Arment et al. (2013) synthesized the literature on adaptive expertise and proposed application of the construct to teacher preparation in special education as a cohesive, guiding conceptual framework. Using this literature as a guide, the current study sought to understand how the conceptual framework of adaptive expertise applies to the problem solving practices of special educators, with the intent of informing teacher preparation policy and practice. De Arment et al. (2013) conceptualized adaptive expertise as being comprised of adaptive dispositions, metacognitive skills, and cognitive skills. Individuals with adaptive dispositions view the world as complex and remain willing to replace previous understandings with new ones so that relying on prior knowledge is not their sole means of problem solving. Asking questions, taking risks, and seeking feedback from others also characterize adaptive dispositions. These individuals are motivated to solve problems, enjoy challenges, and know learning will come form new situations. The metacognitive skills of an adaptive expert consist of much self-assessment. This includes self-monitoring comprehension of a problematic situation and the adequacy of prior knowledge for solving a problem, as well as a strong sense of self as a learner and problem solver. Adaptive experts use metacognitive skills to analyze the feedback they receive from others, tweak their existing problem solving approaches and develop new ones, and monitor those processes and their outcomes. Finally, adaptive experts use the cognitive skills of causal and data-driven reasoning within higher order problem solving approaches. They are cognitively flexible and balance adaptive and routine approaches to meeting challenges, using data and hypotheses to select approaches accordingly. Across metacognitive and cognitive skills, adaptive experts can explain and justify their problem solving approaches and decisions. As presented by Bransford et al. (2005) and De Arment et al. (2013), these adaptive and routine orientations and dispositions, metacognitive skills, and cognitive skills provide the basis for both quantitative and qualitative data collection, and will be used to frame data analyses and draw quantitative, qualitative, and mixed methods conclusions.

Research into the development of adaptive expertise has come primarily from engineering education and medical education fields (e.g., Martin, Rayne, Kemp, Hart, & Diller, 2005; Myopoulous & Regehr, 2009; Pandy, Petrosino, Austin, & Barr, 2004). Despite the extolment of adaptive expertise for teacher development by the NRC (2000) and Darling-Hammond and Bransford (2005), little research examines the adaptive expertise of teachers specifically in the context of PK-12 teaching. Specifically, four studies have investigated the practices of pre-service teachers (Anthony, Hunter, & Hunter, 2015; Hayden & Chiu, 2013; Janssen, de Hullu, & Tigelaar, 2008; Soslau, 2012), one study compared two teachers seeking a reading endorsement (Hayden, Rundell, & Smyntek-Gworek, 2013), four studies have sought greater understanding of the problem solving practices of in-service biology teachers (Crawford, 2007; Crawford, Schlager, Toyama, Riel, & Vahey, 2005; Yoon, Koehler-Yom, Anderson, Lin, & Klopfer, 2015) and prospective engineering design teachers (Martin, Peacock, Ko, & Rudolph, 2015). Special educators, pre-service and in-service, were the focus of only one study related to adaptive expertise (Wetzel, De Arment, & Reed, 2015).

Synthesis of the empirical literature on adaptive expertise reveals several significant gaps that this research sought to address. First, more research is needed with teacher (pre-service and in-service) participants, and with special educators in particular. Second, few measures of adaptive expertise exist and none examine a comprehensive definition of adaptive expertise specifically within the context of teacher development. Third, research examining the developmental trajectory of adaptive expertise is limited.

**Research Questions**

Quantitative, qualitative, and mixed method research questions guided this research investigating the problem solving approaches of special educators. Specific questions included:

1. Does the Special Educators Problem Solving Approaches Survey (SEPSAS) measure special educators' adaptive expertise?
    a. Does the SEPSAS differentiate special educators' adaptive or routine problem solving approaches (Bransford et al., 2005)?
    b. Does the SEPSAS differentiate special educators' adaptive dispositions, cognitive skills, and metacognitive skills (De Arment et al., 2013)?

c. What is the relationship between participants' responses to the SEPSAS and the Adaptive Beliefs Survey (adapted from Fisher & Peterson, 2001)?

2. To what extent are special educators' perceptions of their problem solving approaches as measured by the SEPSAS characteristic of adaptive and/or routine expertise?
3. What relationships exist between special educators' teaching experience and their perceived problem solving practices?
4. How do special educators describe their problem solving and supports in their teaching practice?
5. How do examples from special educators' real world teaching practice relate to their perceptions of their problem-solving approaches as measured by the SEPSAS?

**Methodology**

To study the problem solving approaches of special educators through a lens of adaptive expertise an explanatory sequential mixed methods design was used (Creswell & Plano Clark, 2011). Quantitative data were collected first followed by the collection of supportive qualitative data. Depicted as QUAN → qual, this study employed a fixed design with quantitative priority. The researcher used results of a pilot study of this study's approach sample selection, measures, and study procedures to inform the research.

In the first, quantitative phase of the study, participants initially were recruited through the National Board Certified Teacher (NBCT) database publically available from the National Board for Professional Teaching Standards website (www.nbpts.org). NBCTs from a mid-Atlantic state who agreed to participate were asked to nominate other special educators from their districts. To boost study participation, a second round of participant recruitment was used, targeting other special educators from the NBCTs' school districts who had publicly available email addresses. Those participants were also invited to nominate other special educators. Ultimately, 162 special educators were included in the quantitative phase of the study. Data on demographic characteristics and problem solving approaches were collected using a survey instrument. The first part of quantitative data collection consisted of a researcher-developed measure, the Special Educator Problem Solving Approaches Survey (SEPSAS) which is based upon the Bransford et al. (2005) and De Arment et al. (2013) conceptualizations of adaptive expertise. Participants responded by characterizing their perceptions of how much items targeting either routine or adaptive approaches to problem solving across dispositions, cognitive skills, and metacognitive skills represented their approach to problem solving. The SEPSAS also included three open-ended questions used to prime participants' thinking about their problems of practice prior to completing the survey and several questions to gather demographic information such as licensure status, NBCT status, teaching context, and years of experience. In addition to the SEPSAS, participants responded to the Adaptive Beliefs Survey (Fisher & Peterson, 2001), adapted with permission for the context of teaching. Participants rated their agreement with statements aligned to four constructs underlying adaptive expertise: multiple perspectives, metacognitive self-assessment, goals and beliefs, and epistemology.

Given evidence for construct validity established through factor analysis and correlation with the Adaptive Beliefs Survey (Fisher & Peterson, 2001), the researcher examined survey data to assess teachers' problem solving orientations (more adaptive or more routine) and whether relationships existed between experience level and problem solving approaches. Accordingly, descriptive statistics, correlations, and a chi-square test of independence were conducted. Qualitative data from the few open-ended priming questions of the SEPSAS were analyzed during the qualitative analysis and overall mixed methods analysis following the qualitative phase.

The qualitative phase was conducted as a follow-up to the quantitative phase to help explain the quantitative results. In this exploratory follow-up, a purposive sampling of special educators with adaptive and routine problem solving approaches ($N = 8$) were interviewed about their everyday teaching practices. Purposive sampling was used to select individuals representing variability across SEPSAS score profiles, experience levels, and teaching levels. Through a recursive process, the researcher engaged in two main coding cycles across qualitative data consisting first of attribute coding, hypothesis coding, (Saldaña, 2013) and open coding (Corbin & Strauss, 2008). Pattern coding (Miles & Huberman, 1994) proceeded during the second cycle. Data display matrices of participants and codes were used to aid theme development within and across participants (Maxwell, 2013; Miles & Huberman, 1994).

To understand how special educators' experiences inform their survey responses the findings were synthesized across the quantitative and qualitative phases to determine how selected participants' interview data help explain nuances of their problem solving approaches as indicated by their survey responses. Joint data displays linking qualitative themes to quantitative results were created to facilitate analyses (Creswell & Plano Clark, 2011; Sandelowski, 2003). Qualitative data gathered from the SEPSAS priming questions added to this overall analysis.

**Definition of Terms**

**Special educator.** The National Center for Educational Statistics of the U.S. Department of Education defines a special education teacher as one who "teach[es] special education classes to students with disabilities (U. S. Department of Education, 2011, p. 4). In this study, a special educator is defined as any teacher who instructs students (age 5-21) or young children (age 3-5) with disabilities who require special education services as delineated by Parts B and C of IDEA. This teaching position is distinct from special education administrators, and related service providers such as speech-language pathologists, occupational therapists, and physical therapists. Special educators develop and implement individualized education plans for the students they teach. For the purpose of this study, a special educator also is fully licensed and credentialed by the state in which s/he works.

**Novice special educator.** Other research has defined beginning special education teachers as being in their first year of teaching (Gehrke & McCoy, 2007; Griffin, Kilgore, Winn, Otis-Wilborn, Hou, & Garvan, 2009; Whitaker, 2000; Whitaker, 2001; Whitaker, 2003), first and second years of teaching (Conderman & Stephens, 2000; Kilgore & Griffin, 1998; Youngs, Jones, & Low, 2011), or as having five or fewer years of teaching experience (Billingsley, Carlson, & Klein, 2004; Fall & Billingsley, 2011). For the purpose of this study, a novice special educator is a licensed teacher who has taught in the field of special education for fewer than three full years. This distinction is made because it is within the "early career" timeframe suggested by previous research and during their first three years of teaching, novice special educators are ineligible for pursuing National Board Certification.

**Experienced special educator.** An experienced special educator has three or more full years of special education teaching experience but has not achieved National Board Certification. Lack of the advanced credential may be due to not pursuing National Board Certification or an unsuccessful attempt to certify.

**Accomplished special educator.** Special educators who have earned National Board Certification as Exceptional Needs Specialists are defined as accomplished. The National Board for Professional Teaching Standards requires teachers to be licensed and have completed at least three full years of teaching to be eligible to be a candidate for certification (NBPTS, 2013). To become certified, eligible candidates much proceed through a rigorous assessment process consisting of in-depth reflective analysis of teaching, documentation of accomplishments outside of required teaching responsibilities that impact student learning, and performance on a test of content knowledge.

**Problem/challenge.** As in previous research (e.g., Conderman & Stephens, 2000; Kilgore & Griffin, 1998; Whitaker, 2001; Youngs, Jones, & Low, 2011), problems or challenges will be defined by the special educator participants through the way they think about their own teaching practices. As a result, the researcher will not presume to categorize aspects of special educators' practice as problematic or challenging unless described as such by the participant. Used interchangeably, these terms will describe situations encountered within special educators' work and will form the impetus behind their problem solving approaches.

**Problem solving.** The conceptual framework of adaptive expertise defines problem solving along the dimensions of efficiency and innovation (Bransford et al., 2005; De Arment et al., 2013). A special educator's particular problem solving approach may draw upon what is already known and able to be applied efficiently, thus characteristic of a routine orientation to problem solving. Conversely, an adaptive orientation to problem solving describes the selective application of routine responses or innovative strategies to address challenges based on critical consideration of knowledge, data, and multiple perspectives. As conceptualized by De Arment et al. (2013) and explained in greater detail below and within the Literature Review, certain dispositions and cognitive and metacognitive skills underlie adaptive expertise, and thus an adaptive orientation to problem solving.

**Dispositions**. As defined through the conceptual framework of adaptive expertise, dispositions include the habits of mind, learning orientations, and epistemologies of special educators in relation to how they approach problem solving in teaching.

**Cognitive skills**. Cognitive skills are the thinking processes employed by special educators when problem solving, as defined by the adaptive expertise framework (De Arment et al., 2013). These skills include employing cognitive flexibility, engaging in causal reasoning, and using data to guide decision-making.

**Metacognitive skills**. McCormick (2003) offers the simplified definition of metacognition as "thinking about thinking" (p. 79). Accordingly, in the context of the current study, metacognitive skills are the skills special educators possess to reflect upon their learning and problem solving approaches. These skills are not overtly visible because they take place within the teacher's mind. Therefore, to understand special educators' metacognitive skills, the teachers must make their inner thoughts about their teaching practices "visible" by responding to specific prompts via the survey and interview protocol measures used in the research.

Chapter II

## Review of Literature

Teaching in special education contains challenges and complexities unique to the field. Special educator turnover in the face of these challenges and complexities is an on-going issue. Understanding the nature of special educators' efficient and innovative problem solving to address challenges encountered in everyday teaching has implications for special educator development and retention. This chapter begins with an overview of related literature on critical issues in teaching in special education and teacher development that provide context for the study. Next, a systematic review of the literature on the conceptual framework of adaptive expertise is presented, including theoretical positions, and empirical findings. Finally, the relevance of adaptive expertise to teacher preparation and professional standards is explored.

### Critical Issues in Teaching in Special Education

To understand the current context of teaching in special education, several critical issues must be considered. These include (1) the distinct differences between teaching in special education and general education; (2) the challenges associated with teaching in special education; (3) special educator shortages; (4) special educators' perceived supports; and (5) the current policy climate, including emphases on teacher quality and evidence-based practices. Examining the literature across these contextual considerations is important for understanding how special educators address problems they encounter in their teaching practice.

**Teaching in special education is unique**. Though there are commonalities among all teachers such as the importance of reflective practice and improved learning outcomes for all students, teaching in special education is distinctive from teaching in general education for many reasons. Understanding exactly what makes the context of special education unique for teachers and teaching is a foundational step to understanding other critical issues in the field, implications for special educator pre-service and in-service development, and the relevance of the current research.

Sindelar et al. (2014) and others outline characteristics of special education teaching practice that set it apart from general education. From licensure to service delivery, roles and responsibilities to student needs, the differences are substantial. Licensure in special education across the US is often very broad, spanning K-12 and various disability categories. Preparation must be broad to meet the qualifications for such licensure (Sindelar et al., 2014), yet breadth does not equal depth. Special educators cannot possibly become experts in many different disabilities, manifested in unique constellations of strengths and needs, across the range of content areas, social skills, behavioral skills, and learning strategies from kindergarten through high school. Yet despite lack of training, they may teach students with a range of disabilities, ages, grades, and ability levels in a given classroom (Kaff, 2004). In contrast, general educators typically have licensure for a more focused range of grade levels and content areas. Thus the necessary content knowledge and pedagogical competence are likewise more focused and reasonably attainable.

Among the expectations inherent to the job of a special educator are development and adaptation of curriculum, student evaluation and data collection, knowledge of medical considerations of students, knowledge and preparation of special education paperwork, and collaboration with a variety of individuals (Boyer & Lee, 2001; Kaff, 2004; Youngs et al., 2011). In a study investigating special educators' roles and other workplace factors, Kaff (2004) suggests special educator roles include a combination of teacher, coteacher, coplanner, collaborative consultant, team member, case manager, student advocate, diagnostician, and resources manager. These lists exemplify task variation and role complexity in special education. On top of these activities and roles, special educators must be prepared to teach diverse students across a range of service delivery options. Increasingly, students with disabilities are included in the general curriculum; thus, special educators must collaborate closely with general educators to support inclusive education, while at the same time juggling responsibilities as case managers and advocates (Kaff, 2004; Sindelar et al., 2014).

**Challenges of special educators.** Many of the factors that set special educators apart from general educators are also challenging aspects of their jobs. Broadly, challenges stem from role complexity, teaching complexity, and legal requirements. Across these three broad categories, contextual factors also influence special educators' perceptions of challenges. The challenges presented next are well documented across the literature on beginning teachers in special education as well as literature on the attrition and burnout of experienced special educators.

As noted previously, special educators may function in many, increasingly complex roles (Benedict et al., 2014). Operating within these various roles presents significant challenges to special educators' time for satisfying the requirements of diversified responsibilities as well as planning and collaboration (Brunsting et al., 2014; Conderman & Katsiyannis, 2002; DeMik, 2008; Hillel Lavian, 2015; Kaff, 2004). Roles may be ambiguous as well, where special educators are asked to work with students not on their caseloads, with students across a variety of settings (Youngs et al. 2011), or with disconnects between their licensure and teaching assignment (Busch, Pederson, Espin, & Weissenburger, 2001; Gehrke & Murri, 2006). These ambiguities lead to stress related to job design and decreased job satisfaction (Gersten et al., 2001). Role conflicts may emerge in collaborative relationships with general educators to support inclusion (DeMik, 2008) manifested through communication, planning, and instructional delivery challenges (Billingsley, 2004; Sindelar et al., 2014).

The nature of teaching diverse students with disabilities also presents many challenges for special educators. Understanding and negotiating the general curriculum across multiple grade levels or content areas for students with an array of disabilities and cultural and linguistic diversity is a continual challenge, particularly for beginning special educators (Billingsley, 2004; Boyer & Lee, 2001; Busch et al., 2001; Carlson, Brauen, Klein, Scholl, & Willig, 2002; Emery & Vandenberg, 2010; Kilgore & Griffin, 1998). Further, special educators may be overwhelmed by heavy caseloads (Billingsley, 2004; Emery & Vandenberg, 2010; Kaff, 2004). Other curriculum-based challenges include finding the time to cover the required curriculum (MacDonald & Speece, 2001) and having to create curriculum to meet individualized needs (Carter & Scruggs, 2001; Kaufhold, Alverez, & Arnold, 2006; Whitaker, 2003; White & Mason, 2006; Youngs et al., 2011). Some special educators feel they lack necessary training for meeting individualized needs of students and that professional development opportunities are sparse (Collins, 2007; Conderman & Katsiyannis, 2002). Managing students' problem behaviors is another area of struggle for many special educators (Billingsley, Crockett, & Kamman, 2014; Brunsting et al., 2014). They may encounter great emotional and behavioral variability across the students with whom they work (Hillel Lavian, 2015; MacDonald & Speece, 2001) or work in cramped or overcrowded environments that compound the challenge of supporting positive behavior (Carter & Scruggs, 2001). Rather than being able to focus on the business of teaching and learning, some special educators may feel their time is consumed by working to keep problem behavior under control (Kilgore, Griffin, Otis-Wilborn, & Winn, 1998).

Challenges related to the legal requirements of special education include overwhelming amounts of paperwork (Billingsley, 2004; Boyer & Lee, 2001; Brunsting et al., 2014; Conderman & Stephens, 2000; DeMik, 2008; Kaff, 2004), navigating the continuum of placements and inclusive opportunities for students (Gehrke & Murri, 2006; Kilgore et al., 1998; Sindelar et al., 2014; Youngs et al., 2011), and frustrating disconnects between special education bureaucracy and teachers' abilities to meet the needs of their students (Kilgore & Griffin, 1998). For some beginning special educators, understanding the special education system in their schools is their greatest area of need (Whitaker, 2003).

Contextual factors influence special educators' perceptions of challenges (Kilgore & Griffin, 1998). Therefore, while commonalities exist among the challenges experienced by special educators, individual teaching contexts cannot be discounted. Contextual factors include the nature of the disability program in which teachers work (Collins, 2007; Kilgore & Griffin, 1998; Major, 2012), perceived support from administrators (Billingsley et al., 2014; Brunsting, 2014; Gersten et al., 2001), availability of resources (Carter & Scruggs, 2001; Kaufhold, Alverez, & Arnold, 2006; Whitaker, 2003; White & Mason, 2006; Youngs et al., 2011), proximity to a general education classroom for collaboration, and frequency of interactions with colleagues (Griffin et al., 2009). Geographic location of schools (i.e., rural, urban, suburban) is also a factor that influences working conditions (Collins, 2007; Fall & Billingsley, 2011). Though not an exhaustive list, these factors underscore the importance of understanding the particular teaching context of special educators in relation to their approaches for addressing these challenges.

**Special educator shortages.** Though in recent years demand has decreased, due, in part, to fewer students receiving special education services (Boe, 2014), shortages of fully-certified, extensively prepared, high quality special education teachers persist (Boe & Cook, 2006). Boe (2014) identifies three components of special educator turnover that result in 25% of special educators leaving their teaching positions annually: leaving teaching (attrition), leaving special education for a different teaching job, and moving to a different school. The many challenges associated with teaching in special education are related to, though not wholly responsible for, all three aspects of special educator turnover (McLeskey et al., 2004). One study reports approximately 25% of special educators who leave teaching do so due to dissatisfaction with their jobs or to pursue what they perceive to be better job opportunities (Boe, Cook, & Sunderland, 2008). In response to the revolving door of special educators, school administrators often turn to provisionally licensed or otherwise under-qualified teachers to fill teaching positions (Boe, 2014). This "fix" is often only temporary, however, as teachers without special education certification are more likely to leave these positions than those with certification (Billingsley, 2004).

Age and experience are other factors related to teacher turnover (McLeskey et al., 2004). In her comprehensive review of the special education teacher retention and attrition literature, Billingsley (2004) identified age as a consistent factor linked to attrition. Specifically, younger, inexperienced special educators were more likely to leave or express intent to leave their jobs than their older, more experienced colleagues. In their study, Smith and Ingersoll (2004) found newly hired special education teachers to be about 2.5 times more likely to leave teaching than other teachers entering the profession.

**Special educator supports.** To help address the many challenges associated with special education teaching practice and ameliorate chronic turnover, researchers have investigated what supports are available and perceived as valuable by special educators, particularly novices. Two broad categories of supports evident across the literature are of particular relevance to the current research: support through collegial interactions and supports that come from within special educators themselves.

Special educators perceive support from others within the professional sphere to be essential to their ability to cope with the many challenges associated with special education teaching practice. These include colleagues within and outside of special education, assigned mentors, and administrators. Beginning special educators value shared experience and relevant expertise, perceiving mentors as helpful if they teach within the same school and in similar grade levels with students with the same or similar disabilities (Gehrke & Murri, 2006; Whitaker, 2000; White & Mason, 2006). These novice teachers identify other special educators as significant sources of support (Kilgore et al., 1998) and sources of information and collegiality (Gehrke & Murri, 2006). If not assigned a formal mentor, new special educators may seek out other special educators for support (Busch et al., 2001). As noted by Kilgore and Griffin (1998), "the most substantial discussions concerning teaching and learning [for beginning special educators] occurred with special education colleagues" (p. 163). Mentors and special education colleagues are also sources of emotional support for new special educators (Billingsley et al., 2009; Gehrke & McCoy, 2007; Wasburn et al., 2013; Whitaker, 2000; White & Mason, 2006). General education colleagues, too, are potential sources of support, particularly in relation to collaborative relationships for inclusion of students with disabilities. Special educators value general education colleagues who have knowledge of special education as well as dedicated time for collaborative planning (DeMik, 2008; Kaff, 2004).

Gersten et al. (2001) found administrative support significantly related to special educators' job satisfaction. Administrators provide support through giving praise, showing interest and concern, helping special educators define their roles, and providing financial support for acquiring materials (Billingsley, 2004; Boyer & Lee, 2001; Youngs et al., 2011) and opportunities for professional development (Gersten et al., 2001; Major, 2012). Principals also are supportive by being receptive to special educators' needs and concerns, engaging in collaborative problem solving, and at times, by allowing special educators to do their jobs without administrative interference (Fall & Billingsley, 2011; Gehrke & Murri, 2006).

Special educators also find support within themselves manifested through their professional dispositions and orientations toward learning and improving their teaching practice. Special educators value opportunities to further their learning whether through research or professional development opportunities (Billingsley, 2004; Collins, 2007; Gersten et al., 2001). They seek a greater role in decision-making processes related to the learning of and implementation of services for students with disabilities (Kaff, 2004). While they do not always give themselves credit, successful special educators respond to challenges with energy, enthusiasm, dedication (Busch et al., 2001), and determination (Boyer & Lee, 2001). Gehrke and McCoy (2007) termed this category of attributes "the resourcefulness of self" (p. 494) as they described how special educators sought ways to solve their problems of practice during their first year of teaching. In particular, they noted how special educators exhibited initiative, creativity, and reflection on their teaching, evaluating not only their students' progress but their own development as well. These characteristics embody the call by Benedict et al. (2014) for special educators to continually pursue growth and greater expertise by “taking charge of [their] professional learning” (p. 147).

Illustrating the interconnectedness of collegial relationships and self-regulated problem-solving strategies, special educators seek out help when they need it and vent with peers to manage the challenges of practice (Conderman & Stephens, 2000). Novice special educators cite the importance of capitalizing on opportunities for informal support from other teachers such as unscheduled meetings (Boyer & Lee, 2001; Whitaker, 2000) or “running into someone at the copy machine” (Gehrke & McCoy, 2007, p. 494). Informal support may take place through email exchanges when face-to-face meetings are not possible (Youngs et al., 2011).

In a given special education teaching position, teachers may have little control over the types of external supports available to them for addressing the problems or challenges of practice. In the absence of formal supports structured by an individual school or district (such as an induction program, assigned mentor, or required professional development), special educators may rely on self-support through personal characteristics and a desire to seek out support through interactions with colleagues and new learning. These self-driven supports may be of particular importance for special educators because they are potentially available in any given teaching situation, regardless of the availability of formal support structures. Further, supports nurtured from within can potentially address the dynamic, changing instructional contexts inherent to teaching in special education.

**Policy climate.** Though not always congruent with practice in the field, policy directly influences teaching in special education. IDEA and NCLB guide the delivery of public education to young children and students with disabilities in the United States. At the same time, critics from within and outside of the profession debate the rights, wrongs, and future directions of these policies. Special educators, though often removed from the melee of policy debate, are nevertheless directly experiencing what it means to teach students with disabilities on a day-to-day basis. Two policy topics of most relevance to special educators through the current research are (1) defining teacher quality and (2) emphasis on implementation of evidence-based practices.

***Teacher quality.*** Research points to teacher quality as the most important factor related to student achievement (Hanushek, 2011; McLesky & Ross, 2004). Yet, no single agreed upon definition of what makes a teacher "high quality" exists (Berliner, 2005; Cochran-Smith et al., 2013; Goldhaber & Anthony, 2004; Hodgman, 2012). Reflecting this complexity, Darling-Hammond (2013) suggests teacher quality is comprised of "the bundle of personal traits, skills, and understandings an individual brings to teaching, including dispositions to behave in certain ways" (p. 11). NCLB equates teacher quality with meeting the requirements of having "highly qualified" status. To earn this designation, teachers of core subject areas must meet minimum requirements of (1) having a bachelor's degree, (2) having state licensure in the area in which they teach, and (3) proving their knowledge of the subject matter they teach (NCLB, 2002). As such, recent educational legislation defined teacher quality through the credentials teachers have earned and their performance on content-specific assessments. Although NCLB does not elaborate on teacher quality beyond the highly qualified requirements, the policy has set the tone for teacher accountability for student achievement (Cochran-Smith et al., 2013). Accordingly, other determinations of teacher quality, such as value-added models (Braun, 2005), involve using student achievement data as a metric (Cochran-Smith et al., 2012). Such quantitatively-driven approaches strive to capture an objective measure of teacher quality (Hodgman, 2012). Others support teacher quality determinations based on more subjective teacher characteristics such as their dispositions (Hodgman, 2012), self-efficacy (Carlson, Lee, & Schroll, 2004), and reflective practice (Amobi, 2006).

For special educators, defining teacher quality is complicated by unique factors that set them apart from general educators (Carlson et al., 2004). Teacher shortages, certification requirements, instructional orientation towards individual students, and students' abilities to demonstrate progress towards individualized education plan goals obfuscate a uniform understanding of teacher quality in special education (Jameson & Huefner, 2006). Yet, current legislation does not acknowledge these unique circumstances. As suggested by the Council for Exceptional Children (CEC, 2012), defining teacher quality in special education requires a tailored approach that takes into consideration the unique context of special education. Therefore, evaluating the quality of special educators should likewise comprise more than one source of data. As noted by Stronge et al. (2007), "teacher quality is multi-dimensional and complex in nature, and therefore, should be measured in multiple ways" (p. 186).

One framework for understanding special educator quality suggests expertise in teaching in special education is comprised of specialized knowledge, action, and dispositional dimensions that teachers must actively, and often independently, seek to develop in order to ensure student growth and learning outcomes (Benedict et al., 2014). In this special educator expertise framework, *knowledge* consists of both in-depth knowledge of students as well as pedagogical content knowledge. Benedict et al. (2014) state the *actions* of effective special educators include collaboration, time management, explicit teaching with repeated practice for students, purposeful instruction, and cultivation of a safe and respectful learning environment. Finally, quality special educators exhibit the dispositional characteristics of persistence, reflective analysis of practice and student learning, and a willingness to innovate to support student learning (Benedict et al., 2014). This framework speaks to the multidimensionality of teacher quality in special education, and suggests actions and dispositions characteristic of adaptive expertise are important indicators of quality.

A growing body of research supports the relationship between National Board Certification status and teacher quality as indicated by positive impact on student achievement and teacher or administrator perceptions (e.g., Goldhaber & Anthony, 2004; Hakel, Koenig, & Elliott, 2008; Park, Oliver, Johnson, Graham, & Oppong, 2007; Vandevoort, Amrein-Beardsley, & Berliner, 2004). Vandevoort et al. (2004) examined the relationship between National Board Certification and student achievement on the Stanford Achievement Test-9th Edition. In comparing the performance of third through sixth grade students across four years of test data captured through adjusted gain scores, the researchers found better performance of students of NBCTs than those of non-NBCTs across almost 75% of the 48 comparisons conducted. Vandevoort et al. (2004) also administered surveys to teachers and principals to capture their perceptions of National Board Certification. Many teachers reported their perception of the National Board Certification process as challenging and an avenue for professional growth. NBCT survey respondents felt the certification process made them better teachers because of their critical reflection on their practice, improved student outcomes, or an increased analytical approach to instruction. Over 85% of principals rated their NBCTs as "one of the best teachers" (Vandevoort et al., 2004, p. 26) compared to all of the teachers they had supervised, using terms such as *collaborative*, *organized*, *dedicated*, and *motivating* to describe those who had obtained the advanced certification.

Other research suggests National Board Certified status improves teacher effectiveness through enhanced professional development. For example, through semi-structured interviews with 14 teachers who had either achieved National Board Certification, engaged in the certification process, or considered pursuing certification, Park et al. (2007) noted collegial interactions related to the certification process supported teachers' professional growth. Specifically, participants discussed professional development that entailed enhanced reflection on practice, the creation of a community for professional discourse, higher standards for teaching, and facilitation of collaboration among teachers. Similarly, in-depth study of the teaching practices of NBCTs and non-Board certified teachers revealed clear differences between the two groups across 13 attributes of teaching expertise (Bond et al., 2000). Board-certified teachers outperformed non-Board certified teachers in all areas measured including problem solving and instructional improvisation.

Few studies have specifically investigated special educator teacher quality as a result of National Board Certification as an Exceptional Needs Specialist. Using case study comparisons, Scheetz and Martin (2006) qualitatively sought understanding of the similarities and differences between Board-certified and non-Board-certified master special education teachers of deaf students. Findings indicated both groups of teachers were "highly skilled professionals who took pride in their work" (Scheetz & Martin, 2006, p. 81). Differences were noted between the two groups of teachers in that NBCTs discussed their increased reflective practice, but this theme was not apparent among non-NBCTs. Contrary to expectations, non-NBCTs, but not NBCTs, explicitly discussed the importance of developing critical thinking skills for their students. Wasburn, Wasburn-Moses, and Davis (2012) surveyed a random sampling of Exceptional Needs Specialists who certified in 2006 about the frequency of their participation as mentors in formal and informal mentoring across 19 identified mentor activities. Of the 66 NBCTs who responded to the survey (66% response rate), only 9.2% had never served in a mentoring role; those with mentoring experience indicated greater participation in mentoring activities through informal than formal mentoring relationships. Wasburn et al. noted mentoring activities such as guiding curriculum implementation, and providing emotional support, encouragement, and professional advice were most common across both formal and informal mentoring relationships.

Most research on whether National Board Certification status makes a difference in terms of effective teaching practices and student achievement indicates supportive findings (National Conference of State Legislatures, 2013). In addition, ample research points to teacher perceptions of improved teaching quality through increased reflection and analysis on practice (e.g., Park et al., 2007; Scheetz & Martin, 2006; Tracz, Daughtry, Henderson-Sparks, 2005). What is not known is how adaptive expertise manifests for NBCTs and whether there are differences in approaches to problem solving in comparison to non-NBCTs.

***Evidence-based practices.*** In addition to teacher quality, current educational legislation emphasizes accountability for the learning outcomes of all students through the use of instructional practices drawn from scientifically based research (IDEA, 2004; NCLB, 2002). Educational research based in science aims to find out "what works" through rigorous and systematic methods of testing interventions (Kretlow & Blatz, 2011). In 2002, the Institute for Educational Sciences established the What Works Clearinghouse (WWC) whose mission is to provide educators with the information they need to make evidence-based decisions about instructional practices (WWC, 2014). When scientifically based studies showing cause-and-effect support of an intervention can be aggregated, they constitute an evidence base. Thus, evidence-based practices to support teachers' instructional decision making are those interventions for which the quality and quantity of research are sufficient to constitute strong and compelling evidence base (Coalition for Evidence-Based Policy, 2003; Kretlow & Blatz, 2011).

This policy imperative has considerable implications for the instructional practice of special educators in meeting the needs of diverse students. For young children and students with disabilities, applying practices that are known to be effective is especially important because of their knowledge and skill deficits in comparison to grade level standards (Cook, Tankersley, & Landrum, 2009). Use of evidence-based practices can facilitate a more efficient path to positive learning outcomes and growth through application of instructional strategies with proven track records. Yet, the business of teaching students with disabilities is highly complex due to its individualized and highly contextual nature (Odom et al., 2005). Due in large part to this variability, there is a research-to-practice gap in special education. Often special educators rely more on personal beliefs than objective evidence when making instructional decisions and/or fail to implement evidence-based interventions with fidelity (Boardman et al., 2005; Cook et al., 2009; Kretlow & Blatz, 2011; Kutash et al., 2009). Furthermore, as noted by Odom et al., "Researchers cannot just address a simple question about whether a practice in special education is effective; they must specify clearly for whom the practice is effective and in what context." (p. 141).

The interface between evidence-based practices and the realities of teaching in special education suggests the need for helping special educators understand how to apply professional wisdom while maintaining treatment fidelity (Cook et al., 2009; De Arment et al., 2013; Kretlow & Blatz, 2011; Mason-Williams, Frederick, & Mulcahy, 2014). Special educators must know how to choose appropriate evidence-based practices given their particular instructional contexts and learner characteristics, as well as how to make data-based adaptations that place minimal threat to treatment fidelity (Boardman et al., 2005; Kretlow & Blatz, 2011).

One approach to facilitating teachers' flexibility to adapt evidence-based practices is through application of the universal design for learning framework (UDL; Israel et al., 2014). UDL recognizes that all learners are not created equal, and that traditional approaches to teaching and learning create barriers due to a lack of responsiveness to learner diversity (Rose, Harbour, Johnston, Daley, & Abarbanell, 2006). Thus, to maximize student learning, teachers must be flexible, representing content in multiple ways, giving students options for action and expression in response to content, and capitalizing on students' interests to facilitate engagement (CAST, 2011). By embedding evidence-based practices within the UDL framework, teachers can explore variations for meeting diverse learner needs without compromising the integrity of instructional approaches that are known to be effective (Israel et al., 2014). UDL enables teachers, special educators included, to extend the reach of evidence-based practices to a wider student population, demonstrating the thoughtful adaptation and flexibility characteristic the adaptive expertise.

**Summary of Contextual Factors**

The world of the special educator is multifaceted. With roles and responsibilities distinct from their general education counterparts, special educators must navigate many challenges steeped in the contextual factors of their individual teaching settings. Although they find support through collegial interactions and in their own drive to learn about and develop their teaching practice, turnover remains a chronic issue. Policy emphasis on use of evidence-based practices with fidelity adds further complication to special educators' responsibilities. As "teacher quality" in special education remains a moving target, more research is needed to understand what contributes to special educators' success and longevity in the field given these many challenges and complexities. This research contributes to this understanding by investigating evidence of special educators' adaptive expertise when problem solving.

**Teacher Development**

Teacher development proceeds in response to a proclivity for lifelong learning. Therefore, development is not relegated solely to the domain of pre-service teacher preparation, though this is where the seeds of lifelong learning are sown (Bronkhorst, Meijer, Koster, & Vermut, 2011). Teacher learning is ongoing, through accumulated experiences across teaching practice, beginning in pre-service preparation with guidance from teacher education faculty, and continuing through the pursuit of new knowledge, engagement with colleagues, and critical self-reflection on the lived experience of being a teacher. Though a full review of the teacher development literature is beyond the scope of this review, several important aspects of this theoretical and research corpus are discussed: (1) learning about development from expert teachers; (2) novice problems in learning how to teach; (3) the *learning in community* framework for new teacher development; and (4) a model for special educators' independent professional development.

Though many theorists have offered models of teacher development, Berliner (1986, 1994) has particularly focused on understanding teacher development through comparing novices and experts. Through his research, he proposes a stage theory of progression from novice to expert whereby teachers develop through advanced beginner, competent, and proficient stages along the way. Though Berliner notes not all teachers will reach the expert stage (Berliner, 2001), by studying expert teachers researchers can learn about their thought processes, well-established routines, and exemplary practices for the purposes of informing teacher preparation

(Berliner, 1986). This suggests much can be learned from similarly studying the thought processes and problem solving approaches of adaptive expert special educators.

Leaders in the field purport adaptive expertise as the hallmark of the expert teaching professional (e.g., Darling-Hammond & Bransford, 2005), but becoming an adaptive expert requires teachers to overcome several barriers to development as novices (Hammerness et al., 2005). Well-cited, these include preconceived ideas of teaching that evolved from the novice's own experience and observations of teaching while a student (i.e., Lortie's [1975, p. 61] "apprenticeship of observation"). In addition, novices must translate learning about teaching into practice and recognize and systematically reflect upon the inherent complexity of teaching (Bronkhorst et al., 2011; Hammerness et al., 2005; Soslau, 2012).

Hammerness et al. (2005) offer a *learning in community* framework for supporting new teacher learning as they work to overcome these barriers and pursue adaptive expertise. This framework eschews a stage-based approach to teacher development and instead posits novice teacher learning occurs interactively within a community of learners. The learning community includes teacher educators, peers, and other education professionals encountered during preparation. Within this context, novice teachers develop a *vision* of quality teaching practice that challenges their apprenticeship of observation. Novice teachers learn to integrate deep content- and pedagogy-based *understanding* and growing knowledge and facility with conceptual and practical *tools* into their repertoire of *practices*. Finally, the learning community fosters critical *dispositions* that position novices as persistent and inquiry-oriented (Hammerness et al., 2005).

Drawing from research on effective special educators, Benedict et al. (2014) suggest ongoing independent pursuit of learning as critical to the development of the knowledge, skills, and dispositions characteristic of teaching expertise in special education. Though applied to in-service teachers operating without the guidance of teacher education faculty, their recommendations parallel the Hammerness et al. (2005) *learning in community* framework. First, recognizing the difficulty, if not impossibility, of being an expert in every aspect of the job, Benedict et al. (2014) recommend special educators identify a specific area to target for learning and improvement (following a *vision* of the goal of improvement). Once identified, this learning target becomes the focus of active and scholarly pursuit of new knowledge (*understanding*). By accessing new curricula, collaboratively planning with colleagues, and pursuing resources (*tools*) for knowledge expansion, special educators can develop deeper content knowledge and pedagogical content knowledge. Next, Benedict et al. (2014) advise special educators to devote time to applying new knowledge and practicing newly learned skills and teaching approaches (integrating understanding and tools into *practices*). Finally, special educator development continues through feedback and collaborative problem-solving (*learning community*). Feedback may come in the form of analysis of data, student responses, self-reflection, or colleagues' advice. Throughout this approach to teacher development, special educators demonstrate and nurture critical *dispositions* that support their continued development including persistence and the inclination to analyze teaching practice and innovate. Thus, in this model, teacher development in special education likewise supports the growth of adaptive expertise.

**Summary of Critical Issues and Teacher Development**

The literature across critical issues in special education and teacher development simultaneously inform and reinforce one another. Current conceptualizations of teacher development recognize the inherent complexity of teaching in special education that in-service teachers across experience levels experience on a daily basis. Within a learning community context, special educators can capitalize on collegial supports and internal drives to pursue growth and development in response to problems of practice. By challenging their current levels of expertise, reflecting upon outside perspectives and feedback, and applying flexibly adaptive approaches to meeting diverse students' needs, special educators demonstrate the adaptive dispositions and metacognitive and cognitive skills of adaptive expertise. Discussed comprehensively next, the development of adaptive expertise does not signal an end to teacher development. Rather, through flexibility, improvisation, and an orientation toward self-reflection and -evaluation, the adaptive expert continues to pursue lifelong learning for improving pedagogical efficiency and the ability to innovatively adapt in response to dynamic classroom contexts.

**Systematic Review Guidelines**

Through an iterative process, a variety of search methods were employed to identify peer-reviewed publications on adaptive expertise for inclusion in this review. The author began the literature search process by reading two seminal texts that introduce the construct of adaptive expertise within the contexts of teaching, learning, and teacher preparation. These texts were the National Research Council's *How People Learn: Brain, Mind, Experience, and School* (NRC, 2000) and *Preparing Teachers for a Changing World: What Teachers Should Learn and Be Able To Do* (Darling-Hammond & Bransford, 2005). Next, the author searched for peer-reviewed literature in the electronic databases Education Research Complete, Academic Search Complete, PsychInfo, and ProQuest Dissertations and Theses Global using the database descriptor *adaptive expertise*. These articles were cross-referenced through a search of *adaptive expertise* in Google Scholar. This search revealed an additional unpublished manuscript by a prominent adaptive expertise scholar (Bransford, 2004) and publications in conference proceedings. In addition to database searches, the author conducted numerous ancestry searches by examining reference lists of found literature for additional resources and to determine the literature commonly cited by others.

Inclusionary and exclusionary criteria were used to delimit the literature found through these search methods. Because the author was interested in publications on adaptive expertise since the term was first used in the literature, no restrictions were placed on the year of publication. Therefore, literature through 2015 was included. Only literature specifically targeting adaptive expertise in relation to its relevance for adult learning was included; accordingly, studies investigating the adaptive expertise of school-aged children were removed. Furthermore, because a comprehensive synthesis on adaptive expertise was sought, theoretical/conceptual and empirical articles were included. Although literature examining the adaptive expertise of teachers was initially sought, few articles emerged beyond the seminal texts that were the starting point of the review. Literature focusing on broader investigations of teacher adaptiveness (i.e., Allen, Matthews, & Parsons, 2013) or adaptive teaching (i.e., Corno, 2008) were excluded in favor of research addressing "adaptive expertise" as a construct unto itself. Thus, inclusionary criteria were expanded to include research and theoretical work from other adult learning disciplines such as engineering and medicine. Articles that focused solely on adaptive processes related to mathematical thinking and learning were excluded. Editorials, book reviews, and introductory articles from particular issues of a journal also were excluded because they lacked in-depth adaptive expertise content or recounted information from primary sources already included among the found articles. Ultimately, 33 articles and book chapters and one dissertation were found over and above the NRC (2000) and Darling-Hammond and Bransford (2005) texts.

**Adaptive Expertise**

To fully understand the extent of current knowledge about adaptive expertise requires a thorough examination of literature across theory, research, and disciplines. First, the theoretical background of adaptive expertise is presented. This is followed by empirical research, first from fields outside of education, then from research with teachers. Finally, the relevance of adaptive expertise is considered for special educator preparation and in relation to national standards.

**Theoretical background.** In their discussion of the "Two Courses of Expertise," Hatano and Inagaki (1986) gave rise to the terms "adaptive expert" and "adaptive expertise." Noting that expertise relates to the acquisition of content knowledge in a particular domain across accrued experience, Hatano and Inagaki (1986) offer a conceptualization of expertise that recognizes the complexity and variability that can exist within and across knowledge domains. In this conceptualization, expertise can develop along two courses: one course that leads to routine expertise and another leading to adaptive expertise. According to Hatano and Inagaki (1986), the routine expert possesses procedural knowledge and a high degree of efficiency and accuracy of skills in a given, well-practiced, stable context. For the adaptive expert, conceptual knowledge, or knowing the function of a skill and why a skill works in a given situation, builds upon existing procedural knowledge. Thus, adaptive expertise characterizes the ability to efficiently execute procedural skills but also a higher level of understanding of the justification for a particular skill in the context of its application. Whereas the adaptive expert possesses the ability to flexibly decide when a standard or adjusted approach is better-suited for a given situation, the routine expert selects from a more limited repertoire of tried and true approaches. Hatano and Inagaki (1986) explain that routine expertise is beneficial in environments that remain stable with predictable challenges; adaptive expertise, on the other hand, allows individuals to effectively respond to a variable environment, adapting and innovating in response to changing constraints.

Since the original Hatano and Inagaki (1986) conceptualization, others have contributed to theoretical understanding of adaptive expertise. To visually represent adaptive expertise, Bransford and colleagues have suggested the path to becoming an adaptive expert lies in the balance of efficient and innovative approaches to problem solving (see Figure 1; Bransford et al., 2005; Crawford et al., 2005; Schwartz, Bransford, & Sears, 2005). With efficiency increasing along the x-axis, and innovation increasing along the y-axis, the "optimal adaptability corridor" (Bransford et al., 2005; Crawford & Brophy, 2006; Schwartz et al., 2005) leading to adaptive expertise lies where efficiency and innovation are employed in roughly equal measure. For adaptive experts, learning and problem solving proceed with the goal of figuring out how to do things better, not just more efficiently (NRC, 2000). In contrast, routine expertise lies at the end of a trajectory that favors efficiency and lacks innovation. As termed by Bransford et al. (2005), the *frustrated novice* follows a highly innovative but inefficient path.

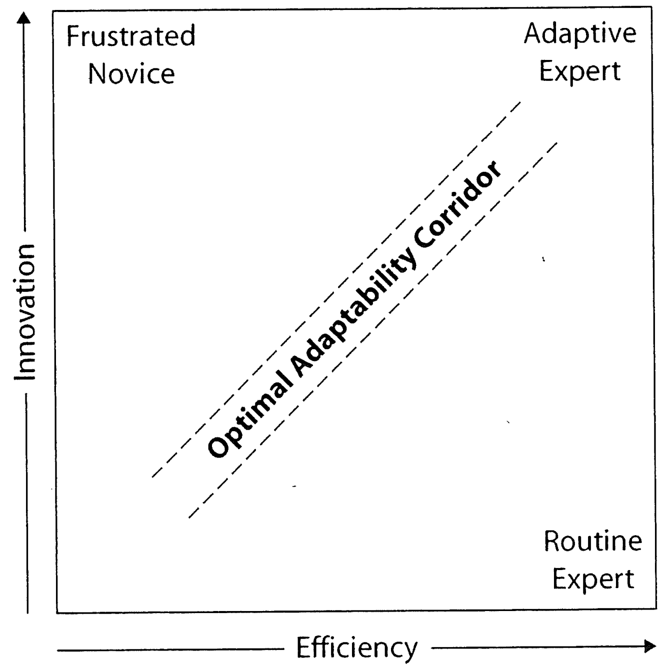


*Figure 1*. The trajectory towards adaptive expertise balances efficiency and innovation via the Optimal Adaptability Corridor.

For both adaptive and routine experts, learning continues throughout the lifetime (Bransford, 2004; NRC, 2000). Yet, the nature of this learning differs in considerable ways. Adaptive experts build on existing knowledge and are able to transfer learning to different situations, applying flexible approaches. They know their strengths and weaknesses as learners and problem solvers and have the ability to learn how to effectively address novel problems (Bransford, 2004). Adaptive experts capitalize on what Baroudy (1977), cited by Schwartz et al. (2005), calls interpretive knowing which focuses on adaptive applications of knowledge that lead to new learning. Challenges offer opportunities for learning expansion and refinement as questions are asked and other perspectives are sought (Bransford, 2004; Crawford & Brophy, 2006; Schwartz et al., 2005). As Lin, Schwartz, and Bransford (2007) explain, adaptive experts are more prepared to learn from novel experiences and situations than their routine-oriented counterparts. For routine experts, replication and application of procedures are the emphases of learning and knowing (Schwartz et al., 2005). Given a novel problem space, routine experts adopt a restricted view, accepting parameters for what they are and drawing from what has worked in the past to quickly find a solution (Bransford, 2004; Crawford et al., 2005). They may discount or choose not to consider novel or disconfirming information in favor of proceeding according to prior assumptions (Crawford et al., 2005). Although adaptive experts may apply knowledge of what has worked in the past, they are also willing to scrap previous heuristics when a situation demands a new approach (Crawford & Brophy, 2006; Schwartz et al., 2005). Thus, problem solving may proceed at a slower, more deliberate pace, than the efficiency-oriented approach of a routine expert (Crawford et al., 2005).

Crawford et al. (2005) operationalized adaptive expertise in terms of two broader categories of characteristics: (1) epistemic and dispositional aspects of adaptiveness and (2) adaptive cognitive and metacognitive processes. Epistemic and dispositional aspects comprise the views that knowledge building is complex, prior knowledge may be inadequate for a given case, and abandoning previous understanding may be warranted in favor of new learning. Here, Crawford et al. emphasize the requirement of "case sensitivity" (p. 7) or an individual's ability to hone in on the details of a given problem space, noting any variability or new information relative to past experience and prior knowledge. The cognitive and metacognitive skills of the adaptive expert underscore reasoning processes driven by data, hypotheses, and causal relationships together with self-reflection that serve to monitor problem solving processes. According to Crawford et al. (2005), epistemic and dispositional aspects and metacognitive skills represent prerequisites to adaptive reasoning that is characterized by the adaptive cognitive processes.

Building from the Crawford et al. (2005) model, the researcher collaborated with faculty to synthesize the adaptive expertise literature; this led to a published conceptualization of the construct across three inter-related subdomains: adaptive dispositions, metacognitive skills, and cognitive skills (De Arment et al., 2013). Summarized in Table 1, this conceptualization purposefully parses out cognitive and metacognitive skills to enhance an operational definition of adaptive expertise. As indicated by citations associated with each indicator presented in the table, most of the primary level indicators across the subdomains are drawn from Crawford et al. (2005). In the De Arment et al. (2013) conceptualization, the skill of justifying decisions and outcomes spans metacognitive and cognitive skills of adaptive expertise. The additional sub-level of indicators further explicates each broader descriptor using language found across the adaptive expertise literature.

Table 1

*Adaptive Dispositions, Metacognitive Skills, and Cognitive Skills of Adaptive Expertise Derived from the Literature (De Arment et al., 2013)*

| | Ability to explain decisions and justify outcomes of these processes[a,b,c,d] | |
|---|---|---|
| **Adaptive Dispositions** | **Metacognitive Skills** | **Cognitive Skills** |
| Maintain an epistemic distance between prior knowledge and model of a case or problem at hand[b]<br>    Willing to abandon previously held understandings[e]<br>    Willing to replace prior assumptions[f]<br>    Holding theories lightly[g]<br>    Resisting initial ideas about a problem[f]<br>    Plasticity of thinking[k]<br>An epistemic stance that views the world as complex, messy, irregular, dynamic, etc.[b] | Questioning current levels of expertise[j] | Cognitive flexibility[b]<br>    Respond to variability in classroom[i]<br>    Accounts for multiple perspectives[n]<br>    Invent new procedures[m]<br>    Balance of efficiency and innovation[e, f] |
| Comfort or willingness to reveal and work at the limits of one's knowledge and skill[b]<br>    Willing to ask questions[f]<br>    Willing to take managed risks that may result in mistakes[g]<br>    Seeking out feedback from others (different others)[g] | Monitoring own learning[b]<br>    Monitor own comprehension[g]<br>    Self-assess[j]<br>    Systematic understanding of the self as a learner[a] | |
| | Assessing own knowledge states[b]<br>    Self-assess thinking[g] | |
| | Assessing adequacy of current knowledge for solving case at hand[b,j] | |

| | | |
|---|---|---|
| An inclination toward learning rather than merely applying knowledge[b]<br>Never satisfied with current levels of understanding[b,e,i]<br>Opportunistic[g]<br>Motivation to problem solve[j]<br>Curiosity[g]<br>Enjoy challenge[a] | Seeking and analyzing feedback about problem solving processes and outcomes[b]<br>Higher order problem solving[k]<br>Systematic understanding of the self as a problem solver learner[a] | Causal reasoning (Develop underlying model or set of contributing factors)[b] |
| Prepared to learn from new situations[f,k] | Monitoring results and performance[b]<br>Modify existing procedural skills[l,m]<br>Invent new procedures[m] | Data-driven forward reasoning (hypothesis-based reasoning)[b]<br>Higher order problem solving[k]<br>Select routine or adaptive approach based on data & hypothesis[g] |

[a] Bransford, 2004 [b] Crawford et al., 2005 [c] Hatano & Inagaki, 1986 [d] Inagaki & Miyake, 2007 [e] Bransford, Derry, Berliner, & Hammerness, 2005 [f] Schwartz, Bransford, & Sears, 2005 [g] Crawford & Brophy, 2006 [h] Lin, Schwartz, & Hatano, 2005 [i] National Research Council, 2000 [j] Bell, Horton, Blashki, & Seidel, 2012 [k] Lin, Schwartz, & Bransford, 2007 [l] Goodnow, Peterson, & Lawrence, 2007 [m] Hatano & Oura, 2003 [n] Fisher & Peterson, 2001

Of note, Bohle Carbonnel, Stalmeijer, Könings, Segers, and Van Merriënboer (2014) more recently synthesized the literature on adaptive expertise. Though they acknowledge the theoretical work of Hatano and others, Bohle Carbonnel et al. (2014) focused their review solely on empirical literature, including publications on adaptive performance as well as adaptive expertise. Thus, conceptual papers and those focusing on adaptive expertise as an explanation for findings rather than as the construct under study were excluded from their review. Though there is some overlap of literature represented in the Bohle Carbonnel et al. (2014) and De Arment et al. (2013) reviews, the latter is preferred for its more narrow focus and alignment with conceptualizations of adaptive expertise within the literature on teaching and teacher preparation (e.g., Crawford et al., 2005; Darling-Hammond & Bransford, 2005). The present review, as delineated by the inclusionary and exclusionary criteria presented earlier, reflects a more in-depth discussion of adaptive expertise in alignment with De Arment et al. (2013).

**Development.** Taken together, adaptive dispositions, metacognitive skills, and cognitive skills represent the "habits of mind, attitudes, and ways of thinking and organizing one's knowledge that are different from routine expertise and take time to develop" (Bransford, 2004, p. 3). Hatano and Inagaki (1986) acknowledge sparse research evidence on the development of routine versus adaptive expertise. Moreover, it is unclear whether routine expertise is a necessary precursor to the development of adaptive expertise. Theoretical evidence suggests development can, and according to some, should, proceed alongside expansion of routine expertise (Bransford, 2004; Crawford & Brophy, 2006). And, advancement in only one dimension of adaptive expertise, efficiency *or* innovation, fails to result in the development of the adaptive expert (Bransford, 2004). Accordingly, while learners gain strong foundational content knowledge in a given domain, they can simultaneously grapple with deviations from routine applications of that knowledge (Bell, Horton, Blashki, & Seidel, 2012). Explained next, the theoretical literature offers insight into purposeful orchestrations of the learning environment that likely contribute to the development of the efficiency *and* innovation as well as the dispositions, cognitive skills, and metacognitive skills characteristic of adaptive expertise.

For Hatano and Inagaki (1986), adaptive expertise evolves given three conditions within a learning environment. First, learners have the opportunity to practice a given skill, but not simply within standard or routine applications. Instead, variations and changing demands are embedded within repeated practice of skill application (Hatano & Oura, 2003). Next, learners work within an environment where there is no expectation of reward for adhering to the routine, efficient, or standard approach. Learners operate within a safe space free from the feeling that one "correct" response is expected. Here, mistakes are expected as part of risk-taking (Crawford & Brophy, 2006) and learners can test ideas, learn from results, and apply that learning to future problems (Schwartz et al., 2005). Relatedly, Hatano and Inagaki's third condition for adaptive expertise development is that the culture of the learning environment champions understanding over performance and values experimental and innovative application of skills. In these contexts, learners can apply knowledge flexibly (Hatano & Oura, 2003) in problem spaces that mirror real-life complexity and variability (Bell et al., 2012; Crawford & Brophy, 2006).

Lin et al. (2007) refine the environmental factors proffered by Hatano and Inagaki (1986) in their explanation of three tiers of variability for promoting adaptive expertise development. In tier one, learners are guided to notice variability across intentionally inconstant environments and learning spaces. In the second tier, "what if" scenarios push learners to apply skills in non-routine ways. Finally, in tier three, learners experience variability through considerations of peer and expert perspectives. Through systematic application of these tiers, instructors can strategically orchestrate opportunities for students to encounter variability and thus advance along the trajectory towards adaptive expertise (Bransford, 2007).

Reflecting the socio-cultural context inherent in Hatano and Inagaki's (1986) considerations of the learning environment and the tiers of variability of Lin et al. (2007), Schwartz et al. (2005) highlight the value of interacting with a variety of artifacts as well as individuals. Crawford and Brophy (2006) note, "interactions with others can provide a catalyst for innovation" (p.18). Through collaboration comes consideration of multiple perspectives in problem solving (Bransford, 2004). This "distributed expertise" approach capitalizes on the prior knowledge and experience individuals bring to bear thus inherently offering a collaborative team of learners working together in multiple ways to approach a given problem. Within a community of learners that values innovation, adaptive expertise can expand beyond the individual level to the organizational level (Crawford & Brophy, 2006).

The How People Learn (HPL) framework (Bransford, Darling-Hammond, & LePage, 2005; NRC, 2000) describes four overlapping perspectives that serve as critical considerations in the way teachers set the stage for students' learning for the promotion of adaptive expertise. These perspectives are *learner-centered*, *knowledge-centered*, *assessment-centered*, and *community-centered* (NRC, 2000). Through learner-centered approaches, teachers consider the unique characteristics of learners themselves such as their strengths, prior understandings, beliefs, and interests. Knowledge-centered environments maintain the importance of ensuring learners acquire certain new information, attitudes, or skills. An assessment-centered environment is one that provides frequent, meaningful opportunities for feedback and revision as part of the learning process. Finally, community-centered approaches consider the environment in which learners are able to learn from one another, feel comfortable taking risks and making mistakes, and value one another's contributions (Bransford, Darling-Hammond, et al., 2005; NRC, 2000).

Across these considerations of the learning environment for promoting adaptive expertise are implicit values for learners to develop as thinkers and problem solvers (Bransford, 2004) through activities that promote reflection and metacognition (Bransford, 2007; Lin, Schwartz, & Hatano, 2005). Iterative opportunities to thoughtfully pursue new applications of learning, ask questions and experiment, and ultimately arrive at innovative solutions backed by justification imply the development of adaptive expertise (Bransford, 2004; Bransford et al., 2005).

**Summary of theoretical literature.** Adaptive expertise is a multifaceted construct that describes the consummate professional in a given learning domain: one who has conceptual and procedural knowledge that can be selectively and innovatively applied in response to changing conditions. Overall, the theoretical literature points to two main approaches for conceptualizing adaptive expertise: first, in relation to routine expertise and second, by its composite dispositional characteristics and metacognitive and cognitive skills. Both approaches to conceptualizing the construct are important for a comprehensive operational definition. Though the development of adaptive expertise prior to or in tandem with routine expertise is not fully known, theory offers suggestions for optimally creating learning environments to foster routine expertise and innovation. Presented next, research from diverse fields provides insight into environmental considerations and implications for adaptive expertise development.

**Empirical evidence from other fields.** Building upon the adaptive expertise theoretical literature, research from business, medical, and engineering fields has implications for promoting the development of adaptive expertise. Overall results suggest (1) breadth of experience and (2) purposeful instruction within a carefully crafted learning environment contribute to the development of adaptive expertise.

Researchers have investigated the approaches and perceptions of individuals across disciplines and experience levels to gain a cross-sectional view of adaptive expertise development. Barnett and Koslawski (2002) considered differences in adaptive expertise among participants of varying experience through their responses to a novel problem. Business consultants (outside of restaurant business), restaurant owners/managers, and non-business undergraduate students (novices; $N = 12$ for each group respectively) participated in individual interviews about a novel restaurant management challenge. Responses to the challenge were evaluated in comparison to an ideal response. Business consultants' responses more closely resembled the optimal solution than those of restaurant managers or students whose responses were similar. Further analysis of participants' reasoning processes revealed business consultants employed deeper, theory-based reasoning than the others. These results suggest breadth of experience and theory-based reasoning facilitate transfer of expertise to novel problems.

Mylopoulous and Regehr (2009) conducted semi-structured interviews with 25 third- and fourth-year medical students engaged in clinical rotations about their perceptions of and experiences related to innovation and expertise. Thematic analysis of interview data revealed novice conceptions of expertise emphasized factual knowledge and skills, with innovation being outside the purview of novice medical practice. Novices expressed the view that they first had to acquire requisite knowledge and breadth of experience before they could innovate in medical practice. Innovation, to them, would become part of their repertoire after an efficiency orientation to practice was achieved. Mylopoulous and Regehr (2009) conclude that as novices, medical students need to recognize their innovative capacities couched within the growth of adaptive expertise as an expected part of developing practice.

Other research in medicine with doctors ($N = 9$) and nurses ($N = 62$) ranging in experience level from novice (trainee) to senior-level staff supports the model of breadth of experience leading to greater adaptive expertise. Varpio, Schryer, and Lingard (2009) conducted observations and interviews over an eight-month period to understand participants' "interprofessional communication strategies" (p. 680) around problems associated with use of electronic patient records. Although doctors and nurses across experience levels used workaround strategies when they encountered problems, trainees did not communicate with colleagues about possible effects when they employed workaround strategies. Varpio et al. (2009) suggest trainees operated as routine experts with efficient knowledge for employing workaround strategies learned through informal curricula associated with addressing problems. On the other hand, experienced staff exemplified adaptive expertise. Not only did they have routine problem-solving approaches mastered, but they demonstrated a deeper understanding of conceptual knowledge related to their practice that was evident in their awareness of confusion that could result from workaround strategies without follow up interprofessional communication.

Other researchers examined adaptive expertise in relation to individuals' experience levels through measure development. Fisher and Peterson (2001) developed and validated a survey measure of adaptive beliefs derived from the adaptive expertise literature. Survey items related to four underlying constructs of adaptive expertise: multiple perspectives, metacognitive self-assessment, goals and beliefs, and epistemology. Participants represented varying experience levels across engineering faculty ($N = 17$), biomedical engineering freshmen ($N = 37$) and seniors ($N = 44$), and all engineering freshmen ($N = 209$). Results indicated significant increases in overall adaptive expertise scores from freshmen to seniors to faculty. Differences among the underlying constructs were noted as well. Compared to freshmen, seniors' survey data yielded significantly higher scores in multiple perspectives and goals and beliefs but similar metacognitive self-assessment scores. Faculty differed significantly from freshmen in all constructs but epistemology and from seniors in all areas but goals and beliefs. The common theme across these studies is the differential level of adaptive expertise of individuals of varying experience within a given domain. In particular, those with more experience, especially with applying innovative problem-solving approaches backed by deep content knowledge, exhibited more qualities of adaptive expertise than novice or less experienced individuals.

More recently, Bohle Carbonell, Könings, Segers, and Van Merriënboer (2015) developed a measure of adaptive expertise. Unlike Fisher and Peterson (2001), Bohle Carbonell used a sample of graduate student ($N = 216$) and working professionals ($N = 172$) across a wide variety of work domains. Rather than focus on adaptive beliefs (Fisher & Peterson, 2001), Bohle

Carbonell et al. (2015) concentrated on grounding participants' responses within their specific work domain. As initially designed, their Adaptive Expertise Inventory contained three subscales addressing domain skills, innovative skills, and metacognitive skills. However, exploratory and confirmatory factor analysis led to measure refinement along only two subscales: domain skills (five items) and innovative skills (five items). Extending their measure development work, the researchers sought understanding of how type of work domain (high-, medium-, and low-validity), degree of task variety within the work domain, and years of work experience related to the adaptive expertise scores of working professionals in the sample. Results indicated that professionals working in high-validity environments where they receive ample feedback about the correct response to a given situation had significantly lower adaptive expertise whereas there was no difference between those in medium- and low-validity environments. Further, Bohle Carbonell et al. (2015) found that greater task variety within a work domain yielded greater adaptive expertise. Increasing years of work experience related only to greater domain-specific skills and not skills of innovation or overall adaptive expertise.

Research in engineering education has examined specific instructional design characteristics for the promotion of students' adaptive expertise within coursework. Martin, Petrosino, Rivale, and Diller (2006) applied the How People Learn framework to instruction in a biomedical engineering course on biotransport for promoting student adaptive expertise. More specifically, the course was designed around a challenge-based instructional model called the STAR Legacy Cycle (Schwartz, Brophy, Lin, & Bransford, 1999). In the first phase of this model, learners receive a realistic challenge related to the knowledge domain. After learners generate their own ideas for addressing the challenge, they consider the perspectives of experts in the field and engage in research to inform revisions to their approach to the challenge. In the last two phases of the cycle, learners have opportunities to apply knowledge through formative assessments and finally publically share their solutions to the challenge (Schwartz et al., 1999). Students in the biotransport course progressed through ten STAR Legacy Cycle modules (Martin et al., 2006).

Fifty-four third year undergraduates participated in the Martin et al. (2006) study, each taking three exams measuring knowledge, innovation, and adaptive expertise across the progression of the course. Knowledge items required application of content knowledge acquired in the course. Items addressing innovation asked students to tackle a “highly novel problem” (Martin et al., 2006, p. 38). Finally, adaptive expertise items combined the emphases of knowledge and innovation items; students were expected to have the requisite knowledge needed to address a transfer problem. In addition to these exams, participants completed Fisher and Peterson’s (2001) Adaptive Beliefs Survey pre and post. As the study was longitudinal, participants acted as their own control group.

Overall, results suggest the HPL-based STAR Legacy Cycle promotes adaptive expertise development for learners of varying adaptive beliefs. Martin et al. (2006) report students’ knowledge, innovation, and adaptive expertise all improved across time, while adaptive beliefs were similar pre to post. Growth in knowledge and innovation followed a similar pattern, with greatest improvement noted between the first and second exams. Growth in adaptive expertise appeared to follow growth measured by the knowledge and innovation items, with greatest improvement between exams 2 and 3. Participants with lower levels of adaptive beliefs initially showed the greatest change in their adaptive expertise from exam 1 to exam 3.

Other researchers working with biomedical engineering students used comparison with a control group receiving typical instruction to understand the effects of the HPL-based STAR

Legacy Cycle. Though measured differently, results across these additional studies also indicate increased adaptive expertise for participants in the groups receiving HPL-based instruction via the STAR Legacy Cycle in comparison to typical instruction. Martin, Rayne, Kemp, Hart, and Diller (2005) randomly assigned 36 first year undergraduate students in a bioengineering ethics course to either the HPL or lecture group for content spanning two class periods and one homework assignment. Students completed pre- and post- tests containing three factual knowledge questions and one question that posed a novel problem for which students had to develop and justify a solution. The latter question was a measure of adaptive expertise. Students across both groups increased their factual knowledge from pre- to post-test. However, only students in the HPL group significantly increased in adaptive expertise as measured by consideration of multiple perspectives in their responses to the novel problem. Martin et al. (2005) conclude that because instruction via HPL afforded students with opportunities to generate and revise ideas, they developed more flexible understanding of the novel problem.

Pandy, Petrosino, Austin, and Barr (2004) also measured biomedical engineering students' adaptive expertise, pre and post, in response to either an HPL-based STAR Legacy Cycle module or traditional lectures related to biomechanics. Twenty-five students in the senior-level course were randomly assigned to either the HPL or control group and completed questionnaires to measure their factual knowledge, conceptual knowledge, and transfer of knowledge to novel situations. Pandy et al. (2004) operationalized adaptive expertise as a weighted combination of these three areas: .1Factual + .4Conceptual +.5Transfer. Results indicated that students who experienced the HPL approach to learning showed a significantly greater increase in conceptual knowledge and knowledge transfer over their control group counterparts. The researchers attribute the overall increase in adaptive expertise of the HPL group to the presence of formative assessment, consideration of multiple perspectives, and group brainstorming within the context of challenge-based instruction. Considered together, these studies point to instruction based on the HPL framework, and more specifically the STAR Legacy cycle, as valuable for promoting adult learners' adaptive expertise across course experiences.

**Teacher adaptive expertise.** Lin et al. (2005) call for teachers to develop "adaptive metacognition" to address the variability and challenges they face in the classroom. Despite this and other emphases on the development of cognitive and metacognitive skills and dispositions comprising adaptive expertise in the theoretical literature, little research has directly investigated how teachers develop or enact adaptive expertise in their teaching practice. Eleven empirical studies, including one dissertation and its associated research publication (discussed as a single study with emphasis on the publication), one study presented through conference proceedings and a research publication (discussed as one study), and one conceptual article comprise the literature base on teacher adaptive expertise. Although the conceptual article does not represent a research study, it contributes to the present discussion of how the adaptive expertise framework has been applied to understanding teacher development through direct work with teachers. These articles consider teacher thought processes, reflections, and discourse and position such activities as essential for movement along the trajectory from novice to adaptive expert.

While some researchers draw upon the adaptive expertise literature solidly within the theoretical framework of their studies (Anthony et al., 2015; Crawford, 2007; Crawford et al., 2005; Martin et al., 2015; Soslau, 2010, 2012; Wetzel et al., 2015; Yoon et al., 2015; Yoon, Koehler, Wang, & Anderson, 2014), others draw connections between adaptive expertise and additional theoretical frameworks (Hayden & Chiu, 2013; Hayden, Moore-Russo, et al., 2013;

Hayden, Rundell, et al., 2013) or address the development of adaptive expertise as a research implication (Janssen et al., 2008). Published between 2005 and 2015, this literature reflects the assertion of Hammerness et al. (2005) that adaptive expertise is "the gold standard for [the teaching] professional" (p. 360). Though the seminal *Preparing Teachers for a Changing* World (Darling-Hammond & Bransford, 2005) is more than ten years old, recent studies of adaptive expertise and teaching (Anthony et al., 2015; Hayden & Chiu, 2013; Hayden, Rundell, et al., 2013; Martin et al., 2015; Soslau, 2012; Wetzel et al., 2015; Yoon et al., 2015; Yoon et al., 2014) reaffirm the continued significance and timeliness of the construct for the study of novice and experienced teacher development.

***Research purposes.*** All studies and the conceptual paper sought to illuminate aspects of participants' internal thinking about their teaching practice as either evidence of or catalyst for adaptive expertise. Being exploratory in nature, several studies aimed to understand the nature of teachers' adaptive expertise. Anthony et al. (2015) explored prospective teachers' development of adaptive expertise and responses to particular instructional approaches within a Classroom Inquiry course. Hayden and Chiu's (2013) research purpose broadly sought understanding of how novice teachers reflect in writing about their teaching practices, including links among problems, adaptations, and resolutions. Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014) wanted to understand how teachers demonstrate flexibility, deeper understanding, and deliberate practice associated with adaptive expertise. Research by Crawford et al. (2005) was similarly exploratory. They sought "to identify and characterize episodes or sequences of adaptive and efficient orientations in teachers' reasoning as they analyze[d] student work and perform[ed] instructional decision making" (p. 11). In the related Crawford (2007) study, the research purpose was refined to include investigation of differences among adaptive and routine-oriented experts and novices in the way they address a contrived, but realistic instructional problem.

Other researchers investigated teachers' activities or experiences as opportunities to promote adaptive expertise. Martin et al. (2015) wanted to understand the effects of participation in a summer institute on teaching engineering on high school teachers' innovation, efficiency, and adaptive expertise. Wetzel et al. (2015) sought understanding of how pre-service and in-service special educators' adaptive expertise can be elicited through specific reflection prompts. Janssen et al. (2008) wanted to understand the differences between participants' reflections based on negative teaching experiences and positive teaching experiences in terms of content and associated emotions and motivation to implement reflection-based resolutions. Although not driven by a formal question in the context of research, the work of Hayden, Moore-Russo, et al. (2013) organically evolved from conversations on teaching practice between the second and third authors. Exploring in-context teacher reflections, their article chronicles how a critical incident prompted a secondary math teacher (Marino) to reflect upon his novice teaching practice and iteratively adapt a particular lesson.

Most pointed of the research purposes in this review was that of Soslau (2010, 2012). The earlier dissertation research (Soslau, 2010) more broadly explored supervisory conference discourse, both in terms of content and discourse type, and then investigated the meaning each conference participant ascribed to the conference experience, or participant intersubjectivity. In the latter, dissertation-derived publication, Soslau (2012) addresses a more specified research purpose: understanding how supervisory conference discourse around common novice problems in learning to teach and supervision styles promotes the development of student teachers' adaptive expertise.

***Research approaches.*** Overwhelmingly qualitatively-driven, these studies inconsistently applied a well-defined research design. At the more general end of the spectrum, Wetzel et al. (2015) employed qualitative data collection and analysis procedures while Martin et al. (2015) employed quantitative data collection and analysis in a pre-test post-test design. Janssen et al. (2008) described their work as a comparative study and employed both qualitative and quantitative methods to answer their research questions. Unlike this general application of qualitative and quantitative approaches, Hayden and Chiu (2013) used an exploratory mixed methods design to address their research purpose. Patterns emerging from initial qualitative data gave the researchers a clear rationale for pursuing follow-up confirmatory quantitative analyses. Anthony et al. (2015), Hayden, Rundell, et al. (2013), Soslau (2010, 2012), and Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014) each used a qualitative case study design across participants. Both Crawford studies employed a "laboratory-based cognitive task analysis methodology" (Crawford, 2007; Crawford et al., 2005, p. 11).

Citing Dewey's pragmatism, Hayden and Chiu (2013) are the only researchers to make reference to a guiding worldview as the theoretical lens for their study. Others cite various theoretical frameworks such as situated learning theory (Soslau, 2010, 2012), positive psychology (Janssen et al., 2008), *learning in community* (Wetzel et al., 2015), and reflective practice (Hayden, Rundell, et al., 2013). The literature on adaptive expertise forms the theoretical framework for only three studies: Crawford et al. (2005), Crawford (2007), and Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014).

***Participants and settings.*** Researchers studied novice and experienced teachers (range $N = 2$ to $N = 33$) in isolation, in comparison, and through their interactions across various fields of education and settings. Janssen et al. (2008) compared the reflective responses of pre-service biology teachers ($N = 16$) who were engaged in a student teaching experience. Although they were novice teachers, all had previously earned a master's degree in the life sciences. No other demographic information was provided about the participants. Hayden and Chiu (2013) studied the written reflections of 23 teacher education students who were enrolled in an elementary reading methods course with a summer reading clinic field experience component. Of the 23 female participants, 17 were undergraduates and six were graduate students; 18 had some limited teaching experience as instructional assistants, teaching English overseas, and in school counseling. Research by Anthony et al. (2015) included two prospective teacher participants (one male, one female) in their last semester of a teacher preparation program who were part of a Classroom Inquiry course focused on math teaching with nine to eleven year olds. These participants were selected because of their differing academic performance within previous math education coursework.

Soslau (2010, 2012), too, studied pre-service teachers engaged in student teaching ($N = 3$), but included their university supervisors ($N = 3$) in the participant group. These resulted in three student teacher-supervisor dyads. As in other research (i.e., Hayden & Chiu, 2013), all participants were female. Although all three student teachers worked in inclusive classrooms for at least one of the two eight-week placements, only one was pursuing a dual certification degree in elementary and special education. Supervisors held master's degrees and had more than ten years teaching experience and supervisory experience. Soslau (2010, 2012) used conference observation and post-conference interview data to identify the three supervisors' supervision styles. One supervisor exhibited *guiding* and *reflecting* supervision styles as she prompted the student teacher to think critically about her planning and reflect upon student needs. Soslau (2010, 2012) identified the next supervisor as having a *telling* style of supervision as she relied on offering the student teacher suggestions and offered her own opinions. The third supervisor combined the supervisory practices of the other two and was identified as *telling*, *reflecting*, and *guiding*.

The only researchers to specifically examine teacher adaptive expertise within the context of special education, Wetzel et al. (2015) studied the reflections of both pre-service and in-service special education teachers. Participants were practicing special educators either in early childhood special education (ECSE; $N = 2$) or K-12 special education ($N = 2$) or engaged in a pre-service preparation master's program for ECSE ($N = 2$) or special education – general curriculum ($N = 2$).

Participants in the remaining studies were in-service teachers of varying experience. The research of Crawford et al. (2005), Crawford (2007), and Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014) was with high school biology teachers of varying experience levels. In the earlier Crawford study, participants ($N = 12$) were recruited through nomination, and then selected for participation based on degree of teaching experience and likelihood of exhibiting a routine or adaptive orientation to problem solving as evidenced by responses to a questionnaire about their prior teaching and content area experience (Crawford et al., 2005). One teacher was identified as a novice (2-3 years teaching), and 11 other teachers were experienced (7+ years teaching). Of the experienced teachers, some ($N$ not reported) were adaptively oriented and others were deemed unlikely to adaptively respond to study stimuli. The latter Crawford study included 13 biology teachers: four novices with two to three years of teaching experience and nine experienced teachers with seven or more years of experience (Crawford, 2007). Four of the nine experienced teachers were identified as fitting a literature-based adaptive profile, while the remaining five fit the routine orientation profile. Half of the novice teachers had research experience through a previous career which suggested the presence of some general problem-solving expertise. Although some participants must have differed across the two Crawford studies due to the differences in *N*, the researchers do not provide enough information to discern whether the majority of participants were the same. Similarly, the researchers do not reveal the exact setting of the studies other than to say they were in the context of hypothetical, rather than actual, teaching. Participants (2 females, 1 male) in the study by Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014) varied in teaching experience (6, 9, and 16 years) and two school demographic variables: students receiving free and reduced lunch (6, 30, and 58%) and students scoring in the advanced range on the state science assessment (14, 20, and 47%).

Like Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014), Martin et al. (2015) similarly studied experienced in-service teachers. Participants in this research included 33 high school math and science teachers who were participating in a six-week summer program on engineering. These teachers had a mean of over seven years of teaching experience and were approximately evenly split by gender. Over a quarter of these teachers held master's degrees while almost another 50% were enrolled in a master's program at the time of the study.

Like the work of Crawford and colleagues, Hayden, Rundell, et al. (2013) studied teachers of novice ($N = 1$) and experienced status ($N = 1$). As in other research by Hayden (Hayden & Chiu, 2013), these two male teachers were taking a graduate course as part of a reading specialist endorsement program; all collected data were based on the teachers' one-on-one work with elementary aged students in a summer reading clinic. The experienced teacher had taught for 20 years while the novice teacher had two years of classroom experience. Hayden, Rundell, et al. (2013) selected these two teachers from a pool of 15 enrolled in the reading course due to the nature of their written reflections and their representation of either end of the experience continuum.

Though not considered a participant in the traditional sense, Mark, the third author of the Hayden, Moore-Russo, et al. (2013) conceptual article, represents both the novice and experienced teacher perspectives as he recounts the longitudinal evolution of a particular introductory statistics lesson from his years as a high school math teacher.

***Data collection and analyses.*** Researchers across all studies but one collected qualitative data and engaged in coding as part of data analysis. Though several studies employed quantitative analyses as well, only Janssen et al. (2008) specifically collected quantitative data in addition to qualitative data; others quantitized qualitative data for analysis (Hayden & Chiu, 2013; Soslau, 2010, 2012; Wetzel et al., 2015) or collected only quantitative data (Martin et al., 2015). One study (Crawford et al., 2005) provides only preliminary details about data analyses, noting the study at the time of publication was ongoing. Therefore, it is unclear whether analyses were solely qualitative in nature or involved numeric data as well. Though data analyses reportedly differ across studies by the same author (i.e., Crawford, 2007; Crawford et al., 2005; Hayden & Chiu, 2013; Hayden, Rundell, et al., 2013), data collection procedures are similar. Details of each study's data collection procedures and analyses are presented next beginning with qualitative only research followed by research with quantitized data, and finally the Janssen et al. (2008) study.

Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014) collected qualitative data across several sources for each case study including classroom observations, individual and focus group interviews, and teacher surveys. (Of note, Yoon et al. [2014] mention the collection of student achievement data; however, these are not discussed in terms of data analysis or findings. Yoon et al. [2015] explain these data are forthcoming in a future publication.) Data across all sources were coded deductively for three aspects of adaptive expertise: flexibility, deeper level understanding, and deliberate practice. Two researchers independently coded the full data set for each case; then, codes were discussed until agreement was achieved. The researchers developed a categorization manual to anchor evaluations of teachers' adaptive expertise as high, moderate, or low across each coding area.

Like Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014), Anthony et al. (2015) collected multiple sources of data representing each case. These included journal entries, researcher field notes, and pre and post interviews that captured each participant's thinking and perspectives about their developing mathematics teaching practice and their coursework experiences. Data analysis included coding for themes representing an existing framework on teacher expertise that advocates for practice-based approaches to teacher preparation (Timperley, 2013 as cited by Anthony et al., 2015). The researchers remained open to other emergent themes across the data as well. In particular, Anthony et al. (2015) sought evidence of how each prospective teacher's reflections and thinking shifted in focus across experiences within the Classroom Inquiry course.

Crawford et al. (2005) had participants respond to an extensively pilot-tested, authentic teaching task scenario through a think-aloud process. Embedded within the task were opportunities for participants to identify patterns in hypothetical students' understandings and misunderstandings and learn new information related to the science content. Task administration occurred in three phases: (1) participants worked through the task independently, (2) the researcher re-oriented participants to aspects of the task through specific prompting, and (3) the participants and researcher engaged in a cognitive interview to clarify participant thought processes in the previous two phases. The resulting verbal protocols first were analyzed using researcher-developed rubrics to evaluate each participant's task performance. Second, Crawford et al. (2005) employed "microanalytical textual analysis" to understand participants' adaptiveness and efficiency across verbal protocol data. Finally, the researchers correlated results across the first two phases of data analysis. Though Crawford et al. (2005) use quantitative language in their account of data collection and analysis (e.g., "…rubrics evaluate extent to which…"; "…rubric ratings and adaptive expertise analysis are correlated"), preliminary findings are reported qualitatively. Further, Crawford et al. (2005) do not share the rubrics used for rating participants' task performance. Therefore, it is unclear whether data were quantitized and analyzed statistically or remained qualitative for categorical evaluation via rubrics.

Hayden, Rundell, et al. (2013) and Hayden and Chiu (2013) collected participants' written reflections for data analysis. Participants in both studies structured their written reflections following the SOAR acronym: subjective retelling of the lesson, progress toward objectives, analysis of the lesson, and reflection. In total, Hayden, Rundell, et al. (2013) gathered 14 and 13 written reflections from each of their 2 participants respectively; Hayden and Chiu (2013) collected 175 written reflections for analysis from 23 participants. Despite the similar data collection processes, data analyses reflected each study's unique purpose.

Hayden, Rundell, et al. (2013) coded instances of "critical incidents," events that prompted thorough reflective consideration, across each participant's written reflections. Critical incidents were coded as either problems or dilemmas, then the researchers coded instances of participants' discussion of adaptations related to the problem or dilemma. Two of the three researchers coded the reflections, then the third recoded the reflections independently; final codes resulted from comparative discussions among the researchers. Though not through a formal study, Hayden, Moore-Russo, et al. (2013) similarly discussed the critical incidents that prompted the third author to adapt his math lesson.

Citing a mixed methods research design, Hayden and Chiu (2013) collected only qualitative data, but quantitized axial codes to enable both qualitative and quantitative analyses. Data analysis began with recursive coding through theme identification and axial coding across participants' written reflections. The researchers coded participants' challenges as problems or dilemmas. Then, noticing problems were more frequent across reflective data, these became the primary focus with refined coding to include instances of problem exploration and types of problems represented. With problems clearly identified, the researchers next reviewed data for instances of participants' discussion of adaptations and resolutions related to a given problem exploration. For a dual coded data set of 100 quotations, Hayden and Chiu (2013) report interrater reliability of $\alpha = .71$, .74, and .70 for problem explorations, adaptations, and resolutions, respectively. Noticing patterns among reflections on problems, adaptations, and resolutions, Hayden and Chiu (2013) quantitized reflection data using frequencies in order to perform statistical discourse analysis around relationships in the problem-adaptation-resolution cycle. Through three multilevel regression models for predicting problem resolutions, Hayden and Chiu (2013) sought confirmatory quantitative evidence of relationships evidenced through qualitative analysis.

Other researchers quantitized qualitative data outside of employing a mixed-methods design. Wetzel et al. (2015) used an a priori coding scheme based on the adaptive expertise framework to code narrative data resulting from participant interviews following a reflection prompt protocol. Independent and negotiated coding of narrative data resulted in a coding dictionary containing 11 codes across dispositional characteristics, metacognitive skills, and cognitive skills.  The researchers report returning to initially coded data as a check for consistency across application of the final coding dictionary across coders; this procedure resulted in "high consistency supporting dependability of the coding scheme" (Wetzel et al., 2015, p. 7). Wetzel et al. (2015) further quantitized data by calculating frequencies of codes across participants. Following the data gathering procedures of Crawford et al. (2005), Crawford (2007) coded transcribed data according to either a knowledge-building task orientation (exploring the problem to expand knowledge) or efficiency task orientation (simplifying the problem for quick resolution). Reported coding reliability was above .95 for both orientations. Coding disagreements were discussed, and coding decision rules were refined as a result. Codes were quantitized by calculating mean percentages for each coding category. Crawford (2007) then conducted t-tests for group comparisons.

Soslau (2010, 2012), too, quantitized qualitative data. Her research followed three student teacher-university supervisor dyads across two eight-week student teaching placements. Data were collected at four time points, two per placement, through observation, audio-recording of post-observation supervisory conferences, and one-on-one interviews with all six participants after each conference. In addition, Soslau (2012) collected data through field notes, student teachers' lesson plans, supervisory observation feedback forms, and surveys to thoroughly capture the content of each supervisory conference and triangulate data. Data analysis following discourse analysis procedures focused on the discourse exchanged during supervisory conferences as the case unit. Data coding proceeded according to a priori codes for discourse types (factual, prudential, justifactory, critical) and novices' problems (dual purpose, unquestioned familiarity, context). Inter-coder reliability (Kappa) reached 0.90. Additionally, Soslau (2012) quantitized narrative data through frequencies to more precisely make comparisons across participants and discussions of novice problems.

Like Hayden and Chiu (2013), Janssen et al. (2008) specifically report on qualitative and quantitative data analyses; however, the latter were the only researchers to collect quantitative data in addition to qualitative data. First, pairs of student teachers interviewed one another to prompt reflection about two positive and two negative teaching experiences. For both types of teaching experiences, participants described what happened, what went wrong/right and why, and what they resolved to do as a result of the experiences. Interview data were collected through participant note-taking on a researcher-developed worksheet. Next, Janssen et al. (2008) had the student teachers indicate whether or not they felt certain emotions, classified as general or specific based on valuation theory. Finally, following expectancy-value theory, participants scored (1 to 7) each resolution identified in the interview in terms of (1) its importance (value) and (2) the likelihood of being implemented (expectancy).

Data sources included the notes each interviewer recorded as well as participants' emotion and motivation ratings. Initially, Janssen et al. (2008) identified the three resolutions each participant ranked most highly important; these became the primary data for subsequent analysis. Two of the researchers independently categorized the resolutions then discussed categories until agreement was reached. Emotion ratings were counted resulting in scores for positive experience- and problem-based reflections across general and specific positive and negative feelings. Motivation-based scores for expectancy and value were averaged across positive and problematic experience reflections.

Among the studies included in this review, Martin et al. (2015) represented the only purely quantitative research. Participants completed pre and post content tests based on each of three engineering design units within the summer program that included *efficiency* items targeting direct assessment of material learned and *innovation* items design to assess application of knowledge to a novel situation. In addition, participants completed two online surveys pre and post to measure their adaptive beliefs (Fisher and Peterson's [2001] Adaptive Beliefs Survey) and beliefs about engineering design (Design Survey adapted from Mosborg et al., 2005). Both surveys used a five-point Likert scale whereby participants rated their beliefs from *strongly disagree* to *strongly agree*. Martin et al. (2015) analyzed content test data using a 2 x 2 repeated measures ANOVA to assess relationships across the within-subjects factors of time (pretest/posttest) and test measure (efficiency/innovation). The same approach was applied to data analysis based on the participants' pre and post responses to the Design Survey, as items were categorized as either efficiency- or innovation-oriented. Because the Adaptive Beliefs Survey contained four subscales representing adaptive beliefs, a 2 x 4 repeated measures ANOVA was used to analyze these data for participants across time (pretest/posttest) and subscale (Multiple Perspectives, Metacognitive Self-Assessment, Goals and Beliefs, and Epistemology).

***Assurances of quality and rigor.*** Of the studies represented in this review, researchers in only two studies systematically address design features that enhance the quality and rigor (i.e., trustworthiness or validity) of the research. Hayden and Chiu (2013) cite Tashakkori and Teddlie's (2006, 2008) integrative framework for reporting on quality and rigor of mixed methods research including design suitability, within-design consistency, analytic adequacy, interpretive consistency, theoretical consistency, and integrative efficacy of the design. For each aspect of the framework, they provide direct evidence from their study design and interpretations. Soslau (2010, 2012) is similarly thorough in addressing research design considerations to enhance the confirmability, credibility, dependability, and transferability of her research, thus contributing to the overall trustworthiness of results and conclusions. The remaining eight studies (Anthony et al., 2015; Crawford, 2007; Crawford et al., 2005; Hayden, Rundell, et al., 2013; Janssen et al., 2008; Martin et al., 2015; Wetzel et al., 2015; Yoon et al., 2015; Yoon et al., 2014) provide more piecemeal evidence of quality and rigor.

***Discussion of findings.*** Synthesis of findings across teacher adaptive expertise research show emerging support for theoretical applications of the construct to teaching and corroborates empirical evidence from other adult learning domains. Overall, findings suggest three main implications for teacher adaptive expertise: (1) teachers exhibit indicators of routine and adaptive expertise in their instructional practice, but vary widely in the extent of adaptive- or efficiency-orientations; (2) adaptive expertise can develop alongside the development of routine expertise associated with efficiency-oriented learning of content and how to teach; and, (3) teacher reflection and deep thinking, when intentionally guided, supported, and challenged, can be an avenue for adaptive expertise development. Each implication is discussed in light of findings across teacher research on adaptive expertise with links to theory as appropriate.

Findings illustrate the nature and extent of teacher adaptive expertise, with variations across teachers' adaptive or routine expertise orientations and experience level. By analyzing transcribed participant think-alouds, Crawford et al. (2005) discerned distinct patterns of adaptive processes and efficiency-oriented processes among the participants. Biology teachers with adaptive orientations were slow to draw conclusions, explored given data systematically, tested their hypotheses against new data, and approached novel content with curiosity. Conversely, efficiency-oriented teachers developed conclusions quickly, engaged with data more superficially, developed hypotheses based on prior knowledge rather than new data, and were disinterested in new content. These characteristics of adaptive- and efficiency- (routine expertise) oriented problem solving processes echo descriptive indicators from the theoretical literature and provide evidence that teachers can be distinguished by their approach to problems within the framework of adaptive expertise. Reflecting a more comprehensive definition of adaptive expertise from the literature, Wetzel et al. (2015) found evidence of 11 adaptive expertise indicators across dispositional, cognitive, and metacognitive characteristics for both pre-service and in-service special educators. Patterns of expression of adaptive expertise indicators suggested relationships across certain dispositional characteristics and cognitive and metacognitive indicators such as wanting feedback from others (disposition), seeking it out (cognitive), and processing how that feedback integrates within the overall problem solving approach (metacognitive). Least exemplified across participant data were indicators of causal reasoning and justification of decisions as part of problem solving.

Anthony et al. (2015) noted their two case study prospective teachers began their Classroom Inquiry experience with different orientations toward learning. Initially one was more focused on developing her own pedagogical knowledge and skills related to math teaching (indicators of routine expertise). On the other hand, her counterpart began the learning experience with the expectation that his prior assumptions about learning and teaching math would change, and that these were inherently connected to students' responses to his teaching (indicators of adaptive expertise). Despite these initial differences, by the end of the learning experience, Anthony et al. (2015) noted both prospective teachers had progressed in their development along the trajectory toward adaptive expertise, shifting their focus from teaching efficacy to teaching agency for impacting student mathematics learning.

Crawford's extended research (Crawford, 2007) took experience level into consideration as well as problem solving orientation. Comparisons of mean percentages of knowledge-building or efficiency codes from the first phase of the instructional task were conducted across groups according to their a priori designations: adaptive veterans, routine veterans, and novices. Results showed that adaptive and routine veterans had similar percentages of efficiency oriented codes (11.52% and 13.55% of all codes, respectively) but much more disparate mean percentages for knowledge-building codes (17.37% and 7.68% of all codes, respectively). Analysis of novice data revealed mean percentage of knowledge building codes similar to that of veteran adaptive teachers (16.35%), and a significantly smaller percentage of efficiency codes (2.6%) than that of all veteran teachers combined (12.65%; $t[11] = 2.34$, $p = .039$). These findings lend empirical support to the Schwartz et al. (2005) conceptualization of adaptive expertise as the balance between efficiency and innovation. Whereas all veteran teachers demonstrated high levels of efficiency codes, the data from adaptive veterans also revealed extensive knowledge-building characteristic of innovation. Thus, adaptive veterans operated within the "optimal adaptability corridor" (Bransford et al., 2005; Schwartz et al., 2005) along the trajectory towards adaptive expert status. Novices, with evidence of knowledge-building similar to that of experts but minimal evidence of efficiency, responded in a pattern resembling "frustrated novices" (Bransford et al., 2005).

Experienced teachers in the study by Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014) demonstrated varying levels of adaptive expertise within the context of integrating technology-based reform curricula in high school biology. The teacher with the greatest teaching experience exhibited the least evidence of adaptive expertise overall, with low flexibility in adapting instructional practices and minimal evidence of deep understanding of the goals of the new curricula. Though evidence of this teacher's deliberate practice (e.g., effort and attention to monitoring student learning to inform instruction) was rated moderate, the two teachers with less experience (though not novice teachers) exhibited high levels of this aspect of adaptive expertise. The more adaptive teachers also showed moderate levels of flexibility and deep understanding. Considered in light of research by Crawford and colleagues (Crawford, 2007; Crawford et al., 2005), these teachers represented more adaptively-oriented veterans whereas the most experienced veteran was more efficiency-oriented. Yoon and colleagues (Yoon et al., 2015; Yoon et al., 2014) suggest the more adaptive teachers enhanced implementation of the novel science curricula. This underscores the importance of supporting the development of teachers' adaptive expertise across various instructional contexts, including special education, for improved instructional experiences for students.

Other research further points to developmental differences in teacher adaptive expertise. Wetzel et al. (2015) noted experienced teachers' discussions of special education teaching practice resulted in far more examples of the dispositions and cognitive and metacognitive skills of adaptive expertise than those of pre-service teachers. Hayden, Rundell, et al., (2013) found distinct disparities between the written reflections of the novice and experienced teacher in their study. The novice relied on descriptive reflection and had much fewer adaptations than his more experienced counterpart. He could identify dilemmas but had difficulty developing strategies to address them. Instead of focusing on his agency as a teacher, drawing from past experience and pedagogical content knowledge, the novice discussed characteristics of the student as roadblocks to progress. In contrast, the experienced teacher drew from his vast experience, his understanding of his teaching interactions with the student, and analysis of data to develop hypotheses that led to adaptations. Hayden, Rundell, et al. (2013) note the experienced teacher "demonstrated an internalized habit of reflective practice" (p. 410) characteristic of adaptive expertise; for the novice, written reflections alone proved inadequate for promoting adaptive expertise. These findings mirror evidence of the initial routine-oriented teaching practice of the third author/teacher in the conceptual paper by Hayden, Moore-Russo et al. (2013). At first, his reflections were descriptive in nature, and although they led him to adapt his instruction, the adaptations related to superficial promotion of students' engagement in the math lesson. With subsequent reflective cycles prompted by principal evaluation and professional development over the ensuing few years, the teacher's reflections had become more critical and more focused on the relationship between students' deep content understanding and engagement.

Hayden and Chiu (2013) noted participants most often explored problems in written reflections about their own skill development as teachers. Other reflective content focused on skill deficits in the students with whom they worked and their students' performance toward objectives and readiness for new learning. Quantitative analysis resulted in confirmation of the problem exploration-adaptation-resolution cycle noted through qualitative analysis. Across the 175 written reflections, the researchers noted 33 problem explorations, 86 adaptations, and 33 resolutions. Contrary to other findings suggesting greater experience is related to more evidence of teacher adaptive expertise (e.g., Crawford, 2007; Hayden, Moore-Russo et al., 2013; Hayden, Rundell, et al., 2013; Wetzel et al., 2015), graduate novices were significantly less likely to report resolutions in their reflections than undergraduate novices across the three multilevel regression models tested. Hayden and Chiu (2013) explain this finding may be due to more experienced novices (graduate students) engaging in greater consideration of problems and adaptions than undergraduate novices or wanting more confirmation that an adaptation is effective before reporting resolution in their reflections. Overall, the more adaptations a novice discussed, the more resolutions were present in a given reflection. Furthermore, greater problem explorations or adaptations discussed in the prior week's reflection led to significantly more resolutions in the following week's reflection. Evidence from the work of Hayden and colleagues (Hayden & Chiu, 2013; Hayden, Moore-Russo, et al., 2013; Hayden, Rundell, et al., 2013) adds more nuanced understanding to how adaptive expertise manifests in novice and experienced teachers.

Research with novice and experienced teachers suggests routine and adaptive expertise can develop in tandem. Teachers engaged in field-based experiences as part of coursework or culminating student teaching placements are charged with putting their accumulated routine-oriented content and pedagogical knowledge and skills into practice. However, because field experiences juxtapose demonstration of teaching efficiency with the complexity of real world teaching practice, opportunities for adaptation and innovation are ever present. A prospective teacher in research by Anthony et al. (2015) simultaneously strengthened her pedagogical skills and self-confidence for teaching (efficiency characteristic of routine expertise) while also developing a greater sense of the connections between her actions and decisions and students' learning outcomes (experimenting and modifying instruction characteristic of adaptive expertise). Janssen et al. (2008) found student teachers made innovative resolutions to address problems of practice they encountered while student teaching when asked to reflect upon positive teaching experiences. Soslau (2010, 2012) found student teachers demonstrated adaptive expertise when given the opportunity to engage in critical and justifactory discourse during post-observation supervisory conferences. Discourse of these types required student teachers to justify their instructional decisions and self-assess around typical novice problems of practice. Research by Hayden and colleagues (Hayden & Chiu, 21013; Hayden, Rundell, et al., 2013) similarly noted characteristics of adaptive expertise alongside a more well-developed repertoire of routine expertise. Novices incorporated adaptations into field-based instruction resulting from work with the course instructor (Hayden, Rundell et al., 2013) and developed adaptations and instructional decisions from structured reflection on the problems they experienced while teaching (Hayden & Chiu, 2013).

Like this research with novice teachers, Martin et al. (2015) similarly found simultaneous growth in efficiency and innovation orientations when studying the engineering content acquisition and application of experienced math and science teachers. Though these teachers were not directly engaged in fieldwork like the novice participants in other research, they engaged in an authentic engineering design process while contending with real-world engineering design problems. Further, unlike research with novices, Martin et al. (2015) found statistically significant growth in efficiency and innovation based on their content test scores through 2 (pre, post) x 2 (innovation, efficiency) repeated measures ANOVA ($F$ [1,32] = 28.14, $MSE$ = .080, $p < .05$) where time emerged as a main effect.

Investigation of teacher reflection and deep thinking was a common thread woven throughout the empirical teacher adaptive expertise literature. Findings suggest teacher reflection and deep thinking can prompt adaptive expertise when thoughtfully leveraged by experienced others (administrators, supervisors, instructors, colleagues) through deliberate planning; conversely, without thoughtful prompting by others, opportunities may be missed for adaptive expertise development. Moreover, though it may take many forms, teacher thinking needs to be challenged by the introduction and discussion of other perspectives, by consideration of instructional decisions and their justifications, and through attention to positive and successful previous experiences.

Research by Anthony et al. (2015) and Martin et al. (2015) highlights the intentionality behind structuring teachers' learning experiences towards the development of adaptive expertise through coursework. A "cyclical teaching-as-inquiry" practice-based approach formed the foundation of the Classroom Inquiry course studied by Anthony et al. (2015, p. 110) that involved field work teaching math and course-based teaching practice and learning activities. Key elements of this approach promoted prospective teachers' development of adaptive expertise, though emergent. Throughout cycles of inquiry and knowledge-building, prospective teachers were prompted to reflect upon the connections between their teaching with student learning outcomes in order to promote the shift of focus from self to student and deeper understandings about teaching and learning. Further, the prospective teachers repeatedly engaged with their peers in teams to discuss instructional planning, decisions, and reflections on practice. Throughout the course, prospective teachers had opportunities to take risks and experiment with approaches within a "safe" space. Research literature and frameworks also were salient aspects of the course that prompted prospective teachers to expand upon their existing pedagogical and content knowledge and skills.

Learning experiences studied by Martin et al. (2015) similarly used a cyclical approach to structure how veteran math and science teachers engaged with engineering content during a summer engineering institute. Martin et al. (2015) noted that this approach, design-based instruction, is a variant of challenge-based instruction such as the STAR Legacy Cycle studied by Martin and colleagues (Martin et al., 2005; Martin et al., 2006) and others (Pandy et al., 2004). Within design-based instruction, teams of teachers are confronted with a real-world engineering design problem, and proceed through recursive phases of understanding the problem, quantifying the need, engineering the concept, embodying the concept, implementing the design, and ultimately finalizing the design. Analysis of teachers' pre and post test scores across three units of study revealed that initially, teachers were more innovative than efficient in their approach to engineering content. However, through grappling with course content through the design-based instructional approach, promoted significant increases in teachers' content knowledge (efficiency) such that they were commensurate with their degree of innovation. As described previously, by the third unit, teachers' efficiency and innovation scores showed significant increases across time relative to that unit's content. Pre to post comparisons of teachers' innovating and efficiency attitudes as measured by the Design Survey indicated teachers' beliefs changed significantly across time, with greater beliefs that both efficiency and innovation were related to engineering. Teachers' mean scores resulting from Fisher and Peterson's (2001) Adaptive Beliefs Survey did not change significantly over the course of the summer program. Overall, results suggest the fluid and flexible design-based instructional approach to the teaching and learning of engineering content fosters teachers' adaptive expertise.

Other research looked more specifically at individualized instances of prompting reflection, rather than through the overall design of coursework. Soslau (2010, 2012) found many opportunities were missed during supervisory conferences to discuss novice problems of practice in ways that would promote the pre-service teachers' adaptive expertise. Across the twelve conferences (four per dyad), Soslau (2010, 2012) identified 31 potential opportunities for dyads to discuss the three novice problems. Of those, dyads engaged in 20 discussions but missed opportunities to discuss novice problems on 11 occasions. Further, supervisors inconsistently prompted discussion around particular novice problems across conferences. The dyad with the guiding and reflecting supervisor resulted in the greatest number of discussions of novice problems while the other dyads, both of whom employed telling supervisory styles at least in part, had far fewer problem-based conversations. Soslau (2010, 2012) found guiding and reflecting supervisory styles to be associated with critical and justifactory discourse, where supervisors facilitated student teachers' articulation of their decision-making processes while teaching. Yet, the researcher noted supervisors were inconsistent in their use of these discourse types. Thus, Soslau (2010, 2012) concluded that supervisors needed a greater awareness of opportunities to leverage conference discourse in critical and justifactory ways around novice problems to promote student teachers' adaptive expertise. Soslau (2010, 2012) suggested the increased use of critical and justifactory discourse during conferences would help pre-service teachers to self-assess and justify their instructional decisions, both indicators of adaptive expertise.

The only adaptations the novice in Hayden, Rundell et al.'s (2013) research made to his instruction directly resulted from his work with a course instructor; indeed, the researchers noted the novice would have benefitted from additional guidance from the course instructors on how to consider multiple perspectives. Similarly, it took a "critical incident"—specific observational feedback from an administrator—to prompt the third author in the Hayden, Moore-Russo, et al. (2013) conceptual paper to reflect more deeply about instructional adaptations to deepen his students' thinking. For some novices, simply reflecting without purposeful prompting to grapple with issues and multiple perspectives leads to little to no adaptations to instructional practice (Hayden, Moore-Russo, et al., 2013; Hayden, Rundell, et al., 2013; Soslau, 2010, 2012).

Research exploring the differences between students teachers' reflections on positive versus negative experiences points to another way teacher education faculty can prompt novice development of adaptive expertise. Student teachers engaging in prompted reflection based on positive experiences showed more positive feelings and greater motivation to act on their resolutions than those who reflected on negative experiences (Janssen et al., 2008). Further, when positive experiences were the basis of reflection, student teachers were more likely to resolve to employ innovative approaches in their subsequent teaching than when problematic experiences were used in reflection. Thus, Janssen et al. (2008) suggested reflection on positive experiences as a way to promote the development of adaptive expertise in aspiring teachers.

Wetzel et al. (2015) employed a *learning in community* framework whereby knowledgeable researchers prompted in-service special educators' adaptive expertise, and those experienced teachers, in turn, prompted pre-service teachers' adaptive expertise. Through this purposeful prompting following a reflection prompt protocol, all participants' discussions of their teaching practice included all investigated indicators of adaptive expertise.

Intentional prompting discussed by these researchers should not be confused with the specific prompting employed in research by Crawford et al. (2005). Though during the second phase of task administration by Crawford et al. (2005) the experimenter prompted participants to examine or re-examine aspects of the task scenario, this level of prompting was not sufficient to alter participants' efficiency orientation towards routine expertise. Participants demonstrating evidence of an efficiency-orientation during their independent work with the problem-based task maintained that orientation even with prompting by the researcher. The same was true for adaptive-oriented participants. These findings suggest that in order for prompting by others to effectively engage adaptive thought processes, prompting must involve deeper discussion that challenges decision-making and forces consideration of other perspectives.

***Limitations.*** Taken together, the studies represented in this review have several limitations. Due to small sample sizes (range $N = 2$ to $N = 33$) and highly contextualized qualitative approaches, generalizability, or transferability, of findings is limited. Yet, findings across these studies lend support to one another despite being of varied context and participants. Further research is needed with larger samples of teachers to help fill in gaps in understanding about the continuum of routine and adaptive expertise and the associated developmental trajectory. Teacher samples should also be more representative of various disciplines within education.

Another limitation of the research is lack of a specific measure of teacher adaptive expertise. Researchers overwhelmingly coded narrative data, and in some cases quantitized the data to represent the extent of teachers' adaptive expertise. Rubrics used by Crawford et al. (2005) for evaluating participant think-aloud data for evidence of adaptive-orientation are unclear. Measures used by Martin et al. (2015) focus on evidence of efficiency and innovation and adaptive beliefs within the specific context of engineering education. Furthermore, adaptive expertise is conceptualized in various ways across the literature. A comprehensive operational definition that relates to the context of teaching, such as that employed by Wetzel et al. (2015), is needed to inform the development of a more precise measure that evaluates the nature and extent of teacher adaptive and routine expertise.

A final limitation is the lack of systematic attention paid to clearly establishing evidence for validity/trustworthiness across the studies. Researchers of two studies employed careful consideration to establishing the validity and trustworthiness of their research (Hayden & Chiu, 2013; Soslau, 2010, 2012); evidence is less clear among the remaining studies reviewed. As some research is reportedly preliminary in nature (Crawford et al., 2005; Yoon et al., 2015; Yoon et al., 2014), these researchers incompletely described procedures and findings presented are not well developed. Clearly more research is needed that employs rigorous methods with thorough evidence established for internal validity through design and data analysis considerations.

**Summary of theoretical and empirical literature on adaptive expertise.** The theoretical literature on adaptive expertise clarifies leading conceptualizations of the construct and suggests approaches for promoting learner development in pursuit of adaptive expert status. Adaptive expertise describes individuals who have repertoires of innovative and efficient approaches to meeting the demands within a learning domain. Adaptive experts understand the "messiness" of the world and embrace challenges and others' perspectives as opportunities to learn and develop within their field. They know who they are as learners and systematically reflect upon the limits of their current knowledge and practice. Data and multiple perspectives inform adaptive experts' selection of routine or innovative approaches to a given problem. Together with an understanding of the relationship between the efficiency and innovation comprising adaptive and routine expertise, these dispositions and metacognitive and cognitive skills comprise a comprehensive definition of the construct. To advance toward adaptive expertise, the theoretical literature suggests the design of learning environments that systematically engage learners with novelty, variability, new perspectives, and opportunities to transfer knowledge and collaborate.

Across disciplines, empirical literature offers support for theoretical perspectives on adaptive expertise and its development. Unique, yet limited measures distinguish learners in their degree of adaptive expertise. From engineering education, adaptive expertise has been measured through Fisher and Peterson's (2001) Adaptive Beliefs Survey, content-specific exam items (Martin et al., 2005; Martin et al., 2006), and a content-specific questionnaire with weighted values for factual, conceptual, and transfer-based knowledge (Pandy et al., 2004). Within the domain of teacher education in engineering, Martin et al. (2015) applied a similar approach to measuring adaptive expertise through content-specific pre and posttest items targeting efficiency and innovation. Overall, however, measures of teacher adaptive expertise are largely based on quantitized coding of narrative data about certain aspects of adaptive expertise such as adaptations and resolutions (Hayden & Chiu, 2013; Hayden, Rundell, et al., 2013), knowledge-building and efficiency orientations (Crawford, 2005), and flexibility, deliberate practice, and deep understanding (Yoon et al., 2015; Yoon et al., 2014). Though valuable as contributions to understanding the nature and extent of individuals' adaptive expertise and development, none of these measures take into account a fully conceptualized definition of adaptive expertise that includes items targeting adaptive and routine orientations as well as the breadth of dispositions, cognitive and metacognitive skills. Wetzel et al. (2015) employed a more comprehensive operational definition of adaptive expertise to their qualitative coding scheme, but much more could be understood about special educators' adaptive expertise by applying this definition using mixed methods research approaches to the perspectives of a larger sample of participants.

Though most empirical evidence suggests breadth and depth of experience contributes to more adaptive orientations to problem solving (Barnett & Koslawski, 2002; Hayden, Rundell, et al., 2013; Mylopoulous & Regehr, 2009; Varpio et al., 2009; Wetzel et al., 2015), assumptions of adaptive expertise based solely on experience would be flawed. Among research with teachers, veterans and more experienced students did not necessarily exhibit greater adaptive expertise (Crawford, 2007; Crawford et al., 2005; Hayden & Chiu, 2013; Yoon et al., 2015; Yoon et al., 2014). This conclusion indicates the need for further study of the nuances of adaptive expertise across experience levels of individuals within a domain.

Empirical evidence across disciplines also suggests deliberately designed learning environments and experiences can promote the development of adaptive expertise. By employing the HPL-based STAR Legacy cycle, or the related design-based inquiry approach, several researchers positively affected aspects of learners' adaptive expertise (Martin et al., 2005; Martin et al., 2006; Martin et al., 2015; Pandy et al. 2004). Deep, systematically prompted reflection, whether written (Hayden & Chiu, 2013; Hayden, Rundell, et al., 2013) or embedded in discussion of teaching practice (Janssen et al., 2008; Soslau, 2010, 2012; Wetzel et al., 2015) or both (Anthony et al., 2015) offered opportunities for adaptive expertise development as well. Yet, these studies investigated small samples within specific domains. More cross-disciplinary research on adaptive expertise development longitudinally and crossectionally with larger samples is needed.

**Conceptual framework for special educator preparation.** As noted by Hayden, Rundell, et al. (2013), the goal of teacher preparation is to promote fledgling teachers' development of "an internalized habit of reflective practice" (p. 410) characteristic of adaptive expertise. Together with research by Wetzel et al. (2015), recent publications in *Teacher Education and Special Education* directly highlight the value of promoting adaptive expertise development in pre-service special educators and reflect the research-based implications discussed previously. Recognizing the complexities inherent to teaching in special education and the need for cohesive teacher preparation (Darling-Hammond & Hammerness, 2005), De Arment et al. (2013) reviewed the literature on adaptive expertise and offered specific implications for special educator preparation.

Building upon the model of adaptive expertise suggested by Crawford et al. (2005), De Arment et al. (2013) suggest adaptive expertise, comprised of dispositional, cognitive, and metacognitive indicators, as a unifying conceptual framework for the preparation of special educators. Guided by this framework, faculty can evaluate existing preparation standards and learning opportunities, then thoughtfully and deliberately plan for scaffolding adaptive expertise throughout the preparation program. Habitual opportunities to deepen teacher candidate reflection on teaching by requiring consideration of other perspectives, data-based reasoning, evaluation of knowledge limits, and justification of instructional approaches will enhance candidates' ability to recognize and overcome the problems in learning to teach. Further, as novice special educators gain routine expertise through learning about best practices in special education, they can, as Bransford (2004) and others suggest, simultaneously develop adaptive skills and dispositions. By developing measures of adaptive expertise aligned to literature-based indicators and professional standards, faculty can enhance feedback to teacher candidates and evaluate program outcomes.

Drawing from the De Arment et al. (2013) conceptual framework of adaptive expertise in special educator preparation, Mason-Williams, Frederick, and Mulcahy (2014) describe their program's Capstone Intervention Project as a carefully crafted opportunity for students to demonstrate routine expertise and develop adaptive expertise and potentially contribute to practice-based evidence in special education (Kratochwill et al., 2012). This project "requires pre-service [special education teachers]…to design a student or classwide intervention to implement based on an operationally defined academic, behavioral, or social need" (Mason-Williams et al., 2014, p. 2). Pre-service teachers proceed through the Implementation Stages framework as they learn how to put an identified intervention into practice. As Mason-Williams et al. (2014) explain, throughout each of the four stages of intervention implementation, teacher candidates grapple with balancing efficiency and innovation as they determine whether an intervention will work, identify needed adaptations, make adjustments to teaching practice, and come to understand their work in relation to practice-based evidence.

The NRC (2000) notes, “Teachers are learners and the principles of learning and transfer for student learners apply to teachers (p. 242). Reflecting this notion, the IRIS Center, funded by the Office of Special Education Programs (OSEP) of the US Department of Education, strives to enhance pre-service and in-service teacher development for working with students with disabilities and their families (IRIS, 2013). Chief among the resources the IRIS Center provides are challenge-based modules centered on the STAR Legacy Cycle. Whereas research in engineering utilized the STAR Legacy Cycle to enhance students’ adaptive expertise (Martin at al., 2005; Martin et al., 2006; Pandy et al., 2004), IRIS modules promote teacher adaptive expertise around challenges associated with teaching students with disabilities. Teacher education faculty and professional development providers have the opportunity to access technical assistance, including webinars, web tours, and tutorials, as well as extensive materials for the enhancement of pre-service and in-service teacher learning.

Given these applications to special educator preparation, nurturing adaptive expertise in special education teacher candidates allows for scaffolded and supported experiences applying routine and adaptive approaches to teaching in special education. By systematically integrating opportunities to grapple with the preconceived notions and variable contexts of teaching in special education, faculty can promote routinized adaptive expertise. Yet, empirical evidence based on the enactment of adaptive expertise by experienced and successful special educators is needed to more comprehensively justify a reorientation of special educator preparation to the development of adaptive expertise. Empirical evidence from the current study also informs the crafting of reflective opportunities aligned to the complex nuances of real life teaching practice. By validating a literature-based survey measure of adaptive expertise and subsequently conducting group comparisons and in-depth interviews, this study sought evidence of adaptive expertise in the problem solving of special educators. Knowing how in-service special educators enact adaptive expertise through their problem solving approaches lends empirical support to this framework for special education teacher preparation.

**Congruence with professional standards.** The relevance of adaptive expertise to teacher development is further evident through emphasis of adaptive skills and dispositions in various standards for professional teaching practice (Darling-Hammond, 2000). National and state standards for effective teaching in general, and special education-specific standards from leading professional organizations echo one another in emphasis on instructional adaptations, feedback from and collaboration with others, analysis and reflection on instruction, and continuous teacher learning and growth. Though not exhaustive, this sampling of standards suggests commonly held value for key indicators of adaptive expertise in teachers. Table 2 presents the congruency between exemplar standards from various professional organizations and the literature-based indicators of adaptive expertise.

Table 2

*Congruence of Professional Standards with Adaptive Expertise Indicators*

| Organization | Audience | Competency/Standard | Adaptive Expertise Indicator |
|---|---|---|---|
| Council of Chief State School Officers' (CCSO) Interstate Teacher Assessment and Support Consortium (CCSO, 2013) | Teachers P-12 | 2(c) The teacher brings multiple perspectives to the discussion of content, including attention to learners' personal, family, and community experiences and cultural norms. | • Seeking out feedback from others (D)<br>• Accounting for multiple perspectives (C) |
| | | 7(q) The teacher believes that plans must always be open to adjustment and revision based on learner needs and changing circumstances | • View of the world as messy, dynamic, complex (D)<br>• Cognitive flexibility characterized by responding to classroom variability and inventing new procedures (C) |
| | | 9(d) The teacher actively seeks professional, community, and technological resources, within and outside the school, as supports for analysis, reflection, and problem-solving. | • Willingness to reveal the limits of one's knowledge and skill (D)<br>• Monitoring own learning and comprehension (M)<br>• Seeking and analyzing feedback about problem-solving processes and outcomes (M)<br>• Accounting for multiple perspectives (C) |
| National Board for Professional Teaching Standards: Exceptional Needs Specialists (NBPTS, 2011) | Teachers of children/ students age birth-21with exceptional needs | Standard X: Accomplished teachers of students with exceptional needs select, adapt, create, and use rich, unique, and varied resources, both human and material, to promote individual student learning. | • Invent new procedures (C)<br>• Select routine or adaptive approaches (C) |
| | | Standard XII: Accomplished teachers of students with exceptional needs regularly analyze, | • Assess adequacy of current knowledge for solving case at hand (M)<br>• Monitor results and |

| | | | |
|---|---|---|---|
| | | evaluate, and synthesize their practice to strengthen its quality. | performance related to teaching (M)<br>• Modify existing procedural skills (M) |
| Council for Exceptional Children (CEC) Initial Preparation Standards (CEC, 2012a) | Pre-service teachers of students with exceptional needs | 3.3 Beginning special education professionals modify general and specialized curricula to make them accessible to individuals with exceptionalities. | • Use data-driven forward reasoning (C)<br>• Select routine or adaptive approach based on data & hypothesis (C) |
| | | 5.1 Beginning special education professionals understand the significance of lifelong learning and participate in professional activities and learning communities. | • An inclination toward learning rather than merely applying knowledge (D)<br>• Prepared to learn from new situations (D) |
| | | 7.3 Beginning special education professionals use collaboration to promote the well-being of individuals with exceptionalities across a wide range of settings and collaborators. | • Seeking out feedback from others (D)<br>• Accounting for multiple perspectives (C) |
| CEC Advanced Preparation Standards (CEC, 2012b) | Experienced teachers of students with exceptional needs | 2.3 Special education specialists use understanding of diversity and individual learning differences to inform the selection, development, and implementation of comprehensive curricula for individuals with exceptionalities. | • Invent new procedures (C)<br>• Accounting for multiple perspectives (C) |
| | | 6.4 Special education specialists actively participate in professional development and learning communities to increase professional knowledge and expertise. | • Seeking out feedback from others (D)<br>• Assess adequacy of current knowledge for solving case at hand (M)<br>• Accounting for multiple perspectives (C) |

*Note.* D = adaptive disposition; M = metacognitive skill; C = cognitive skill

**Summary of Literature Review**

As noted by Lin et al. (2005), teachers are faced with variable situations as part of their day-to-day jobs and routine problem solving strategies are not sufficient within this dynamic context. This may be even more applicable within the complex context of special education where special educators take on various roles and instruct diverse students with disabilities across multiple grade levels and content areas. The challenging context of special education, further complicated by policy, contributes to persistent teacher turnover. Special educators find support through collegial interactions and orientations toward lifelong learning and professional growth; however, more research is needed to understand the factors that make a difference for special educator success when addressing the challenges of practice and contribute to teacher retention.

Theory from teacher development and adaptive expertise literatures suggests adaptive expertise is a critical construct for the development of the professional special educator. The dispositions of expert special educators as proffered by Benedict et al. (2014) mirror the adaptive dispositions in the conceptual framework of adaptive expertise. Further, conceptual models for promoting adaptive expertise in special educator pre-service preparation programs garner the theoretical relevance of adaptive expertise for special educators. Yet, minimal research supports this theoretical understanding. Empirical data are needed to test theory and inform practice and policy guiding teacher preparation and development in special education. In the words of Inagaki and Miyake (2007), "we need to examine whether this notion [of adaptive expertise] is useful by applying it to a variety of subject matters, and elaborate general principles for designing learning environments that will foster adaptive experts in the future." (p. 10). This research aimed to answer this call by establishing a stronger empirical base for understanding the contribution of adaptive expertise to teacher development, particularly for special educators. Table 3 summarizes gaps identified in existing research and how this research addressed them.

Table 3

*Identified Gaps in the Literature and Associated Features of the Present Research*

| | Gaps in Literature | Present Research |
|---|---|---|
| Adaptive expertise | • Empirical evidence needed to support theory | • Empirically applied adaptive expertise theoretical lens to study of special educators' problem solving approaches; cross-sectional sample of special educators' across experience levels contributes understanding to developmental trajectory of adaptive expertise |
| | • Existing measures inadequately capture full conceptualization of adaptive expertise | • Employed researcher-developed measure based on comprehensive review of adaptive expertise literature that considers multiple conceptualizations of adaptive expertise |
| | • Existing teacher research emphasizes qualitative approaches with small samples; no research examines special educator adaptive expertise | • Investigated a large cross-sectional sample of special educators ($N$ = 162) across experience levels |
| Methodology | • Existing teacher research lacks methodological design quality and rigor | • Applied specified mixed-methods research approach and Tashakkori and Teddlie's (2008) Integrative Framework for quality and rigor of inferences |
| National Board Certification | • Limited studies with Board-certified Exceptional Needs Specialists | • Included Board-certified Exceptional Needs Specialists as one of three main population targets for study participation |
| | • Limited understanding of how Board-certified status relates to teacher quality | • Investigated adaptive expertise of Board-certified special educators as a measure of one aspect of teacher quality |

Chapter III

## Methodology

Given the complexity of teaching diverse students with disabilities, special educators face many challenges in individualizing instruction to address unique learning strengths and needs. Nurturing the development of adaptive expertise may be a beneficial strategy for equipping special educators with the skills and dispositions to successfully address those challenges and apply new learning to future challenges. Yet, research investigating the application of the adaptive expertise construct to teaching is limited, and to date, only one study has examined teacher adaptive expertise within the context of special education. The purpose of this research was to address these gaps by using the adaptive expertise conceptual framework to understand how special educators' perceive and enact their problem solving approaches in response to challenges they encounter while providing educational services to students. Specific research questions were:

1. Does the Special Educators Problem Solving Approaches Survey (SEPSAS) measure special educators' adaptive expertise?
    a. Does the SEPSAS differentiate special educators' adaptive or routine problem solving approaches (Bransford et al., 2005)?
    b. Does the SEPSAS differentiate special educators' adaptive dispositions, cognitive skills, and metacognitive skills (De Arment et al., 2013)?

c. What is the relationship between participants' responses to the SEPSAS and Adaptive Beliefs Survey (adapted from Fisher & Peterson, 2001)?

2. To what extent are special educators' perceptions of their problem solving approaches as measured by the SEPSAS characteristic of adaptive and/or routine expertise?
3. What relationships exist between special educators' teaching experience and their perceived problem solving practices?
4. How do special educators describe their problem solving and supports in their teaching practice?
5. How do examples from special educators' real world teaching practice relate to their perceptions of their problem-solving approaches as measured by the SEPSAS?

**Study Design**

Recognizing that quantitative and qualitative research approaches can be complementary in providing a more complete understanding of the world (Onwuegbuzie & Johnson, 2006), an explanatory sequential mixed methods design was used to address the purpose of this study through collection of quantitative survey data followed by qualitative interview data. The mixed methods explanatory sequential design is characterized by two interactive phases of research (Creswell & Plano Clark, 2011). Depicted as QUAN → qual, this study employed a fixed design that prioritized the initial quantitative phase as a means of providing general understanding of the research problem through numeric data analysis (Ivankova, Creswell, & Stick, 2006). In the first phase, the researcher collected and analyzed quantitative data. During this phase of the study, a convenience sample of special educators responded to surveys about their problem solving approaches and adaptive beliefs within the conceptual framework of adaptive expertise. Results from the quantitative phase directly informed the second, qualitative phase of the research.

During this phase, qualitative data were gathered and analyzed. In this research design, qualitative methods are used as a follow-up to data collection and analysis of the quantitative phase; accordingly, qualitative results are used to explain quantitative results (Creswell & Plano Clark, 2011). In the follow-up qualitative phase of this study, participants provided varying perspectives on problem solving and adaptive expertise through their interview responses; the researcher purposefully sampled participants to capture those unique perspectives. Qualitative data from participants allowed for the inductive and deductive development of patterns and themes. Further, these data provided descriptive details that helped explain the statistical findings of the first research phase (Creswell & Plano Clark, 2011). Quantitative and qualitative mixing occured at the design and interpretation stages of the study. Appendix A illustrates the study design in terms of each phase and the associated procedures and products. Discussed in greater detail in the Sample Selection and Instrumentation sections, the researcher completed a small-scale ($N$ = 15) pilot study of the present research to test and evaluate study measures and procedures. This pilot research was completed with approval from Virginia Commonwealth University's Institutional Review Board.

A pragmatist worldview guided data collection and analysis across both phases of the research. Researchers ascribing to this paradigm seek knowledge that is constructed and based in reality as it is experienced (Onwuegbuzie, Johnson, & Collins, 2009). As noted by Wertz at al. (2011), "Pragmatists view humans as active agents who can interpret and act upon their situations" (p. 59). Pragmatism rejects the incompatibility thesis that qualitative and quantitative methods cannot be combined in research. Instead, this worldview is well-suited for mixed-method research where together, qualitative and quantitative approaches lead to "warranted assertions" for knowledge generation (Noddings, 2005, p. 58; Onwuegbuzie et al., 2009).

Accordingly, the researcher applied a mixed-methods research approach to develop warranted assertions about special educators' real world problem solving practices. Findings are considered in light of practical applications related to what works for addressing problems in special educator teaching practice (Creswell, 2013; Johnson & Onwuegbuzie, 2004; Onwuegbuzie & Johnson, 2006).

Using a mixed methods approach to understand adaptive expertise within the context of special educator problem solving is appropriate, and arguably necessary, to help address a lacking research base. Combining quantitative and qualitative methods within a single study allows for a more complete understanding of the phenomenon under study as a broader range of research questions can be examined than if a single method approach was used (Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2008). In addition, the weaknesses of one approach can be addressed by the strengths of the other. For example, whereas knowledge gained from qualitative research is limited in its generalizability (transferability) due to small sample size, quantitative results are based on data from a larger group of participants and therefore generalizability is enhanced. In the present research, narrative data add richer meaning to numeric data.

Recently, Klingner and Boardman (2011) argued that more mixed methods research was needed to address gaps in special education research. In teacher preparation literature in special education, mixed methods approaches to research are less frequent than quantitative-only or qualitative-only approaches. In their content review of *Teacher Education in Special Education* from 2004-2009, Spooner, Algozzine, Wood, and Hicks (2010) noted only 11% ($N = 13$) of published empirical articles used a mixed methods approach whereas 55% ($N = 64$) were quantitative studies and 14% ($N = 16$) represented qualitative research. Clearly, more mixed methods research is needed in the field to help address what Sindelar et al. (2010) identified as a research base in special education teacher preparation that is more like "Swiss cheese than concrete" (p. 8).

**Sample Selection**

The focus of this study is to understand how special educators approach problem solving in their day-to-day teaching. Accordingly, the researcher sought a purposive sample of special educators as participants. The pool of potential participants is comprised of all licensed (but not provisionally licensed) in-service, public school-based special educators in Virginia. The Virginia Department of Education annually collects data on teaching assignments of instructional personnel. As an estimate of the potential pool of special educators for the current study, there were 9,984 instructional personnel in Virginia who met study criteria during the 2013-14 school year, (B. Mason, personal communication, February 27, 2015). Because the researcher did not recruit participants with direct assistance from school districts, the pool of participants was further limited to a convenience sample of those whose email addresses were publicly available via school district or individual school websites. Participants may have taught in early childhood special education (age 3-5), elementary (kindergarten to fifth grade), or secondary (sixth to twelfth grade or age 21) settings. Further, participants may have taught students with any disability label according to the 14 categories identified in the Individuals with Disabilities Education Act: autism, deaf-blindness, developmental delay, deafness, emotional disturbance, hearing impairment, intellectual disability, multiple disabilities, orthopedic impairment, other health impairment, specific learning disability, speech or language impairment, traumatic brain injury, and visual impairment (IDEA, 2004). In addition, participants may have had any amount of special education teaching experience, designated in the current study as novice (0-3 years), experienced (more than three years), or accomplished (more than three years and National Board Certified as an Exceptional Needs Specialist).

Initially, a two-pronged approach was used to recruit participants. First, the researcher accessed the NBCT directory publicly available through the National Board for Professional Teaching Standards website (www.nbpts.org/nbct-search). Using this directory, the researcher identified all listed Exceptional Needs Specialist NBCTs within a mid-Atlantic state ($N = 229$) and determined their self-reported school districts. Then, through school district and individual school websites, the researcher located teacher email addresses. As expected, only a portion of the NBCTs in the Virginia database were located, likely due to reasons such as teachers changing school districts, exiting teaching, or changing their legal last name due to a life event. In addition, some schools did not make teacher email addresses publicly available. In total, the email addresses of 124 NBCT special educators' were located. Participant recruitment continued through a snowball approach (Creswell, 2013), whereby NBCTs who agreed to participate in the study were asked to nominate other licensed special educators in their schools or districts who might be interested in participating in the study. This two-pronged approach resulted in recruitment of 51 participants; however, a larger *N* was needed to support intended measure validation procedures through exploratory factor analysis. Although there is no agreement on the exact number of participants necessary for factor analysis, literature suggests maximizing the number of participants is desirable (Comrey & Lee, 1992; MacCallum, Widamen, Zhang, & Hong, 1999). Therefore, this approach to participant recruitment was repeated a second time to increase the study's sample size.

For the second round of recruitment, the researcher first located other special educators with publicly available email addresses within the school districts represented by the initial pool of NBCTs ($N$ = 23 school districts). This search resulted in email contact information for 6079 individuals. Using a random number generator, a random selection of just over 25% of this overall pool ($N$ = 1615) were invited to participate in the research. Regardless of round of recruitment, all participants completing the initial survey phase of the study were prompted to nominate other special educators.

During the pilot of these procedures 8 of 103 NBCTs emailed chose to participate in the study for a response rate of 8%. In contrast, NBCTs' nominees' response rate was higher with 7 respondents out of 15 (response rate of 47%) suggesting that the use of both nominees' and nominator's names in the solicitation email enhanced participants' willingness to participate. So as not to place undue pressure on participants, the researcher gave the option of indicating the preference that their name not be used for nominee recruitment. The present study did restrict nominations to only two additional special educators as done in the pilot study. Instead, the SEPSAS provided 10 additional spaces for participants to write in nominees. As additional participants were nominated, the researcher distributed the SEPSAS with a personalized solicitation email including the name of the nominee and the nominator, consistent with pilot procedures yielding the improved response rate. Respondents in the second wave of survey distribution also had the opportunity to nominate special educator colleagues.

In an effort to recruit as many participants as possible, the researcher used incentives to further improve survey response rate over pilot results. Specifically, all special educators who participated in the initial survey phase of the research were entered into a random drawing for one of four $50 gift cards to Amazon.com.

In lieu of gathering participant consent, the researcher informed participants of the possible benefits and risks associated with participation in this phase of the study as well as how confidentiality would be assured through a recruitment email (Appendix B). A link to the survey measure was provided in the recruitment email; potential participants could choose whether or not to proceed to the survey by clicking on the individualized link. Once they clicked the link to enter the survey, further information about the research and the survey was provided, as well as the researcher's contact information for participant questions or concerns. Participants had the option to print this information to retain for their personal records (Appendix C).

**Instrumentation**

Participants were given an online survey developed by the researcher that investigates problem solving approaches when teaching, the Special Educator Problem Solving Approaches Survey (SEPSAS; Appendix E). The SEPSAS consists of three parts. Part I uses three open-ended questions to prime respondents to think about their problem solving approaches when teaching: (1) Please provide a few examples of particular challenges you have encountered as part of your special education teaching practice; (2) What is your greatest challenge in your role as a special educator?; (3) What support(s) have you found to be most helpful in addressing these challenges?

In Part II, participants provide ratings from 1 (This never applies to my problem solving approach) to 9 (This always applies to my problem solving approach) for 28 items to indicate to what extent the item is descriptive of their problem solving approach when they encounter challenges in their teaching practice. Each item begins with the stem, "When I encounter a problem, I…" and ends with a statement addressing adaptive or routine dispositions, cognitive skills, or metacognitive skills as operationalized from the literature on adaptive expertise. Overall 14 items are routine expertise oriented, and 14 suggest adaptive expertise; within each of these subscales, five items address dispositions, five pertain to metacognitive skills, and the remaining four concern cognitive skills. Example adaptive expertise items include "…consider what I learn from new situations" (dispositions), "…engage in self-assessment" (metacognitive skills), and "invent new procedures and ways for solving problems" (cognitive skills). Items addressing an orientation towards routine expertise include "…quickly address the challenging situation" (dispositions), "…rely on what I already know" (metacognitive skills), and "…try to solve a problem quickly and efficiently" (cognitive skills).

Part III of the SEPSAS asks demographic questions such as years of teaching experience, disabilities of students served, and National Board Certification status. Aside from demographic questions, SEPSAS items are based on the Bransford et al. (2005; trajectory of adaptive and routine expertise) and De Arment et al. (2013; adaptive dispositions, metacognitive skills, and cognitive skills) conceptualizations of adaptive expertise.

Prior to initiating the present study, the researcher took several steps to build initial evidence for reliability and validity of inferences resulting from SEPSAS administration. To establish validity evidence based on test content (American Educational Research Association [AERA], American Psychological Association, & National Council on Measurement in Education, 2014), the researcher developed all SEPSAS items from an in-depth review of the literature on adaptive and routine expertise. In addition, the survey was developed in consultation with other researchers who have in-depth knowledge of the adaptive expertise literature and survey methods. Feedback from other researchers led to rewording of items for clarity, revised items structure, and changes to survey organization. Next, the researcher piloted the SEPSAS with NBCT and non-NBCT special educators in a southeastern state ($N = 15$). Pilot participants were asked to provide feedback on the clarity of survey items, with prompting for elaboration about why specific items, if any, are unclear. Participant feedback indicated no issues with item clarity, providing validity evidence based on response process (AERA et al., 2014). As pilot testing was completed with a small number of teachers, factor analysis was not possible. Therefore, the researcher examined the SEPSAS through reliability analyses as a measure of internal consistency (AERA et al., 2014). Cronbach's alpha values for the 14 items addressing adaptive expertise and 14 routine expertise items were .74 and .88 respectively. Initially, alphas across the six subscales of adaptive and routine dispositions, adaptive and routine metacognitive skills, and adaptive and routine cognitive skills ranged from .14 to .85. To further understand the relationship among items within each subscale, the researcher performed scale if item deleted analyses. For five of the six subscales, the deletion of one item improved the alpha value (range .50 to .87). Mitchell and Jolley (2010) suggest alpha values of at least .70 are necessary to justify the claim of internal consistency of a measure. Table 4 provides these alpha values across each subscale of the measure with improved values given removal of an item noted. Because pilot data were based on only 15 participants, no items were removed from the scale at that time; further reliability analysis with the large sample in the current study were conducted to inform measure refinement.

Table 4

*SEPSAS Pilot Alpha Values (with Improvements if Item Deleted)*

| | Full Scale | Subscales | | |
|---|---|---|---|---|
| | | Adaptive dispositions (*N* = 10) | Metacognitive skills (*N* = 10) | Cognitive skills (*N* = 8) |
| Adaptive expertise (*N* = 14) | .74 | .14 (.50) | .60 (.84) | .61 |
| Routine expertise (*N* = 14) | .88 | .66 (.72) | .85 (.87) | .49 (.59) |

*Note. N* = number of items per subscale

The researcher also examined the range of pilot participants' responses to each item. The measure was designed as a 9-point scale (rather than 5- or 7-point) to enhance measure sensitivity for detecting differences among participants (Mitchell & Jolley, 2010). Of the 28 items in the measure, 18 items yielded responses that spanned across the neutral center and included both negatively- and positively-oriented responses. Of those, one item pertaining to adaptive metacognitive skills appeared heavily skewed in the positive direction (14 responses in the 7, 8, and 9 range) but one participant indicated a response of 3. Responses to six items (three cognitive skills, three dispositions, all adaptively-oriented) ranged from neutral (5) through positively-oriented responses only; responses to the remaining four items (one cognitive and three metacognitive skills, all routine-oriented) ranged from neutral through negatively-oriented responses only. Though patterns among responses suggest some items lack sensitivity for detecting differences in the intended sub-domains, they are based on the responses of only 15 participants in the pilot study. Thus, the researcher examined the range of responses again during the present research with data from a much larger sample of participants.

Finally, the researcher correlated responses to the SEPSAS with responses to a related measure, the Adaptive Beliefs Survey, adapted with permission from Fisher and Peterson (2001; F. T. Fisher, personal communication, March 28, 2014) and detailed next. Although participant responses on the two measures overall were not significantly correlated (Pearson's $r[13] = .094$; $p = .738$), the researcher found significant correlation between the adaptive expertise items on the SEPSAS and the full ABS-A ($r[13] = .59$, $p = .020$) as well as between items on the metacognitive subscales on each measure ($r[13] = .74$, $p = .002$) therefore establishing emerging evidence for validity of the SEPSAS in relation to other variables (AERA et al., 2014).

The *Adaptive Beliefs Survey* (Appendix F) was developed originally as a measure of adaptive expertise in engineering students and faculty. Informed by the adaptive expertise literature, the measure consists of four underlying constructs: multiple perspectives, metacognition, goals and beliefs, and epistemology. *Multiple perspectives* refers to the use of a "variety of representations and approaches" (p. 4) within the engineering domain. There are 11 items in this subscale, seven written in the negative. Examples include, "For a new situation, I consider a variety of approaches until one emerges superior" and "There is one best way to approach a problem" (negative item). The nine *metacognition* items address self-assessment and self-monitoring through statements such as "I monitor my performance on a task" and "As I learn, I question my understanding of the new information." Items comprising the *goals and beliefs* construct address respondents' perspectives about their learning and the development of expertise within their field. Examples of the 13 stimuli in this subscale are "Challenge stimulates me" and "Expertise can be developed through hard work." Lastly, nine items comprise the *epistemology* subscale. Examples include "Knowledge that exists today may be replaced with new understanding tomorrow" and "Scientific knowledge is developed by a community of researchers."

Respondents select the degree to which they agree (1-strongly disagree to 6-strongly agree) to each of the 42 items on the full ABS. Fisher and Peterson (2001) wrote 24 of the 42 items in the negative to discourage respondents from selecting responses without thought. For the purposes of this research and the associated pilot study, the researcher adapted items for relevance to education/teaching. For example, the original ABS item "To become an expert in engineering, you must have an innate talent for engineering" was re-written as "To become an expert in teaching, you must have an innate talent for teaching." Fisher and Peterson reported Cronbach's alpha levels ranging from .66 to .80 across the four constructs and across three participant groups as a measure of internal consistency.

The researcher used a semi-structured interview protocol based on the reflection prompt protocol employed by Wetzel et al. (2015) to guide initial interview questions with each participant (see Appendix G). The researcher piloted the Wetzel et al. (2015) protocol with three special educators (two NBCTs, one non-NBCT) selected as a convenience sample from the survey pilot participants. During pilot testing, each participant framed her responses around problem solving related to challenges of practice outside of teaching; they spoke of responding to challenges in working with colleagues and parents. As a result of pilot testing, the researcher modified the interview protocol to probe participants to respond solely about their direct teaching experiences in working with students with disabilities in an effort to narrow the scope of challenges discussed. Because interview questions were based upon how participants responded overall to the SEPSAS, additional participant-specific probes were used beyond those on the initial interview protocol. Though research literature documents the many and varied challenges of special education teaching practice, special educators' real world narrative examples of their problem solving practices as they work directly with students with disabilities were of particular interest.

**Procedures**

**Quantitative phase.** Once participants were identified, the SEPSAS and ABS-A (combined as one survey instrument) were made available to each participant through a link within an email sent to her/his school email address. Participants could access the combined survey from any location of their choosing. The web-based survey and database tool REDCap (Harris et al., 2009) was used to administer the survey and store and maintain responses. Participants were required to complete the survey in one sitting. If they did not complete the survey within two weeks of receiving the initial email link, the researcher sent them a reminder email (Appendix H).

**Need for follow-up explanations.** Although quantitative analyses yielded valuable information about the validity of the SEPSAS tool and the relationships among special educators' experience and perceived problem solving approaches, numeric data alone only partially represented the full scope of validity evidence and what problem solving means for these teachers. Follow-up explanations were needed to add greater meaning to quantitative data and represent the voices of special educators. As detailed next, the second, qualitative phase of research sought narrative data from a select group of participants who elaborated about their problem solving approaches and provided examples from their teaching practice. Taken together, the combination of quantitative and qualitative data and analyses allowed for fuller understanding of the validity of the SEPSAS measure as well as special educator problem solving approaches than either research method could provide alone (Tashakkori & Teddlie, 2008).

**Qualitative phase.** Participants identified for qualitative follow up were individually interviewed in depth to gain greater insight into their problem solving approaches. Interviews took place via phone according to the convenience of the participant. Interviews took between 18 and 43 minutes to complete. With participants' permission (see Appendix I for Phone Script for Interview), the researcher audio-recorded interviews for later transcription and analysis. Individual transcripts were shared with each participant for member-checking (Krefting, 1991) to enhance the credibility of the data. In this way, participants had the opportunity to review all transcribed data and clarify, change, or omit their comments as deemed necessary. Reliability, or dependability (Miles & Huberman, 1994), was achieved by maintaining an audit trail throughout the study and by describing all aspects of the study with thick description so others could follow the same procedures and obtain similar conclusions (Brantlinger, Jiminez, Klinger, Pugach, & Richardson, 2005).

## Data Analysis

**Quantitative data analysis.** The *Statistical Package for the Social Sciences* software, version 23 was used for all quantitative data analyses with significance set at the $p \leq .05$ level. First, the researcher removed participants who did not meet study inclusion criteria. Then, data were screened for missing values and outliers beyond the survey scale of measurement. To ensure participants with missing values across SEPSAS data were not different from those who had complete data sets, the researcher used descriptive statistics to compare frequencies across responders according to grouping variables of interest, their means and standard deviations, and item response frequencies. Ultimately, only complete data sets were entered into the subsequent analysis.

Next, the researcher assessed the suitability of the data for exploratory factor analysis first by examining descriptive statistics and skewness and kurtosis per variable. Then, item-level correlations were investigated, and both the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity were calculated. With data deemed amenable, the researcher proceeded with several iterations of exploratory factor analysis to reveal the underlying factor structure of the SEPSAS. The SEPSAS was refined through deletion of items that did not contribute to the factor structure. Cronbach's alpha was calculated as a measure of internal consistency of the items constituting the resulting factors. Then, the researcher used Pearson's correlation analysis to examine the relationships between responses to the SEPSAS and the ABS-A.

Following refinement of the SEPSAS measure, the researcher again calculated descriptive statistics for participants across each subscale, and plotted their paired subscale scores to visually represent the spread of scores. Z-scores and frequencies were used to further examine score profiles of participants across experience levels in relation to each subscale's mean and the SEPSAS scale midpoint value. The researcher compared means and standard deviations of participants by their experience level and calculated the correlation between years of teaching experience and each SEPSAS subscale score and differences between paired subscale scores. Finally, the researcher used a chi-square test of independence to assess likelihood of experience group membership for those with balanced or imbalanced score profiles.

**Qualitative data analysis.** Recorded interviews were transcribed verbatim. Initially, the researcher read through each transcript individually and wrote analytic memos to capture preliminary impressions and interpretations of the data (Bogdan & Biklen, 2007; Saldaña, 2013). Analytic memo-writing continued throughout the recursive coding process to create an organized, written record of reflections on the coding process and data analysis.

Atlas.ti (version 1.0.15 for Mac) qualitative coding software was used for data management and to facilitate examination of participants' own words throughout coding. Though data coding proceeded in two main cycles, each special educator's transcript was read multiple times. In the first cycle, three specific coding methods were used to analyze participants' interview data: attribute coding, hypothesis coding, and open coding. The researcher engaged in attribute coding at the start of the coding process for each interview data set in order to identify participant characteristics and organizing information (Saldaña, 2013). Codes recorded teaching level (and grade if known), teacher roles, experience level, and other aspects shared about participants' teaching contexts. Given that the overall purpose of this research was to understand special educators' problem solving approaches through the lens of adaptive expertise, hypothesis coding was most emphasized during qualitative data analysis. Hypothesis coding is used when the researcher applies an a priori coding scheme to the data based on a hypothesis about what will be found (Saldaña, 2013). The researcher hypothesized that examples of participants' problem solving approaches explained within the context of their teaching practice would elicit descriptive indicators of adaptive expertise across interview data. The researcher did not limit coding to a pre-determined coding scheme. Through open coding (Corbin & Strauss, 2008), other emergent codes were applied, particularly in instances when data did not fit within the adaptive expertise framework. Though the researcher first applied attribute coding methods to the data, hypothesis coding and open coding methods occurred concurrently rather than sequentially as data were read and re-read.

In the second cycle of coding, the researcher engaged in pattern coding for the purpose of identifying emergent themes across the data (Miles & Huberman, 1994; Saldaña, 2013). Saldaña (2013) describes pattern coding as generating meta-codes that contribute to the development of major themes from the data. Accordingly, this represented an intermediary step between the initial coding cycle and final theme development as the researcher coded patterns revealed across first cycle coding. Data display matrices of interview data and first cycle codes and coding co-occurrences aided theme development across participants' discussions of their problem solving approaches (Maxwell, 2013; Miles & Huberman, 1994).

Throughout the coding process, the researcher developed and maintained a codebook containing codes organized by type (hypothesis, open) with content descriptions and examples from the data set (Saldaña, 2013; see Appendix K). To support dependability of the researcher's coding scheme and credibility of data analysis, a second coder was used as a reliability check. This individual was a recent doctoral graduate in educational psychology who had experience with qualitative data analysis and was familiar with the adaptive expertise construct. Though she lacked P-12 teaching experience in special education, she understood the context of teaching students with disabilities. The researcher identified approximately 15% of the full data set for dual coding. The selected portion represented one page of data per participant, with responses representing all standard questions across the interview protocol. In addition, this data sample did not contain any of the example quotations provided in the codebook.

Prior to independent coding, the researcher took several steps to train the second coder. First, the second coder was provided with two articles that presented operationalized indicators of adaptive expertise across dispositions and cognitive and metacognitive skills (De Arment et al., 2013) and a study employing similar coding procedures to data resulting from similar interview probes (Wetzel et al., 2015). The second coder reviewed this literature prior to the initial meeting with the researcher. During the pre-coding meeting, the researcher and second coder thoroughly reviewed and discussed each entry in the codebook and the full set of standard interview questions. Then together, the researcher and second coder coded one page of data, unique from the selected 15% and codebook examples, and discussed each application of codes. Following independent coding of the data selection, the researcher and second coder met to discuss coding, including challenges and insights, and to determine the percentage of coding agreement. The results of this process are discussed in Chapter IV.

To further support credibility of data analysis, the researcher provided qualitative phase participants with a document that summarized the themes that emerged from qualitative data analysis across interview data for further member-checking (Krefting, 1991; Maxwell, 2013). In this way, interviewees had the opportunity to provide feedback to the researcher regarding the credibility of the data analysis and interpretation from this phase of the study.

**Mixed-method data analysis.** To understand how special educators' experiences informed their survey responses, the researcher synthesized data across the quantitative and qualitative phases of the study by looking for ways in which selected participants' qualitative (interview) data explained nuances of their quantitative (SEPSAS) data. Joint data displays that combined both quantitative and qualitative data were created to facilitate analyses (Creswell & Plano Clark, 2011; Sandelowski, 2003).

### Quality and Rigor

Employing both quantitative and qualitative methods in this research necessitated careful attention to study design to ensure quality of inferences resulting from each separate phase of data collection and analysis as well as the combined mixed methods analysis. Tashakkori and

Teddlie (2008) suggest an integrative framework for certifying design quality and interpretive rigor in mixed methods research. This framework manages cumbersome consideration of the varied terms related to quality and rigor across each research tradition (i.e, validity, reliability, trustworthiness, dependability, etc.) by proposing research criteria to systematically address issues of design and interpretation across both research traditions.

Design quality considerations include design suitability, design adequacy/fidelity, within design consistency, and analytic adequacy (Tashakkori & Teddlie, 2008). These criteria address the suitability of the chosen research design given the research questions and the fidelity of design implementation. Questions guiding design quality considerations include:

- Are the methods of study appropriate for answering the research questions? Does the design match the research questions? (*Design Suitability*)
- Are procedures implemented with quality and rigor? Are methods capable of capturing the meanings, effects, or relationships? Are the components of the design implemented adequately? (*Design Adequacy/Fidelity*)
- Do the components of the design fit together in a seamless manner? (*Within Design Consistency*)
- Are the data analysis procedures/strategies appropriate and adequate to provide possible answers to research questions? (*Analytic Adequacy*)

Interpretive rigor characterizes the credibility of interpretations resulting from research. Tashakkori and Teddlie (2008) consider five criteria related to interpretive rigor: interpretive consistency, theoretical consistency, interpretive agreement, interpretive distinctiveness, and integrative efficacy. Questions guiding interpretive rigor considerations include:

- Do inferences closely follow the relevant findings in terms of type, scope, and intensity? Are multiple inferences made on the basis of the same findings consistent with each other? (*Interpretive Consistency*)
- Are the inferences consistent with theory and state of knowledge in the field? (*Theoretical Consistency*)
- Do other scholars reach the same conclusions on the basis of the same results? Do the investigators' inferences match participants' constructions? (*Interpretive Agreement*)
- Is each inference distinctively more plausible than other possible conclusions that can be made on the basis of the same results? (*Interpretive Distinctiveness*)
- Does the meta-inference adequately incorporate the inferences made from quantitative and qualitative strands of the study? (*Integrative Efficacy*)

Table 5 presents characteristics of this research that addressed criteria explicated by Tashakkori and Teddlie's (2008) integrative framework.

Table 5

*Study Design Features Contributing to Quality and Rigor (Tashakkori & Teddlie, 2008)*

| Aspects of Inference Quality | Research Criterion | Design Characteristics |
|---|---|---|
| Design quality | Design suitability | SEPSAS measured self reported adaptive and routine expertise while follow up interviews sought to explain and elaborate upon SEPSAS data<br>Research questions aligned to explanatory sequential mixed methods design (Appendix J) |
| | Design adequacy/fidelity | Research procedures (sampling, survey administration, follow up interviews) piloted<br>Approval from Institutional Review Board |
| | Within design consistency | Research had logical progression from broad quantitative data collection and analysis that pointed to representative cases for follow up interviews; data mixing occurred after quantitative and qualitative data were analyzed separately and sequentially |
| | Analytic adequacy | Factor analysis proceeded given sufficient N; group comparisons were contingent upon SEPSAS validity evidence<br>Procedures were identified to deal with missing survey data<br>Recursive coding (attribute, hypothesis, open, and pattern coding) proceeded in two cycles to deductively and inductively identify themes in interview data |
| Interpretive rigor | Interpretive consistency | Coding a selection of interview data by second coder following researcher developed codebook; inter-coder agreement calculated; codes negotiated until agreement |
| | Theoretical consistency | Hypothesis coding aligned to adaptive expertise framework<br>Inferences considered in light of existing theory and knowledge on adaptive expertise |
| | Interpretive agreement | Member-checking of qualitative interpretations<br>Peer-debriefing (chair/committee review) throughout development of inferences and conclusions<br>Audit trail maintained throughout research |
| | Interpretive distinctiveness | Researcher bias disclosed and managed through reflexivity throughout research |
| | Integrative efficacy | Inferences from qualitative data analysis were compared to quantitative inferences for congruence and/or discrepancy<br>Inferences from quantitative, qualitative, and mixed methods data analysis considered in relation to research questions |

## Institutional Review Board

Because this research involved human subjects, approval from the Institutional Review Board (IRB) of Virginia Commonwealth University was sought prior to beginning data collection. The study qualified for exemption under category 2 (IRB HM20004786).

## Summary of Methodology

This mixed methods research sought to understand the nature of special educators' problem solving approaches through the lens of adaptive expertise. This study addressed identified methodological gaps in the literature on teacher preparation in special education. The explanatory sequential design entailed administration of surveys about problem solving and adaptive and/or routine expertise orientations to a large sample of special educators followed by semi-structured interviews with purposive sampling of survey respondents representing the variability of all participants. A pilot study of participant recruitment, study measures, and procedures informed refinement of the design and implementation of this study. The table presented in Appendix J presents the alignment between research questions, data sources, and data analyses. Steps were taken throughout development of the study design to ensure design quality and help ensure rigor of resulting interpretations and conclusions.

Chapter IV

## Results

The purpose of this research was to apply the adaptive expertise conceptual framework to understanding how special educators' perceive and enact their problem solving approaches in response to challenges they encounter in teaching practice. An explanatory sequential mixed methods design was used to address this research purpose, whereby first quantitative data were gathered by survey instrument, then analyzed, and subsequently, qualitative data were gathered by interview and analyzed. Mixed methods analysis followed these sequential phases of data collection and analysis. Results presented address the five research questions guiding this study:

1. Does the Special Educators Problem Solving Approaches Survey (SEPSAS) measure special educators' adaptive expertise?
    a. Does the SEPSAS differentiate special educators' adaptive or routine problem solving approaches (Bransford et al., 2005)?
    b. Does the SEPSAS differentiate special educators' adaptive dispositions, cognitive skills, and metacognitive skills (De Arment et al., 2013)?
    c. What is the relationship between participants' responses to the SEPSAS and Adaptive Beliefs Survey (adapted from Fisher & Peterson, 2001)?
2. To what extent are special educators' perceptions of their problem solving approaches as measured by the SEPSAS characteristic of adaptive and/or routine expertise?

3. What relationships exist between special educators' teaching experience and their perceived problem solving practices?
4. How do special educators describe their problem solving and supports in their teaching practice?
5. How do examples from special educators' real world teaching practice relate to their perceptions of their problem-solving approaches as measured by the SEPSAS?

Quantitative data analysis provided validity evidence for the SEPSAS measure and revealed the range of participants' adaptive- and routine-oriented problem solving approaches as measured by the survey. Analysis of interview data revealed indicators of adaptive expertise and emphasis on the influence of contextual factors, collegial support, and experience on enactment of problem solving approaches. Combining data during mixed methods analysis added insight about the nuances of teachers' problem solving in relation to their SEPSAS score profiles.

## Quantitative Phase

### Participants

Of the 1615 individuals who were sent the SEPSAS, 201 responded to the survey for a response rate of 12.5%. Respondents represented 23 (17.3%) of 133 districts across seven of eight Virginia Department of Education regions in the state. Seventy-three (36.3%) respondents opted to nominate other individuals for participation in the study, though nominees of 11 of these were excluded due to closure of survey administration and data collection. Of the remaining 62 nominators, 25 (40.3%) requested their names not be used in the nomination of others. The response rate for participants who were primary contacts was 11.3% ($N$ = 171 of 1508 contacted), while nominees of primary contacts responded with more frequency at a rate of 28% ($N$ = 30 of 107 contacted). Overall, nominees represented 14.9% of respondents, and were four times more likely to respond to email solicitation for survey participation if their nominator's name was used in the email (22.4%) than if it was not (5.6%).

Of the 201 survey respondents, 186 (92.5%) met study eligibility criteria. Participants who indicated they were not licensed to teach special education, not currently teaching students with disabilities as a primary role, or who left either or both questions blank on the survey were removed from the study ($N = 13$). Review of qualitative data from the three initial priming questions of the SEPSAS revealed two additional participants who did not meet eligibility criteria because they explained they held provisional teaching licenses. Therefore, a total of 15 participants were removed from the research. Table 6 presents the demographic characteristics of eligible participants.

Table 6

*Demographic Characteristics of Eligible Participants (N = 186)*

| | Frequency | Percent |
|---|---|---|
| Teaching Experience | | |
| Novice (0-2 years) | 13 | 7.0 |
| Experienced (3+ years) | 144 | 77.4 |
| Accomplished (3+ years and NBCT) | 29 | 15.6 |
| Teaching Level | | |
| Early Childhood | 9 | 4.8 |
| Elementary | 87 | 46.8 |
| Secondary | 90 | 48.4 |
| Setting | | |
| Urban | 22 | 11.8 |
| Suburban | 152 | 81.7 |
| Rural | 12 | 6.5 |
| Disabilities Served | | |
| Autism | 152 | 81.7 |
| Deaf-blindness | 6 | 3.2 |
| Deafness | 16 | 8.6 |
| Emotional disability | 116 | 62.4 |
| Hearing Impairment | 43 | 23.1 |
| Intellectual Disability | 99 | 53.2 |
| Multiple Disabilities | 92 | 49.5 |
| Orthopedic Impairment | 33 | 17.7 |
| Other Heath Impairment | 147 | 79.0 |
| Specific Learning Disability | 135 | 72.6 |
| Speech Language Impairment | 103 | 55.4 |
| Traumatic Brain Injury | 23 | 12.4 |
| Visual Impairment | 27 | 14.5 |
| Developmental Delay | 67 | 36.0 |

*Note.* Participants served students across multiple disability categories. NBCT = National Board Certified Teacher

**Data Screening**

The researcher screened data for outliers and missing values. While no outliers were noted, 24 participants had at least one missing value across their SEPSAS data. To understand whether these 24 cases were distinctive from the remaining 162 cases, descriptive statistics were examined. Trends in frequency of experience were similar. Although almost twice as many elementary level special educators had incomplete data sets than secondary, no distinct patterns were evident across items for which there were missing responses or across missing values per respondent. In addition, means and standard deviations changed very little with deletion of these 24 cases per subgrouping of participants (by experience or teaching level), and ultimately the overall mean remained constant given rounding to two decimal places (see Table 7). Examination of means and standard deviations by item revealed similar results, with little change given deletion of the 24 incomplete cases (see Table 8). Means and standard deviations per item differed by no more than .07, with many values remaining stable.

Table 7

*Means and Standard Deviations on SEPSAS Before and After Deletion (Listwise) of Missing Cases*

| | Initial Sample | | Incomplete Cases | | Final Sample | |
|---|---|---|---|---|---|---|
| | *N* (%) | *M (SD)* | *N* (%) | *M (SD)* | *N* (%) | *M (SD)* |
| Experience | | | | | | |
| Novice | 13 (7.0) | 6.51 (.79) | 1 (4.2) | 7.16 ( - ) | 12 (7.4) | 6.47 (.87) |
| Exp. | 144 (77.4) | 6.61 (.84) | 21 (87.5) | 6.56 (1.25) | 123 (76.0) | 6.62 (.76) |
| Accomp. | 29 (15.6) | 6.49 (.81) | 2 (8.3) | 6.63 (1.39) | 27 (16.6) | 6.48 (.80) |
| Teaching Level | | | | | | |
| Early Ch. | 9 (4.8) | 7.04 (.72) | 1 (4.2) | 7.63 ( - ) | 8 (4.9) | 6.98 (.73) |
| Elem. | 87 (46.8) | 6.52 (.89) | 15 (62.5) | 6.51 (1.44) | 72 (44.4) | 6.52 (.74) |
| Second. | 90 (48.4) | 6.61 (.78) | 8 (33.3) | 6.54 (.67) | 82 (50.6) | 6.61 (.80) |
| Total | 186 (100) | 6.59 (.83) | 24 (100) | 6.59 (1.20) | 162 (100) | 6.59 (.77) |

Table 8

*Descriptive Statistics by Item Before and After Deletion (Listwise) of Missing Cases*

| | Initial Sample | | Final Sample | |
|---|---|---|---|---|
| Item | *N* | *M (SD)* | *N* | *M (SD)* |
| Invent new procedures and ways for solving problems | 186 | 7.09 (1.56) | 162 | 7.07 (1.56) |
| Stick with what has worked before | 186 | 5.51 (1.71) | 162 | 5.51 (1.68) |
| Remind myself I know what I'm doing | 185 | 6.51 (2.08) | 162 | 6.47 (2.05) |
| Take my time to solve the problem | 185 | 6.87 (1.77) | 162 | 6.83 (1.78) |
| Consider what I learn from new situations and challenges | 186 | 7.63 (1.31) | 162 | 7.64 (1.28) |
| Think about what I know and what I don't know | 185 | 7.09 (1.60) | 162 | 7.10 (1.59) |
| Work on my own to figure out a solution | 186 | 5.29 (2.03) | 162 | 5.36 (1.96) |
| Rely on what I already know | 185 | 6.14 (1.61) | 162 | 6.12 (1.57) |
| Tolerate the challenge, knowing that it will pass | 183 | 5.17 (2.337) | 162 | 5.22 (2.31) |
| Monitor how a student responds to my approach and make changes accordingly | 186 | 7.89 (1.39) | 162 | 7.90 (1.36) |
| Use data to guide my decision-making | 186 | 7.49 (1.58) | 162 | 7.49 (1.57) |
| Avoid approaches that might involve making mistakes | 184 | 4.73 (2.21) | 162 | 4.69 (2.21) |
| Quickly address the challenging situation | 186 | 6.96 (1.60) | 162 | 6.99 (1.59) |
| Choose between approaches that I know have worked before and new, innovative approaches as appropriate | 185 | 7.11 (1.49) | 162 | 7.09 (1.49) |
| Try to solve a problem quickly and | 184 | 7.16 (1.49) | 162 | 7.16 (1.50) |

| | | | | |
|---|---|---|---|---|
| efficiently | | | | |
| Want to avoid having to develop new approaches | 185 | 3.30 (2.15) | 162 | 3.30 (2.13) |
| Engage in self-assessment | 185 | 6.50 (1.86) | 162 | 6.53 (1.86) |
| Decide what to do based on approaches with which I am familiar and/or comfortable | 185 | 5.81 (1.65) | 162 | 5.76 (1.65) |
| Try approaches that I know how to do efficiently | 184 | 6.49 (1.48) | 162 | 6.46 (1.49) |
| Think about what I know about myself as a problem solver | 182 | 6.29 (2.07) | 162 | 6.22 (2.07) |
| Think about what I have learned in my teacher training that works for this type of problem | 184 | 6.46 (2.09) | 162 | 6.45 (2.07) |
| Modify approaches I already know | 185 | 7.23 (1.34) | 162 | 7.27 (1.28) |
| Take risks to solve the problem | 185 | 6.35 (1.85) | 162 | 6.33 (1.84) |
| Seek feedback from others | 186 | 7.65 (1.57) | 162 | 7.67 (1.54) |
| Think about how I understand the problem | 185 | 7.07 (1.63) | 162 | 7.07 (1.58) |
| Consider multiple perspectives | 185 | 7.45 (1.47) | 162 | 7.44 (1.47) |
| Ask questions | 186 | 7.77 (1.41) | 162 | 7.80 (1.35) |
| Think about my past success with challenges | 184 | 7.42 (1.52) | 162 | 7.45 (1.47) |

The researcher also examined missing values by item to determine whether participants systematically omitted responses to certain items. Of the 28 items on the SEPSAS, 19 items had at least one missing value. Four participants (3%) did not complete *think about what I know about myself as a problem solver* and three participants (2%) omitted responses to *tolerate the challenge, knowing that it will pass*. Twelve other items had only one missing value across participants, and five items had two values missing. Because missing values were scattered across items and represented a small percentage of respondents, the researcher determined these data were missing at random by item. Ultimately, three of the 19 items with missing values were removed from the measure through measure validation processes outlined below separate from the missing values analysis.

Given the characteristics revealed through data screening and the requirement of complete data sets for exploratory factor analysis, 162 cases were entered into analysis representing 10% of the initial pool of participants and over five participants per variable. Participants ranged in teaching experience from being in their first to fortieth year of teaching, with a median of 12 years teaching ($M$ = 12.8, $SD$ = 8.56). In addition to the means and standard deviations presented in Table 7, Table 9 summarizes demographic characteristics of the final 162 participants retained for the first, quantitative phase of the research. Comparison of these characteristics with those of the initial sample of eligible participants ($N$ = 186) reveals similar patterns in frequency across experience and teaching level as well as disability categories served.

Table 9

*Demographic Characteristics of Retained Participants (N = 162)*

| | Frequency | Percent |
|---|---|---|
| Teaching Experience | | |
| Novice (0-2 years) | 12 | 7.41 |
| Experienced (3+ years) | 123 | 75.9 |
| Accomplished (3+ years and NBCT) | 27 | 16.7 |
| Teaching Level | | |
| Early Childhood | 8 | 4.9 |
| Elementary | 72 | 44.4 |
| Secondary | 82 | 50.6 |
| Setting | | |
| Urban | 22 | 13.6 |
| Suburban | 129 | 79.6 |
| Rural | 11 | 6.8 |
| Disabilities Served | | |
| Autism | 135 | 83.3 |
| Deaf-blindness | 3 | 1.9 |
| Deafness | 14 | 8.6 |
| Emotional disability | 105 | 64.8 |
| Hearing Impairment | 39 | 24.1 |
| Intellectual Disability | 88 | 54.3 |
| Multiple Disabilities | 83 | 51.2 |
| Orthopedic Impairment | 26 | 16.0 |
| Other Heath Impairment | 130 | 80.2 |
| Specific Learning Disability | 119 | 73.5 |
| Speech Language Impairment | 89 | 54.9 |
| Traumatic Brain Injury | 18 | 11.1 |
| Visual Impairment | 21 | 13.0 |
| Developmental Delay | 57 | 35.2 |

*Note.* Participants served students across multiple disability categories. NBCT = National Board Certified Teacher

**Validity Evidence Based on Internal Structure: Exploratory Factor Analysis**

Exploratory factor analysis was used to answer research question 1, with particular emphasis on the first two sub-questions:

Does the Special Educators Problem Solving Approaches Survey (SEPSAS) measure special educators' adaptive expertise?

a. Does the SEPSAS differentiate special educators' adaptive or routine problem solving approaches (Bransford et al., 2005)?

b. Does the SEPSAS differentiate special educators' adaptive dispositions, cognitive skills, and metacognitive skills (De Arment et al., 2013)?

To assess suitability of the data for factor analysis, the researcher first examined descriptive statistics per variable. Means ranged from 5.22 to 7.90, thus no items were deleted due to mean values close to either end of the scale of measurement. Range of responses and visual examination of item distributions suggested normality, though follow-up analysis of skewness and kurtosis per item revealed some distributions outside of the suggested -1 to 1 range for these values (Field, 2009) across six variables. Table 10 summarizes descriptive statistics and skewness and kurtosis values per SEPSAS item.

To further investigate data suitability for factor analysis, next the researcher examined correlations among the 28 SEPSAS items. All items had at least one correlation with another item of at least .30, suggesting reasonable factorability. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .82, which exceeds Tabachnick and Fidell's (2007) suggested minimum value for quality factor analysis of .60. Finally, Bartlett's Test of Sphericity provided a significant result ($X^2$[378, $N$ = 162] = 1804.2, $p < .001$) which provided further evidence of the amenability of data to factoring (Field, 2009). Thus, despite some non-normal distributions among variables, evidence overall suggested factor analysis was appropriate for this data set.

Table 10

*Descriptives, Skewness, and Kurtosis across All SEPSAS Items*

| | Min | Max | *M* | *SD* | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Invent new procedures and ways for solving problems | 2 | 9 | 7.07 | 1.56 | -.54 | -.33 |
| Stick with what has worked before | 1 | 9 | 5.51 | 1.68 | -.36 | .46 |
| Remind myself I know what I'm doing | 1 | 9 | 6.47 | 2.05 | -.94 | .60 |
| Take my time to solve the problem | 1 | 9 | 6.83 | 1.78 | -.67 | .01 |
| Consider what I learn from new situations and challenges | 2 | 9 | 7.64 | 1.28 | -1.05 | 1.55 |
| Think about what I know and what I don't know | 2 | 9 | 7.10 | 1.59 | -.72 | -.03 |
| Work on my own to figure out a solution | 1 | 9 | 5.36 | 1.96 | -.10 | -.36 |
| Rely on what I already know | 1 | 9 | 6.12 | 1.57 | -.16 | -.38 |
| Tolerate the challenge, knowing that it will pass | 1 | 9 | 5.22 | 2.31 | -.10 | -.86 |
| Monitor how a student responds to my approach and make changes accordingly | 1 | 9 | 7.90 | 1.36 | -1.87 | 5.32 |
| Use data to guide my decision-making | 1 | 9 | 7.49 | 1.57 | -1.14 | 1.31 |
| Avoid approaches that might involve making mistakes | 1 | 9 | 4.69 | 2.21 | .15 | -.78 |
| Quickly address the challenging situation | 2 | 9 | 6.99 | 1.59 | -.69 | .04 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Choose between approaches that I know have worked before and new, innovative approaches as appropriate | 3 | 9 | 7.09 | 1.49 | -.52 | -.37 |
| Try to solve a problem quickly and efficiently | 2 | 9 | 7.16 | 1.50 | -.72 | .06 |
| Want to avoid having to develop new approaches | 1 | 9 | 3.30 | 2.13 | .88 | .03 |
| Engage in self-assessment | 1 | 9 | 6.53 | 1.86 | -.58 | -.09 |
| Decide what to do based on approaches with which I am familiar and/or comfortable | 1 | 9 | 5.76 | 1.65 | -.35 | .21 |
| Try approaches that I know how to do efficiently | 2 | 9 | 6.46 | 1.49 | -.36 | -.16 |
| Think about what I know about myself as a problem solver | 1 | 9 | 6.22 | 2.07 | -.76 | -.12 |
| Think about what I have learned in my teacher training that works for this type of problem | 1 | 9 | 6.45 | 2.07 | -.87 | .22 |
| Modify approaches I already know | 3 | 9 | 7.27 | 1.28 | -.77 | .75 |
| Take risks to solve the problem | 1 | 9 | 6.33 | 1.84 | -.71 | .25 |
| Seek feedback from others | 2 | 9 | 7.67 | 1.54 | -1.47 | 2.18 |
| Think about how I understand the problem | 2 | 9 | 7.07 | 1.58 | -.81 | .32 |
| Consider multiple perspectives | 1 | 9 | 7.44 | 1.47 | -1.10 | 1.54 |
| Ask questions | 4 | 9 | 7.80 | 1.35 | -1.07 | .33 |
| Think about my past success with challenges | 3 | 9 | 7.45 | 1.47 | -.89 | .14 |

To identify the most suitable factor structure of the SEPSAS, the researcher engaged in several rounds of exploratory factor analysis. For each iteration, principal axis factoring was used as the method of extraction due to non-normal distribution of data (Costello & Osborne, 2005). An oblique (oblimin) rotation was employed as it was expected that the underlying factors would relate to one another (Osborne, 2014). Initially, all 28 items were entered into analysis with no limitation on the number of factors to be extracted. A seven-factor solution emerged, with the first factor explaining over 25% of the variance, the second factor over 11% of the variance, the third factor over 6%, and the remaining factors 5% or less of the variance. Because these factor delineations did not reflect adaptive dispositions, metacognitive skills, and cognitive skills distinctions as suggested by the theoretical and research literature on adaptive expertise, the researcher sought to simplify the factor structure to enhance the meaningfulness of the SEPSAS measure.

To simplify the factor structure, two and three factor solutions were explored. Ultimately, the two-factor solution was retained for several reasons. First, visual examination of the scree plot suggested two salient factors due to leveling off of eigenvalues after the initial two. Next, the researcher conducted parallel analysis (Ledesma & Valero-Mora, 2007) which yielded an eigenvalue cut point of 1.87. This criterion supported the inclusion of only two factors as suggested by the scree plot because the third factor had an eigenvalue of 1.82. Though this eigenvalue was close to the cut point identified by parallel analysis, the first two factors had eigenvalues much larger than the cut point. Finally, though the three-factor structure accounted for more overall variance than the two-factor structure (44% and 37% respectively), the latter was preferred for its congruence with the theoretical literature.

With a two-factor solution selected, the researcher next sought further refinement of the SEPSAS through removal of items that did not contribute to the overall structure. Examination of item communalities after extraction revealed six variables with values less than .2 (Tabachnick & Fidell, 2007). Though no items had cross-loadings greater than an absolute value of .3, the pattern matrix showed these six items also had low factor loadings (less than .40; see Table 11). Therefore, the researcher removed these six variables from subsequent analysis.

Of note, the item *take my time to solve the problem* was close to the .40 factor loading cut point (.402) and therefore merited additional consideration for inclusion or exclusion from the measure. The researcher explored the two-factor structure without this item in the Factor 1 subscale; this resulted in 1% additional variance explained by the factor. However, ultimately this variable was retained because of its potential theoretical significance for understanding the nature of special educator problem solving and adaptive expertise given that variables associated with speed and efficiency also were encompassed within Factor 1 (*try to solve a problem quickly and efficiently* and *quickly address the challenging situation*). Though both of these items had more robust factor loadings (.48 and .58, respectively), inclusion of the *take my time to solve the problem* within the same factor may help illustrate the need for flexible decision making when problem solving.

Table 11

*Summary of Exploratory Factor Analysis using Principle Axis Factoring with Oblimin Rotation for SEPSAS*

| Item | Factor 1 | Factor 2 | Communality |
|---|---|---|---|
| Consider multiple perspectives | **.74** | -.17 | .55 |
| Think about how I understand the problem | **.73** | .050 | .55 |
| Think about what I know and what I don't know | **.68** | .025 | .47 |
| Think about my past success with challenges | **.64** | .15 | .46 |
| Seek feedback from others | **.62** | -.11 | .38 |
| Consider what I learn from new situations and challenges | **.61** | .011 | .37 |
| Ask questions | **.61** | -.19 | .38 |
| Modify approaches I already know | **.60** | .15 | .40 |
| Take risks to solve the problem | **.59** | -.081 | .34 |
| Think about what I have learned in my teacher training that works for this type of problem | **.58** | .098 | .36 |
| Quickly address the challenging situation | **.58** | .079 | .35 |
| Engage in self-assessment | **.55** | .085 | .32 |
| Use data to guide my decision-making | **.54** | -.28 | .33 |
| Monitor how a student responds to my approach and make changes accordingly | **.54** | .014 | .29 |
| Think about what I know about myself as a problem solver | **.49** | .29 | .36 |
| Try to solve a problem quickly and efficiently | **.48** | .17 | .28 |
| Choose between approaches that I know have worked before and new, innovative approaches as | **.47** | -.023 | .22 |

| | | | |
|---|---|---|---|
| appropriate | | | |
| Take my time to solve the problem | **.402*** | .20 | .22 |
| Invent new procedures and ways for solving problems | .32 | -.084 | **.10** |
| Decide what to do based on approaches with which I am familiar and/or comfortable | -.010 | **.74** | .55 |
| Try approaches that I know how to do efficiently | .17 | **.65** | .48 |
| Want to avoid having to develop new approaches | -.20 | **.63** | .41 |
| Rely on what I already know | .035 | **.56** | .32 |
| Stick with what has worked before | -.041 | .398* | **.16** |
| Tolerate the challenge, knowing that it will pass | .015 | .396* | **.16** |
| Remind myself I know what I'm doing | .11 | .35 | **.14** |
| Work on my own to figure out a solution | -.039 | .34 | **.11** |
| Avoid approaches that might involve making mistakes | .036 | .27 | **.075** |
| Eigenvalues | 7.14 | 3.23 | |
| % Variance explained (Total) | 25.5 | 11.5 (37) | |

*Note.* Factor loadings ≥ .40 and item communalities <.20 appear in bold; * values given in thousandths prior to rounding to illustrate relationship to ≥ .40 criterion

As shown in Table 12, the resulting 22-item, two-factor solution was more suitable for future analyses than the original 28-item, two-factor structure because it accounts for 43% of the variance, an increase of approximately 6%. A comparison of factor loadings from the initial two-factor model to the final two-factor model reveals increases across seven variables. Though the minimum factor loading remained constant at .40, the greatest factor loading increased from .75

to .79 in the final two-factor, 22-item solution. Factor correlations remained similarly modest across each model, with the initial factor correlation at .12 and the final factor correlation at .11.

Table 12

*Summary of Exploratory Factor Analysis using Principle Axis Factoring with Oblimin Rotation and Alphas for Final 22 Items of SEPSAS*

| | Factor Loadings | |
|---|---|---|
| Item | Adaptive Tendencies | Routine Tendencies |
| Think about how I understand the problem | **.75** | .02 |
| Consider multiple perspectives | **.74** | -.13 |
| Think about what I know and what I don't know | **.69** | -.02 |
| Think about my past successes with challenges | **.69** | .13 |
| Seek feedback from others | **.62** | -.10 |
| Consider what I learn from new situations and challenges | **.60** | -.03 |
| Modify approaches I already know | **.60** | .14 |
| Ask questions | **.60** | -.18 |
| Think about what I have learned in my teacher training that works for this type of problem | **.59** | .07 |
| Quickly address the challenging situation | **.58** | .06 |
| Take risks to solve the problem | **.58** | -.09 |
| Engage in self-assessment | **.56** | .07 |
| Monitor how a student responds to my approach and make changes accordingly | **.55** | -.03 |
| Use data to guide my decision-making | **.53** | -.28 |
| Think about what I know about myself as a problem | **.49** | .26 |

| | | |
|---|---|---|
| solver | | |
| Try to solve a problem quickly and efficiently | **.48** | .15 |
| Choose between approaches that I know have worked before and new, innovative approaches as appropriate | **.47** | -.03 |
| Take my time to solve the problem | **.40** | .15 |
| Decide what to do based on approaches with which I am familiar and/or comfortable | .02 | **.79** |
| Try approaches that I know how to do efficiently | .20 | **.71** |
| Want to avoid having to develop new approaches | -.16 | **.59** |
| Rely on what I already know | .06 | **.49** |
| Eigenvalues | 7.00 | 2.51 |
| % Variance explained (Total) | 31.7 | 11.4 (43.1) |
| Alpha | .90 | .73 |

*Note.* Factor loadings ≥ .40 appear in bold.

**Validity Evidence Based on Test Content**

The researcher assigned factor labels based on the content of items included in each factor and knowledge of the conceptual framework of adaptive expertise. Factor 1, or the *Adaptive Tendencies* subscale, represents 13 of the 14 items originally developed from the literature to represent indicators of adaptive expertise (the remaining item was deleted from the measure through analyses discussed above). In addition, this subscale includes five other items originally intended to represent routine expertise indicators. Three of these items, *think about my past successes with challenges*, *modify approaches I already know*, and *think about what I have learned in my teacher training that works for this type of problem* speak to skills associated with determining a suitable strategy for addressing a problem through reflection on current knowledge and skill sets. The other two items, *quickly address the challenging situation* and *try to solve a problem quickly and efficiently,* speak to the need for some challenges to be addressed right away within the special education teaching context. Despite this combination of items across Factor 1, the Adaptive Tendencies label is appropriate because, as the extant theoretical and research literature suggest, the adaptive expertise construct represents an approach to problem solving that selects from adaptive or routine-oriented responses given the nature of a given problem.

The four items representing Factor 2 all derive from the literature on routine expertise. Individually and taken together, these four items speak to a tendency towards drawing solely from problem-solving strategies that are routine by virtue of being *known*, *familiar*, and *efficient*. Thus, the researcher gave this factor the label of *Routine Tendencies*.

The researcher opted not to apply the factor labels of Adaptive Expertise and Routine Expertise because the measure was designed to measure overall adaptive expertise in consideration of respondents' perspectives on not only their adaptive approaches but also their routine approaches when problem solving. The term "tendencies" captures the idea that respondents have to rate how applicable each survey item statement is to their overall problem solving approach.

**Internal Consistency**

The researcher next evaluated the reliability of the resulting 22-item, 2-factor structure as a measure of internal consistency (AERA et al., 2014). Cronbach's alpha for the 18 items representing the first factor was .90. Review of adjusted alpha values given the deletion of each item from the 18-item subscale revealed no improvements. Therefore, all 18 items were retained for Factor 1. At .73, Cronbach's alpha for the four-item Factor 2 subscale also exceeded Mitchell and Jolley's (2010) suggested minimum value of .70 to justify internal consistency of the measure. Examination of changes to alpha values given the deletion of an item in the Factor 2 subscale revealed small improvement with the deletion of the item *want to avoid having to develop new approaches* (.74). Ultimately, however, this item was retained for the Factor 2 subscale for four reasons: (1) the initial alpha value already exceeded the suggested threshold for claiming internal consistency and improvement in alpha was minimal with deletion of this item; (2) Factor 2 consists of only four items therefore it is desirable to retain all four to improve factor stability (Costello & Osborne, 2005); (3) this item is theoretically consistent with the remaining three items within the subscale; and, (4) participant feedback (discussed further next) did not identify difficulty with this item.

**Validity Evidence Based on Response Process**

To gather validity evidence based on response process (AERA et al., 2014) for the SEPSAS, the researcher cross-referenced EFA and measure reliability findings with participants' feedback on clarity of survey items. Of the 19% of participants who provided survey feedback, 11 provided general comments about the difficulty of rating themselves on their overall problem solving approaches due to the changing nature of problem situations. For example, one participant noted, "It's not that one item was unclear, I just use so many of the things discussed and try new things all the time that it was hard to assign a specific value." Four participants felt items were repetitious or redundant, but did not specify which items in particular. Others provided feedback specific to particular items that either indicated an item was unclear without further explanation or provided the reasoning behind the rating the participant gave for an item. Two of the six items identified for removal from the SEPSAS by quantitative analyses also were identified by participants as unclear: *tolerate the challenge, knowing that it will pass* and *remind* *myself that I know what I'm doing*. Overall, participant feedback on the SEPSAS measure was not substantive or detailed enough to warrant changes to items at this early stage of testing the measure.

**Validity Evidence Based on Relation to Other Variables**

To establish validity evidence in relation to other variables (AERA et al., 2014) and address research question 1c:

> What is the relationship between participants' responses to the SEPSAS and the Adaptive Beliefs Survey (adapted from Fisher & Peterson, 2001)?

the researcher correlated participants' SEPSAS scores and their scores on a related measure, the Adaptive Beliefs Survey-Adapted (ABS-A; Fisher & Peterson, 2001). Of the 162 individuals who completed the SEPSAS, 132 submitted complete data sets for the ABS-A as well. Therefore, only 132 sets of data across both measures were entered into the correlation analysis. Following criteria suggested by Cohen (1988) for interpreting size of correlation, participant responses across the SEPSAS and ABS-A overall had a moderate, positive correlation ($r[130] = .41$, $p < .000$). In addition, the researcher found a large, positive correlation between the Adaptive Tendencies subscale of the SEPSAS and the overall ABS-A (Pearson's $r[130] = .52$, $p < .000$) and a small, negative correlation between the Routine Tendencies subscale and the ABS-A ($r[130] = -.26$, $p = .003$). Unlike the SEPSAS which aims to measure indicators of adaptive and routine expertise, the ABS-A concerns only respondents' adaptive expertise. Therefore, these results align with the intent of each instrument, as a few Routine Tendencies items were ultimately included in the final SEPSAS, and correlation between Routine Tendencies items and the ABS-A was small and negative.

**Special Educators' Adaptive and Routine Expertise**

With sufficient validity evidence established, the researcher sought to understand participants' orientations toward adaptive and/or routine problem solving in relation to the second research question:

> To what extent are special educators' perceptions of their problem solving approaches as measured by the SEPSAS characteristic of adaptive and/or routine expertise?

Each participant received two subscale scores representing the mean of all the item scores within each subscale. Therefore, for the Adaptive Tendencies subscale, the score was the mean of all 18 items within that subscale. Similarly, the Routine Tendencies subscale yielded scores that represented the mean of participants' four item scores within that subscale. Overall, the mean Adaptive Tendencies subscale score was 7.14 (*SD* = .97) and the mean Routine Tendencies subscale score was 5.41 (*SD* = 1.28). For the entire SEPSAS measure, the mean score was 6.82 (*SD* = .86). Examining scores on each subscale through descriptive statistics (range, frequencies, means, standard deviations), z-scores, and a scatterplot reveal the adaptive and/or routine nature of special educators' perceived problem solving approaches.

Though scores for each subscale spanned the scale midpoint of 5 (*this sometimes applies to my approach*), scores on the Routine Tendencies subscale came closer to the far negative end of the scale (*this never applies to my approach*) than scores on the Adaptive Tendencies subscale. In addition, far more participants rated items on the Routine Tendencies subscale below midpoint than Adaptive Tendencies items, 59 (36%) and 1 (< 1%) respectively. Table 13 summarizes score ranges across participants' experience levels and overall.

Table 13

*Subscale Score Ranges by Experience Level*

| | Adaptive Tendencies | | | | | Routine Tendencies | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Experience Level | Min | Max | *N* (%) > 5.00 | *N* (%) = 5.00 | *N* (%) < 5.00 | Min | Max | *N* (%) > 5.00 | *N* (%) = 5.00 | *N* (%) < 5.00 |
| Novice | 5.33 | 8.61 | 12 (100) | 0 | 0 | 4.25 | 7.00 | 4 (25) | 1 (8) | 7 (58) |
| Experienced | 4.44 | 9.00 | 126 (99) | 0 | 1 (<1) | 2.75 | 9.00 | 71 (56) | 12 (10) | 40 (32) |
| Accomplished | 5.00 | 8.94 | 26 (96) | 1 (4) | 0 | 2.25 | 7.00 | 12 (44) | 3 (11) | 12 (44) |
| Total | 4.44 | 9.00 | 160 (99) | 1 (<1) | 1 (<1) | 2.25 | 9.00 | 87 (54) | 16 (10) | 59 (36) |

Participants' scores fell into one of three initial profiles: (1) Adaptive Tendencies subscale score > Routine Tendencies subscale score; (2) Routine Tendencies subscale score > Adaptive Tendencies subscale score; or (3) Adaptive and Routine Tendencies subscale scores were equal/approximately equal (within .50). Overall, more participants' had scores that were higher on the Adaptive Tendencies subscale (*N* = 128 [79%]) than higher on the Routine Tendencies subscale (*N* = 11 [7%]). For 23 (14%) participants, the two subscale scores were either equal or approximately equal.

While it is useful to understand which subscale score, if either, was greater for participants, it is further beneficial to know where those scores are in relation to the scale midpoint of 5 (*this sometimes applies to my approach*). Therefore, participants' scores were further categorized first by whether their Adaptive Tendencies or Routine Tendencies score was larger, then by whether the pair of scores were both at or greater than 5.0 (+,+), the larger value was at or greater than 5.0 but the second was less than 5.0 (+,-), or the scores were the same and at or greater than 5.0 (+, +) (see Table 14). Among participants with greater Adaptive Tendencies subscale scores, experienced and accomplished teachers were more likely to have Routine Tendencies subscale scores at or greater than 5.0, than novice teachers whose scores for this subscale were more likely to fall below the scale midpoint. No novice special educators had Routine Tendencies scores that exceeded their Adaptive Tendencies scores, whereas some experienced and accomplished teachers fit this score profile.

Table 14

*Frequencies (N[%]) across Score Profiles and Experience Levels*

| Experience Level | Adaptive Tendencies > | | Routine Tendencies > | | Adaptive Tendencies = Routine Tendencies |
|---|---|---|---|---|---|
| | +, + | +, - | +, + | +, - | +,+ |
| Novice (*N* = 12) | 4 (25) | 7 (58) | 0 | 0 | 1 (8) |
| Experienced (*N* = 123) | 53 (43) | 40 (33) | 9 (7) | 1 (<1) | 20 (16) |
| Accomplished (*N* = 27) | 13 (48) | 11 (41) | 1 (4) | 0 | 2 (7) |
| Total | 70 (43) | 58 (36) | 10 (6) | 1 (<1) | 23 (14) |

*Note.* No participants had a pair of subscale scores that were both below scale midpoint (5.00).

Next, the researcher calculated z-scores in order to identify individuals with scores greater than an absolute value of two standard deviations (+/-2 *SD*) from each subscale's mean.

Three participants had scores greater than two standard deviations below the Adaptive Tendencies subscale mean. In relation to the Routine Tendencies subscale mean, three participants' scores exceeded two standard deviations below the mean and six participants' scores were more than two standard deviations above the mean. No participants had subscale scores that both deviated from the mean by more than two standard deviations.

Though there is no significant correlation between participants' Adaptive Tendencies and Routine Tendencies subscale scores ($r[160] = .138$, $p = .114$), examination of a scatterplot of participants' paired scores provided a visualization of the balance of each orientation across participants. As shown in Figure 2, two reference lines span two standard deviations (or 1.72; based on the overall SEPSAS mean of .86) around x = y, or a perfect balance between Adaptive and Routine Tendencies scores. Participants' whose Routine Tendencies score is much greater than their Adaptive Expertise score fall below the lower reference line. Most commonly in this data set, participants' whose Adaptive Tendencies score is much greater than their Routine Tendencies score fall above the upper reference line ($N = 86$). Those within the corridor created by the reference lines have a more balanced pair of scores ($N = 72$).

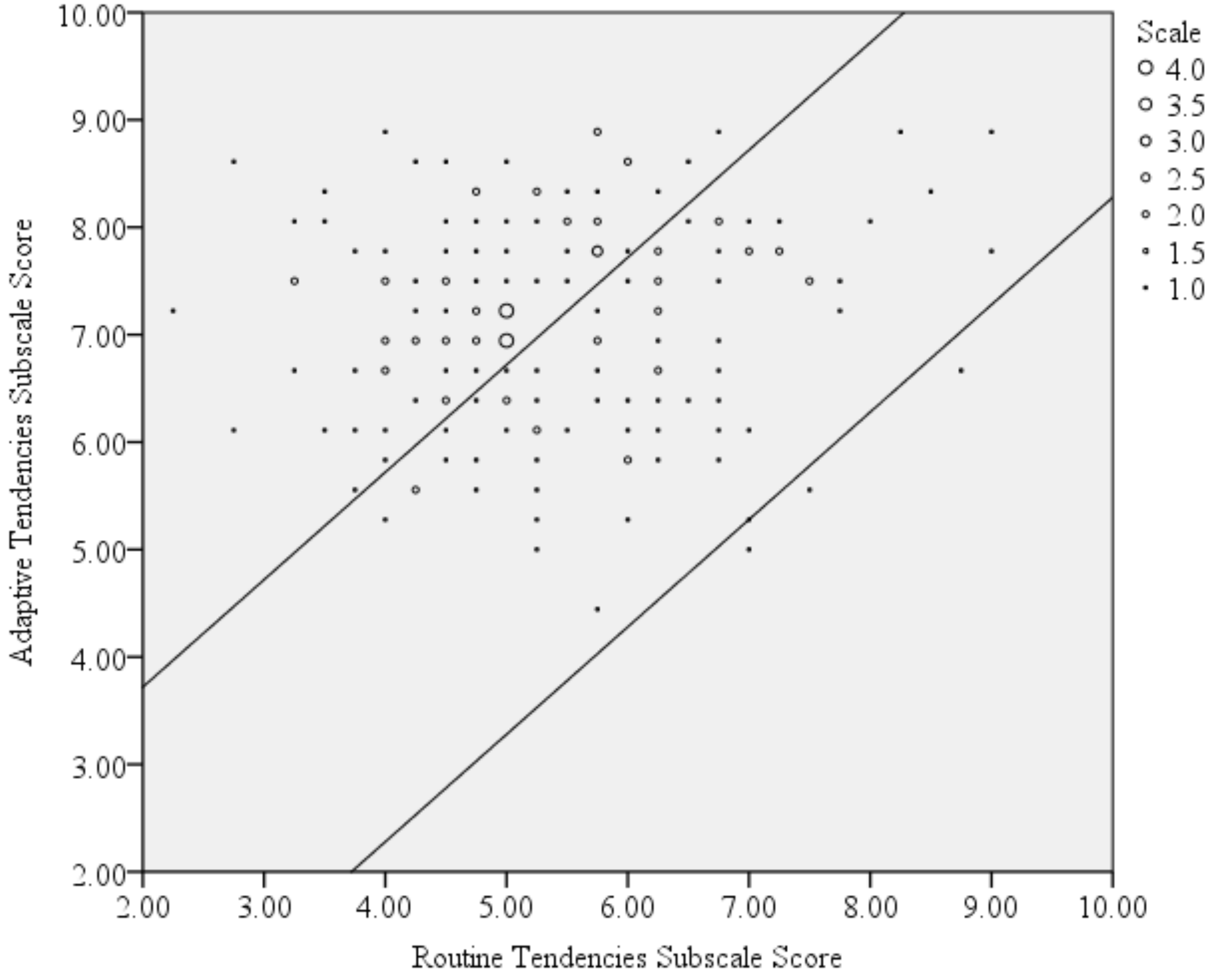


*Figure 2*. Scatterplot of participants' paired subscale scores. Scale denotes the number of participants per plot point.

Next, the researcher analyzed data in reference to research question three: What relationships exist between special educators' teaching experience and their perceived problem solving practices? Though the researcher's original intent was to use ANOVAs across subscale scores to conduct group comparisons by experience level, unequal sample sizes across groups contribute to violation of the assumption of equal population variances for conducting these tests (Howell, 2010). Though the researcher recognizes there are alternative methods for statistically comparing groups with unequal sample sizes, visual comparison of means and standard deviations by group presented in Table 15 suggest no difference in scores across novice, experienced, and accomplished special educators. Therefore, these alternatives were not applied.

Table 15

*SEPSAS Means and Standard Deviations by Experience Level and Overall*

| Experience Level | *N* | Adaptive Tendencies Subscale | | Routine Tendencies Subscale | | SEPSAS Total | |
|---|---|---|---|---|---|---|---|
| | | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Novice | 12 | 7.07 | 1.17 | 5.19 | .94 | 6.73 | 1.02 |
| Experienced | 123 | 7.16 | .96 | 5.50 | 1.32 | 6.86 | .85 |
| Accomplished | 27 | 7.07 | .97 | 5.08 | 1.16 | 6.71 | .85 |
| Total | 162 | 7.14 | .97 | 5.41 | 1.28 | 6.82 | .86 |

A chi-square test of independence indicated there was no relationship between experience level (novice, experienced, accomplished) and the likelihood of having a balanced or imbalanced pair of scores ($X^2$ [2, $N$ = 162] = 1.54, $p$ = .46). The researcher correlated participants' years teaching to SEPSAS scores to determine if there was a relationship between experience and scores outside of the experience categories assigned by the researcher. Results indicated no significant correlations across years of teaching and the Adaptive Tendencies subscale ($r$[160] = -.037, $p$ = .64), the Routine Tendencies subscale ($r$[160] = .13, $p$ = .090), or the SEPSAS overall ($r$[160] = .002, $p$ = .98). Finally, no significant correlation was found between participants' years of teaching and the difference between their subscale scores ($r$[160] = -1.37, $p$ = .083).

## Summary of Quantitative Phase Results

SEPSAS data from 162 special educators were analyzed during the quantitative phase of research to address the first three research questions. First, the researcher sought to refine and validate the SEPSAS. Through iterative exploratory factor analysis, the researcher ultimately identified a two-factor structure comprised of 18 items representing Adaptive Tendencies, and 4 items representing Routine Tendencies. Six items were removed from the original SEPSAS based on low communalities, and were not included in further analyses. Cronbach's alpha values supported the reliability of each subscale. Using complete data sets across 132 participants, the researcher found a moderate, positive correlation between the SEPSAS and a related measure, the ABS-A (Fisher & Peterson, 2001).

Given measure refinement and validity evidence, the researcher next used descriptive statistics to understand participants' adaptive and routine expertise score profiles. Across experience levels, most special educators' Adaptive Tendencies subscale score exceeded that of their Routine Tendencies subscale score. Overwhelmingly, participants rated items comprising the Adaptive Tendencies subscale as at least *sometimes* applicable to their approach to problem solving. The range of responses to Routine Tendencies items was much broader, however, nearly spanning the nine-point scale from *never* to *always*. Most participants' score profiles consisted of either both subscale scores exceeding the scale midpoint (*sometimes*) or their Adaptive Tendencies score exceeding the midpoint while their Routine Tendencies score fell below the midpoint. Plotting paired scores visually represented each participant's balance between Adaptive and Routine Tendencies, while z-scores identified eight participants with one score outside two standard deviations from the subscale mean.

Lastly, the researcher investigated relationships between special educators' experience and SEPSAS scores. Due to unequal sample sizes and similarity of means and standard deviations across novice, experienced, and accomplished teachers, the researcher opted not to conduct statistical comparisons across groups. Group membership was not associated with greater likelihood of having balanced or imbalanced subscale scores. Further, there was no correlation between special educators' years of teaching experience and their SEPSAS subscale scores, their overall SEPSAS mean, or the difference between their subscale scores.

## Qualitative Phase

### Participants

Participants in the second, qualitative phase of research were recruited directly from the sample of individuals with complete data sets in the first, quantitative phase. Of the 19 special educators contacted about participation in a follow-up interview, eight (42%) agreed. These participants represented all teaching experience and teaching level demographic categories within seven school districts across urban, suburban, and rural settings in the state. Table 16 summarizes the characteristics and SEPSAS means of each teacher.

Table 16

*Demographic Characteristics and SEPSAS Means by Interview Participant*

| | Years Teaching | Teaching Level | Adaptive Tendencies Subscale | Routine Tendencies Subscale | SEPSAS Total |
|---|---|---|---|---|---|
| Novice | | | | | |
| Teacher A | 1 | Secondary | 8.17 | 4.75 | 7.55 |
| Experienced | | | | | |
| Teacher B | 11 | Secondary | 6.56 | 8.75* | 6.95 |
| Teacher C | 8 | EC | 7.44 | 6.00 | 7.18 |
| Teacher D | 11 | Elementary | 7.89 | 9.00* | 8.09 |
| Teacher E | 22 | EC | 6.56 | 4.00 | 6.09 |
| Accomplished | | | | | |
| Teacher F | 16 | Secondary | 8.00 | 6.50 | 7.73 |
| Teacher G | 14 | Elementary | 7.28 | 2.25* | 6.36 |
| Teacher H | 25 | Elementary | 5.00* | 7.00 | 5.36 |

*Note.* * Score is > 2 standard deviations from the mean; EC = Early Childhood

**Data Analysis**

Qualitative data analysis through iterative coding addressed research question 4: How do special educators describe their problem solving and supports in their teaching practice? Though the principal source of data to address this research question was participant interviews ($N = 8$), additional information was gleaned from responses to the three open-ended questions on the SEPSAS from the full participant pool ($N = 162$). While hypothesis coding (Saldaña, 2013) using the adaptive expertise framework was used to connect indicators of adaptive expertise to narrative exemplars from special education teaching practice, open coding (Corbin & Strauss, 2008) was used to understand broader themes across the data that could not be captured by the adaptive expertise framework. Following discussion of the dependability and credibility of the overall coding scheme and analysis, results are presented relative to each aspect of the research question, first in relation to special educators' problem solving, then in relation to their supports.

**Dependability and credibility.** Using the researcher-developed codebook (see Appendix K), a second coder applied the researcher's hypothesis (adaptive expertise) and open coding scheme to approximately 15% of the data to support the dependability of the coding scheme and the credibility of data analysis. This data selection represented one page of text from each participant's interview transcript that did not duplicate example quotations used in the codebook. Initial coding agreement, calculated as the percentage of agreements divided by agreements plus non-agreements, was 55% (27 agreements out of 49 possible). However, there was greater agreement between the researcher and second coder for application of open codes (67% [10 of 15 possible]) than hypothesis codes based on the adaptive expertise framework (50% [17 agreements of 34 possible]). For each instance of coding disagreement, the researcher and second coder referenced the codebook and engaged in discussion until consensus was reached. In all cases, agreement was reached quickly, through minimal discussion of the nuances of codes.

Examining patterns across instances of coding disagreement and taking into consideration the second coder's analytic memos while coding provided additional insight into the dependability of the coding scheme and credibility of data analysis. On several occasions, the second coder identified the same quotation as the researcher, but was unsure of which code to apply, thus leaving the data highlighted but not coded. In the second coder's words, "I knew this was something, but I wasn't sure what." The second coder also had discrepancies in applying several closely related hypothesis codes: *reflection on problem solving*, *causal reasoning*, *thinking flexibly*, and *justifying decisions*. For example, the second coder did not identify any instances of *causal reasoning* and *justify decisions*. In the case of *causal reasoning* (two coding instances by the researcher), she thought the participants' data revealed information that was simply descriptive in nature and not identifiable within the adaptive expertise framework. The second coder also did not apply the *justifying decisions* code, instead using *thinking flexibly*, *reflection on problem solving*, or no code at all in comparison to the researcher's coding of the same text. During the coding meeting the second coder expressed some difficulty she had in identifying metacognitive versus cognitive indicators, which is evident in her confusion across these four codes in particular. The second coder's analytic memo while coding indicated that having a single page rather than the full transcript from participants affected her confidence in applying codes. Also, she noted the complexity of the adaptive expertise framework and that applying codes to special educators' discussion of their problem solving is not straightforward.

To further enhance inter-coder agreement, and thus the dependability of codes and credibility of data analysis, the researcher first made clarifications in the codebook that reflected the second coder's feedback and coding difficulties. These clarifications are included in italics within the codebook presented in Appendix K. Then, the researcher and second coder each independently coded a new portion of data. Because the second coder indicated that at times it was difficult to apply codes because more context was needed, the next portion of data for dual coding was one, randomly selected participant's full interview data. Though parts of the selected interview transcript were included in the codebook and the initial data sample for coding agreement, these data were not included in the overall calculation of coding agreement during this second phase. The second coder was provided with the whole transcript for context, but directed to only code the portion that she had never before seen. After independent coding, the researcher and second coder met again to discuss coding agreement. Compared to initial agreement during the first round of dual coding, agreement improved overall. Across all coding there was 64% agreement (21 of 33 agreement opportunities), with 67% agreement (2 of 3 agreement opportunities) for application of the researcher's open coding scheme, and 63% agreement (19 of 30 agreement opportunities) for the hypothesis coding scheme based on the adaptive expertise framework. Again, disagreements were discussed, and in all cases, consensus was reached quickly. The second coder again noted the complexity and nuanced nature of the adaptive expertise framework, and explained her belief in the value of negotiated agreement over absolute agreement when coding data for evidence of complex constructs. No further changes were made to the codebook.

Following these discussions during the second dual coding round, the researcher returned to the remaining seven transcripts and again coded the data with continual reference to the final codebook and the researcher's and second coder's analytic memos about the coding process. After re-coding each transcript, the researcher compared this application of codes to the original transcript coding that took place prior to dual coding. In this way, the researcher was able to ensure consistency across the application of codes, given that more time, thought, and collaborative discussion about the coding scheme had taken place. In areas of discrepancy, the researcher again revisited the codebook and analytic memos to determine the most consistent application of codes.

The researcher sought to enhance credibility of qualitative data analysis further through member-checking (Krefting, 1991; Maxwell, 2013). This included providing teachers the opportunity to review their individual interview transcripts and give clarification or feedback. None contacted the researcher to address any issues with the interview transcript. In addition, all participants were provided with a document summarizing the overall themes noted by the researcher during qualitative data analysis. Again, participants were asked to contact the researcher with any questions or points of clarification; no teachers contacted the researcher in this regard either. Thus, the researcher assumed the data captured in the interview transcripts and interpretations resulting from data analysis were credible relative to participants' perspectives.

**Problem solving.** The researcher used hypothesis coding following the adaptive expertise conceptual framework and open coding to understand special educators' approaches to problem solving across SEPSAS priming questions and interview responses.

***SEPSAS priming questions.*** In the first two priming questions of the SEPSAS, participants were asked to describe some challenges they have encountered in their special education teaching practice, and then identify what they found to be their greatest challenge. These data provide a broader context for understanding the challenges special educators strive to address through their problem solving approaches than what could be understood based on interview data alone.

Using special educators' own words, the researcher applied open coding to these data to determine themes across challenges of practice. Cited with almost the same frequency, the two main challenges that emerged consistently across the data were student variability and lack of time. Student variability referred to teachers having a caseload of students across disabilities, grade levels, content areas, or ability levels as well as the difficulties associated with meeting the individualized needs of diverse students. References to lack of time by participants dealt with having many competing pulls on special educators' time for instructing students, completing required paperwork, complying with services outlined in individualized education plans (IEPs), pacing of curricula, and time to collaboratively plan with other teachers. Related to collaborative planning, many SEPSAS responders noted colleague-related challenges around issues such as poor collaborative teaming, lack of colleagues' understanding of special education in general or particular students' disabilities, and inconsistency of implementation of IEP requirements. Challenges also were noted specific to working with administrators, due to lack of perceived support and understanding of special education and too many new initiatives.

Though many other areas of specific challenge were mentioned by a few SEPSAS responders, two additional areas stood out with particular frequency. First, special educators noted problems associated with lack of appropriate curricula and materials for working with diverse learners. Some teachers described having to create their own curricula for students with severe disabilities, while others lamented having to keep up with general education pacing. In terms of materials, teachers expressed the need for more funding for materials, more materials aligned to curricula, and a general need for more resources for providing appropriate education for students with special needs.

Mirroring the general discussion of challenges prompted by SEPSAS priming question one, special educators identified addressing student variability and lack of time as their greatest challenges. One respondent stated she did not currently have any challenges, citing her work ethic and drive for helping students overcome their own challenges.

***Adaptive expertise framework.*** As a primary means of understanding special educators' own accounts of their problem solving in practice, the researcher applied hypothesis coding using the adaptive expertise framework. The researcher began by coding the data according to the many indicators represented in the comprehensive adaptive expertise framework outlined by De Arment et al. (2013; see Table 1, Chapter II). Then, to make coding more manageable and results more meaningful, the researcher employed a process similar to that of Wetzel et al. (2015) and distilled indicator codes into 10 broader, thematic codes evident across interview data. As shown in Table 17, these themes represented the adaptive dispositions and metacognitive and cognitive skills identified through this study's comprehensive literature review and the De Arment et al. (2013) framework (see codebook in Appendix K for theme-based codes, definitions, and examples across these areas).

Table 17

*Coding Themes Representing Adaptive Dispositions, Metacognitive Skills, and Cognitive Skills of Adaptive Expertise (De Arment et al., 2013)*

| Adaptive Dispositions | Metacognitive Skills | Cognitive Skills |
|---|---|---|
| Epistemic Distance<br>-Willing to abandon previously held understandings and replace prior assumptions<br><br>Complexity<br>-An epistemic stance that views the world as complex, messy, irregular, dynamic, etc. | Reflection on Learning<br>-Questioning current levels of expertise<br>-Self-assessment<br>-Systematic understanding of the self as a learner<br>-Assessing adequacy of current knowledge for solving case at hand | Thinking Flexibly<br>-Cognitive flexibility<br>-Responding to variability in classroom<br>-Accounting for multiple perspectives<br>-Inventing new procedures<br>-Balancing efficiency and innovation |
| Work at Limits<br>-Willing to reveal and work at the limits of one's knowledge and skill<br>-Willing to ask questions<br>-Willing to take managed risks that may result in mistakes<br>-Seeking out feedback from others | Reflection on Problem Solving<br>-Seeking and analyzing feedback about problem solving processes and outcomes<br>-Systematic understanding of the self as a problem solver<br>-Monitoring results and performance<br>-Modify existing procedural skills | Causal Reasoning<br>-Developing an underlying model or set of contributing factors<br><br>Using Data<br>-Data-driven forward reasoning (hypothesis-based reasoning)<br>-Select routine or adaptive approach based on data and hypothesis |
| Learning<br>-Never satisfied with current levels of understanding<br>-Opportunistic<br>-Motivated to problem solve<br>-Curious<br>-Prepared to learn from new situations | Justifying Decisions<br>- Explaining decisions and justifying outcomes of metacognitive and cognitive processes | |

*Dispositions*. Special educators' discussion of their problem solving in action yielded many indicators of the dispositions supportive of adaptive expertise. These can be understood in terms of how they were thinking about the field of special education and their own roles as special educators. Adaptive dispositions across participants' narratives comprised four main themes, each illustrated in turn.

First, participants' adaptive dispositions were evident in the way they discussed their willingness to change what they previously anticipated or understood in response to the realities of their teaching practice on any given day. These instances were coded as *epistemic distance*, because teachers acknowledged anything could happen, that their perspectives and understandings could and, at times, should change, and that often what was planned for was not what ended up taking place. Teacher E described "needing to take a step back" and "look at the bigger picture" in order to understand how to support a new student whose problem behavior affected the safety and learning of himself and his peers. In doing so, she had to let go of her previous understandings of how best to structure the learning environment. She explained her conversations with her instructional assistant: "Okay, let's rewrite the schedule and what we know about teaching special education at this point and look at what the children in this class what their needs are, and we really changed." Other teachers explained their expectation of change in these ways: "always…looking to find a way to do things better" and needing "to be prepared for whatever comes out."

The next theme across adaptive dispositions was interviewees' understanding of teaching in special education as *complex* and *dynamic*. Teacher H noted how the unexpected is always expected through her comment, "I probably have a thousand examples of things that came up but it's so constant that it doesn't even stick out any more." Other teachers highlighted the complexity by explaining that special educators must know curricula across multiple grade levels for students with varying disabilities and needs, while also "trying to keep [students] doing their own thing constantly." For these special educators, every school year and every class was different and as one participant noted, "There's not one student that's similar to another, so there's a lot of juggling." The dynamic nature of teaching contexts was made clearer through comments such as, "So I have to constantly be doing the dance" and "I write a basic lesson plan for two weeks that—I have to put a disclaimer on that, this is barring any interruption, behaviors, emotional outbursts, kids that aren't there or other such things." These descriptions of teaching in special education in both broad terms and specific to individual contexts make clear teachers' perceptions of inherent and ever-changing complexities.

Special educators' willingness to reveal and *work at the limits* of their knowledge was a third dispositional theme evident in the data. Seven of eight participants acknowledged their desire to work collaboratively with others to share ideas and get feedback relative to problem solving. They sought out their general education colleagues, counselors, administrators, parents, district-level special education staff, and fellow special educators. They were comfortable asking questions to help gain greater understanding or additional help, and took risks in trying new strategies and approaches. One novice special educator expressed her willingness to try new approaches, even at the risk of them not working in the following way, "[I'm] always willing to try. Always willing to get burned a little too."

Finally, a consistent theme across special educators' perspectives on problem solving was their disposition toward *learning* as a vehicle for improving their practice. All teachers expressed the inclination to learn more to expand their knowledge and skills for teaching students with disabilities. They attended workshops, read books, accessed online resources, and pursued professional development opportunities such as National Board Certification. Learning resulted from being curious about and experiencing new situations as evident in Teacher F's comments:

> When I asked to be moved over to the emotionally disturbed program, just to get some new experience, I was kind of fascinated by these kids that would just make these bad choices over and over again.

An inclination toward learning was also apparent in two special educators' discussion of their motivation to problem solve and enjoyment of challenges and the process of problem solving respectively. Teacher C described her motivation to problem solve in response to anticipating the arrival of a new student:

> We've already decided a bunch of different things about this child, and we don't have him. So we're already problem solving for that child and trying to work him into our curriculum with the other kids to try to make sure that we can meet his needs as accurately as we're meeting the rest.

Teacher E expressed the enthusiasm for learning in this way:

> I'm always really excited when I learn a new trick. And we learn new things every year and all year, during the year, and I'm always looking for new strategies. I'm so excited when I learn something new that really works.

Taken together, the learning-based dispositional characteristics represented across these four themes drive special educators toward addressing challenges and expanding their knowledge and skillsets.

*Metacognitive Skills*. Special educators' metacognitive skills were subcategorized into two main themes: *reflection on learning* and *reflection on problem solving*. As distinct from adaptive dispositions related to learning and problem solving, within the metacognitive skills context, these themes related to how special educators reflectively considered their own traits as learners and problem solvers. Thus, rather than noting examples of learning or problem solving in action, coding relative to these metacognitive skills identified teachers' explanations of the thought processes that undergirded the actions they took.

Among codes based in the adaptive expertise framework, *reflection on learning* was noted least often across the data with only five coding instances across three special educators. Teacher C was particularly reflective about herself as a learner, first explaining how being engaged in a challenging situation can bring the limits of current knowledge into focus:

> When I can't think of something because I'm in the middle of the situation, for me it's better to reach out to all of my colleagues and to say, hey, I need help with brainstorming some ideas and I need to know what have you used that I haven't used already. You know, what other tools do we have in our tool boxes.

In this instance, she recognized she needs to learn from her colleagues to be able to move forward with solving a problem. Later, Teacher C describes her own characteristics as a learner, and how they relate to her approach with students:

> I'm the person that's hands on. Tell me, show me, make me do it. Then I'm okay. But if you give me job stuff, here it is and this is how you do it, I'm not going to remember it, if you just make me take a few notes, it doesn't mean that you've touched every situation. Work with me, teach me. And it's the same way with teaching.

Special educators' *reflections on problem solving* were more apparent across interview responses than their reflections on learning with evidence across six of eight teachers' interview data. Teachers who pursued National Board Certification discussed the highly reflective nature of this process and its impact on their problem solving. Teacher G observed how getting feedback from others prompted her to "take into context the students that [she had] in front of [her], and what their goals are specifically" rather than focusing on developing a "good" lesson. In addition to feedback from others, participants described how they monitored students' responses to their implementation of strategies, and used those results to inform the next step(s) of their problem solving approach. For example, in relation to the challenging behavior of a particular child Teacher C explained,

> Some strategies, his behaviors increased. Some strategies they decreased and some they stayed the same. Everyone that would decrease, we kept. Anything that didn't help or actually increased the behavior, obviously we dropped. And so on a weekly basis we were doing that because what we were talking about was if we couldn't find three strategies within I think a six-week period that helped to decrease behaviors we were going to start doing, getting ready for a behavior plan.

In this example, the special educator reflected on how the problem solving process and her responses to the child would change depending on how the child responded to the specific strategy being tried. When asked about problem solving quickly in-the-moment versus taking more time to problem solve, Teacher A demonstrated her understanding of herself as a problem solver:

> I guess I go back and forth, there's definitely times when I ask the student to step outside of the classroom, I think that's where I'm trying to take time to problem solve whereas if I'm in a moment where I know the class is not going directly the way that I want it to go, I'm already kind of problem solving in my head.

*Cognitive skills*. The researcher noted three thematic areas related to special educators' discussion of cognitive skills associated with adaptive expertise in their problem solving practices. These were *thinking flexibly*, *causal reasoning*, and *using data*.

All special educators exhibited at least two instances of *thinking flexibly* across their individual interview data; five of the eight teachers had at least six coding instances in this area. This theme represented adaptive expertise indicators comprising teachers' flexible application of strategies, both efficient and innovative, their responses to student variability, and instances where they accounted for others' perspectives. Teachers spoke of having to adjust their approaches based on students' levels and needs and having a "tool box" of strategies or "bag of tricks" to draw from when implementing individualized instruction. As teachers learned new strategies, created new approaches, or tweaked existing approaches, they added more resources to their tool box. Teacher G pulled existing behavior charts from her tool box, and made adjustments to fit a "current student's needs." She explained her approach to responding to student variability as "basically repurposing a lot of things." This flexible thinking allowed her to innovate without having to start from scratch based on her 15 years of experience and accumulated set of skills.

Teacher A directly brought up the importance of flexibility in her role as a special educator, particularly within the context of teaching in collaborative classes. She explained:

> If a lesson doesn't go the way I want it to go, then I will try something else, it doesn't matter if I've had it planned or not, if it gets the kids engaged, I'm going to try something. I often have a have them use manipulatives, cards, have something that gets them moving…so flexibility is definitely a big part of my day.

Special educators also incorporated feedback from their colleagues, administrators, students, and parents as part of their flexible problem solving. An example of how teachers used feedback comes from Teacher F, who discussed a student with challenging behavior:

> Because with his volatility and behavior it was critical for us to know if he had had a bad morning, if he had skipped breakfast, if he had been up all night, I mean, anything that would normally set off behavioral problems. So I would take that information from [his mother].

Interview data were coded relative to *causal reasoning* when special educators explained their understanding of the reasons behind or factors contributing to students' responses to their instructional and problem solving approaches. These instances often followed an "if…then…" pattern, but were noted even when not as explicit. For example, Teacher A discussed a strategy she uses for addressing students being off task due to making irritating comments to one another: "If I shield my body between one of them, normally comments tend to stop." Teacher E similarly explained her understanding a young student's positive response to her approach:

> Once we started to require less of him, he started to participate more often and it just kept improving from there. I think I saw that once I didn't try to push so hard, things happened a lot easier and it was okay to give up my schedule and not teach as much anymore.

These examples highlight teachers' thoughtful consideration of the factors that contributed to students' behaviors in response to what they were doing.

During each interview, the researcher directly asked participants what they perceived was the role of data in understanding the effectiveness of their problem solving approaches. As a result, each teacher provided at least some evidence of *using data* to inform their reasoning and/or strategy selection when working with students with disabilities. Responses varied from a single reference to using data as part of problem solving to up to four coding instances. Some special educators referenced data collection in a specific way, detailing the process, the results, and next steps with their students. For example, Teacher G, who referred to her use of data most often among teachers interviewed, outlined her approach this way:

> I'm using a calendar for each of the kids with their name on it, and…as I'm working with the students, I'll make a quick note that they worked well, or they're struggling with something, if they've gained. Like yesterday I noted that two different students had rote counted to 39 and they got stuck at 39, so I tested a third student to see how he was doing with it, and he got stuck at 39. So today we worked on 40 as a group. So that is a good way to see the data that I'm taking every day and to make adjustments in my lesson to help the students continue to make gains.

Other special educators referred to data-based reasoning more generally as knowing "what works" and "what doesn't work." Teacher H felt it was greatly her "intuition" and a reliance on anecdotal notes that helped her to understand students' progress and understanding.

Though a few teachers mentioned data in terms of standardized state or district-level testing, none explained data-based decision making in relation to those data. Therefore, the data discussed by teachers as captured by the theme, *using data*, were contextualized to each teacher's students and the teacher's problem solving approach. Across teachers, data were based on formal and informal checks for understanding such as exit slips at the close of a lesson or thumbs up or down during instruction. Teacher A mentioned internet-based learning applications that provided not only data on students' learning and understanding but their study behavior as well. Other special educators tracked baseline and intervention data to understand how students' behavior changed with strategy implementation. No matter the type of data, Teacher F's comment sums up these special educators' use for data: "We change if we need to and it's based on what the data tells [sic] us."

*Explain and justify decisions and outcomes.* As outlined in the adaptive expertise framework, the indicator of being able to *explain and justify decisions and outcomes* spans both metacognitive and cognitive skill areas, as teacher reflection and action are intertwined in enactment of adaptive problem solving. All teachers provided some justification for strategies used while addressing the challenges of practice, most often in response to student needs and variability. For example, Teacher D explained how it is important for her to know her students well and promote their motivation and engagement in learning activities. She then justified her choice of instructional materials related to promoting reading engagement:

> Because these kids are not readers anyway, and so you have limited time to try to get them to read, so you may as well read worthwhile material…I buy Scholastic because…it's relevant, that's a lot of information in short sentences, then the kids will engage.

This example mirrors the way most participants spoke about their teaching practice and problem solving. Justifications were rooted in teachers' deep knowledge of their students' strengths and needs, rather than reliance on particular strategies that are efficient or known to work. Further, these special educators did not need specific prompting to explain the "whys" behind their choices and decisions; they naturally explained their reasoning and thought processes throughout their reflections on their problem solving approaches.

*Coding co-occurrences*. Examining coding co-occurrences pointed to other themes across the data and suggested relationships among adaptive expertise indicators. Figure 3 presents a visual representation of coding co-occurrences overall; however, salient themes identified by multiple instances of the co-occurrence are addressed in detail.

| | Epistemic Distance[D] | Complexity[D] | Work at Limits[D] | Learning[D] | Reflection on Learning[M] | Reflection on Problem Solving[M] | Thinking Flexibly[C] | Causal Reasoning[C] | Using Data[C] | Justifying Decisions[M,C] |
|---|---|---|---|---|---|---|---|---|---|---|
| Epistemic Distance[D] | - | | | | | | | | | |
| Complexity[D] | | - | | | | | | | | |
| Work at Limits[D] | | | - | | | | | | | |
| Learning[D] | | | | - | | | | | | |
| Reflection on Learning[M] | | | | | - | | | | | |
| Reflection on Problem Solving[M] | | | | | | - | | | | |
| Thinking Flexibly[C] | | | | | | | - | | | |
| Causal Reasoning[C] | | | | | | | | - | | |
| Using Data[C] | | | | | | | | | - | |
| Justifying Decisions[M,C] | | | | | | | | | | - |

| KEY: | 0 co-occurrences | | | 5-9 co-occurrences | |
|---|---|---|---|---|---|
| | 1-4 co-occurrences | | | 10+ co-occurrences | |

*Figure 3.* Overall thematic coding co-occurrences. [D] = Disposition; [M] = Metacognitive Skill; [C] = Cognitive Skill;

Though coding co-occurrences connected dispositions, metacognitive skills, and cognitive skills, the most common pattern of co-occurrences was between a disposition and cognitive or metacognitive skill. Notably, coding for the theme of *thinking flexibly* co-occurred at least once with every other code, most often with the *complexity* code. This co-occurrence highlights how the cognitive skills associated with flexible problem solving were related to the underlying disposition of understanding the nature of teaching in special education as complex and, at times, unpredictable. Teacher D explained complexity by saying, "you have to know the content at all the grade levels that you're teaching and you need to be able to adapt that content to fit your students," then provided an example of the "balancing act" she felt was required to flexibly differentiate for all students:

> So today, as I'm teaching a numbers group and I've got this student with Down Syndrome in that group, I had other students that I had counting sets to 20, I had some students that were counting sets to 10, and I had the student with Down Syndrome who was counting sets to 3 or 4.

Other codes co-occurred at least once with almost all others; *reflection on problem solving* co-occurred with all codes but *causal reasoning* while data exemplifying *working at limits* co-occurred with all but three other codes.

Two dispositional indicators co-occurred with some consistency: *epistemic distance* and *learning*. This combination represented special educators' discussion of their openness to and expectation of other ideas and understandings related to their teaching practice along with their pursuit of new learning opportunities or a motivation to problem solve. Teacher C exemplified this co-occurrence in this way:

> I'm always looking for new ways to do something, new approaches, new, something different. Just because something has always worked doesn't mean that's not something better out there, and so that's kind of the way I am. I always look to see if there's something new that I can try. Every year I change my curriculum in my classroom. I make it better. I pump it up. I add more things…If I see something that is not right, or "is broken" I try to fix it, or I try to come up with a solution. I like to help people. I like, I don't know there's a part of me that always is looking to find a way to do things better, if that makes sense.

Across all coding co-occurrences, the most common was between *working at limits* and *thinking flexibly*. When teachers discussed the dispositional characteristics of asking questions and seeking the feedback of others, they often expanded this to an explanation of how they accounted for those perspectives of others within their problem solving. For example, Teacher B addressed how she relies on others for their ideas, perspectives, and observations of students. She then further explained how she incorporates feedback from parents in particular: "The parents, if [the students are] having a particularly bad day where they're missing work, get with parents and see what kind of feedback, sometimes the parents can be helpful in giving us strategies that they are using."

***Other emergent themes.*** Other themes emerged across interview data through open coding relative to special educators' problem solving (see Appendix K for codebook outlining theme-based codes, definitions, and examples). Though these themes may relate to themes identified within the adaptive expertise framework, they merit separate mention as notable aspects of special educators' discussion of their problem solving.

*It depends*. Again and again, special educators tempered discussion of their approaches to problem solving with "it depends…" Rather than commit to a particular approach or solution to a challenge, participants instead explained examples of their approaches and then how depending on such factors as student and family needs, children's interests and ability levels, and the subject matter at hand, their approaches might change. Participant H summed up this theme by saying,

> And it all depends…but just trying to assess the situation, trying to see what kind of approach may or may not work with certain students. You don't treat, or you don't deal with two students in the same way, I mean, it's almost an individualized approach for every individual student.

Though not solicited for the purposes of addressing research question four, participant open-ended feedback on the clarity of SEPSAS items reflected this theme as well. Several respondents expressed their view that it was difficult to assign a rating to SEPSAS items because their problem solving approach might vary given the changing nature of problems that arise from year to year or across different groups of students.

*Administration*. Most participants mentioned administrators in their discussion of problem solving practices, but had varying perspectives on the administration's role. For some, administrators made them feel valued and trusted, did not question their teaching and instead left them alone to do their jobs well. One teacher expressed her "love" for her "admin team" but explained she tended not to rely on them for problem solving help due to their being "out of the trenches so long that they don't remember the day-to-day happenings the classroom." Lack of administrator involvement also was discussed as a result of special educators' students completing state alternate assessments (and scoring well) or, in the view of one participant, administrators not caring about special education.

Most spoke positively about administration, however. As a novice teacher, administration had a significant impact on Teacher A as an aspect of her teaching context that influenced her problem solving approach:

> We have a wonderful admin team which is great and they provide us with so much, so many resources and they're always willing to come in and observe and provide feedback which is great. Especially as a new teacher, I love that the administration is so hands on with our classes whenever we need them to be.

Speaking in general terms, Teacher B stressed, "If you have an administrator that is supportive and who shows that they appreciate what you do, it gives you the push to want to do more." In the absence of such support, special educators expressed a preference of being left alone to do their jobs without administrator interference.

*Passion*. Despite many challenges and the continual need for problem solving, interviewees cited their passion for improved outcomes for students with disabilities as the driving force behind their tenure (or intended tenure) in the field of special education. Teacher G explained, "When you can see those successes, when you see a chance for these kids that have it pretty bad, they're severely disabled, when you know that you can make a difference, I mean, that kind of keeps me going." Illustrating how even seemingly small successes are reasons for celebration, Teacher C stated, "For me, it's the tiny victories: it was two years ago when a child we had been trying all year to learn to pedal a tricycle put his feet on those pedals and actually pedaled." Others explained the importance of loving what you do and how that motivates pursuit of new learning and improved teaching skills for the betterment of the teaching experience and students' learning experiences.

*Personal characteristics*. Special educators spoke of the attributes that described the "that's the way I am" of their teaching identities, irrespective of the challenges they encountered. One simply stated she had a gift for teaching while others mentioned such qualities as being creative, and "artsy-craftsy," having the tendency to "do things differently," and being good at "making up stuff."

Notably, three participants disclosed their own disabilities. One explained at the start of her interview that because she had Asperger's syndrome, she tends to speak her mind. She did not mention her disability in response to any interview prompts relative to her problem solving or teaching in special education, though she did speak at length in response to interview probes. The other two special educators described their schooling experience as students with a learning disability, and related that directly to their instructional and problem solving approaches. When asked whether aspects of her particular teaching context shaped her approach, Teacher G explained context was irrelevant because her own special education experience was something that always informed her problem solving:

> I think that one of my greatest gifts as a Special Ed teacher is my experience as a Special Ed student. I was a student with learning disabilities. I found school incredibly hard, I didn't like it, and I know that in order to reach students, I can't just keep repeating the same thing. But I need to find the key that opens it up for them, that helps them figure out how to do it, and to help them learn how to do their own accommodations essentially, to help them learn strategies to solve problems themselves. So I think that's something that I carry with me wherever I go.

Teacher A similarly recounted struggles in school as a student with a learning disability and how that first-hand experience helped shape her approach with her high school students:

> I think as a person growing up with a learning disability I was always in those classes that weren't very flexible and I found myself very frustrated with teachers who didn't quite understand that it was going to take me a little bit longer to get it, or you know, I might need a little bit of extra time or you know, something if I was working in a group, I didn't want to work in a group, so coming from that perspective I knew I wanted to be able to provide students with an opportunity to succeed without being frustrated. So I think that's where my problem solving skills come from as far as thinking what can I do as a teacher to better the success for my students and guiding my brain to think how their brains are, but knowing that every brain is different, so keeping that in mind, oh, if this isn't working, then let's try something else.

These experiences, resulting from the personal characteristics of the participants, helped shape their problem solving approaches.

*Experience*. Participants who disclosed disabilities were not the only ones who referred to early experiences that helped shape their problem solving approaches. Several special educators directly referenced their novice years in special education as contributing to how they address challenges in their current roles. Some specified their student teaching experiences with master teachers while others spoke of the mentorship of more experienced colleagues. One poignantly noted,

> When I got my very first job…there was nobody else that did what I did…and I realized at that time that I was going to spend my career sort of making stuff up as I went along, from the get go.

After more than 25 years teaching, this early career experience still had an impact on this teacher's approach to managing the challenges of special education teaching practice.

Experience was also considered in light of personal experience, but in a more general sense as benefit for problem solving. For example, Teacher C spoke broadly about the differences between novice and experienced special educators:

> I was told when I first started teaching and I can look back and see this is uttermost truth, the first year you are just sinking or swimming. You're just trying to survive. The second year, you feel worse than your first year because you're like, oh, I got this, and then you realize, you know, I really don't, I still have to keep trying hard. It's not until your third and fourth year when you start realizing, oh, those first two years were hard, but this is so much easier now. Every year gets easier because you've got more things in your back pocket to help you.

Teacher E explained the benefits of actual teaching experience for the improvement of teaching:

> I think back to my first few years of teaching, and poor me, you know, you can have as much training and as much education but you really have to experience and learn for yourself what's going to work for you and what your best skills are.

While these references to experience addressed teachers' problem solving as targeted by research question four, they also informed research question three regarding the relationship between special educator experience and problem solving approaches.

*Negative*. In a few instances, special educators spoke strongly about aspects of their teaching practice that had negative implications for their problem solving. Two spoke directly of their disdain for data, particularly around the idea of "collecting data just for the sake of collecting data." Though these participants described knowing their students and monitoring them closely and anecdotally for positive response to teaching strategies, they did not address these formative assessments as data collection specifically. Rather, data were associated with "trying to give the administration the data, want they want," terms that suggest standardizing testing and policy-driven measures of student performance that were at odds with students' individualized needs. These comments paralleled negative feelings toward administrators as discussed previously.

Other negative influences on problem solving included lack of parental involvement and isolation due to teaching students with a low incidence disability. Both of these areas related to special educators' ability to problem solve with others, specifically that lack of parental involvement and lack of others who knew and understood a low incidence disability, meant problem solving occurred without the perspectives of others at times. Teacher H, a teacher of the deaf, explained:

> My problem solving has really always been…in isolation just with me and myself. There's … not a big brain trust and sharing of ideas just because my students are such a different type of disability from most of the other students in Special Ed in our building.

For this teacher, problem solving also largely lacked the input of families due to the perceived disconnect between hearing parents and an understanding the needs of deaf children.

**Supports.** Hypothesis coding and open coding as outlined previously also helped the researcher understand special educators' perceived supports for problem solving across SEPSAS priming question ($N = 162$) and interview data ($N = 8$).

***SEPSAS priming questions.*** The third priming question from the SEPSAS asked participants to identify what supports help them address their identified challenges of practice. Special educators overwhelmingly responded that colleagues, and relatedly, administrators were their greatest support. Supportive colleagues included district and school level special education leaders, specialists, general education and collaborative teachers, other special educators, and more generally, "understanding colleagues." Supportive administrators were identified as those who understand special education, advocate for training and staffing needs, creatively provide planning time for teachers, and are part of the problem solving team. Eleven SEPSAS respondents addressed this priming question negatively by stating there were no or unknown supports for addressing the challenges of special education teaching practice.

***Adaptive expertise framework.*** Special educators' discussion of their supports during interviews added further insight into their problem solving approaches. When examined through hypothesis codes based on the adaptive expertise framework, special educators' problem solving supports were evident in several areas. Under dispositional indicators, teachers emphasized seeking feedback from and asking questions of colleagues as well as pursuing new learning opportunities to enhance their knowledge and skills. These underlying dispositions prompted special educators to seek out supports that they then used to promote their adaptive cognitive and metacognitive skills. For example, Teacher F demonstrated her disposition towards seeking feedback from others and then explained exactly how she incorporated that feedback into her instruction: "You can learn different things from your colleagues. So, in fact, I just implemented a new behavior chart for one of my kids based on an idea that my Assistant Principal gave." She went on to explain her reflections on her problem solving around this strategy:

> He said, what about using like a traffic light, because most kids understand that you know, red, yellow and green, and I think I can work with that. So red is no, yellow is ask, and green is yes… I had tried to think about how to make something simple and it's very visual, and very simple.

This example demonstrated how supports can bolster special educators' problem solving across adaptive dispositions and cognitive and metacognitive skills.

Following a similar pattern, an orientation towards learning prompted special educators to pursue opportunities to enhance their teaching as mentioned earlier. This disposition then led to an enhanced "tool box" of strategies that teachers could selectively draw from in response to student variability. The connection between a disposition towards learning supporting the cognitive skill of flexible thinking is evident here:

> I've developed either strategies or my way of doing things through different workshops that seemed to be effective for certain types of students, and through research and reading, and other classes and all. I just took a class last week on self-regulation because we've got kids who just don't seem to be able to control themselves. So it's something else in the tool box.

An orientation toward learning manifested differently for these teachers. Though Teacher H felt strongly that professional development was not helpful, being "self-driven," she pursued and achieved National Board Certification to strengthen her teaching practice.

***Other emergent themes.*** Special educators spoke in general terms about the importance of having support from others, including supportive parents of the students they teach, colleagues, and administrators. Interviewees consistently identified other special educators as supportive, in particular those "who have been there the longest and have the most experience." Teacher B explained the benefit of a supportive administrator this way: "If you have an administrator that is supportive and who shows that they appreciate what you do, it gives you the push to want to do more." Some special educators also discussed how they attend to their own mental health as a means of supporting their work with students with disabilities. Teachers used humor, “Lots of red wine,” and rest and relaxation as mental health supports. Teacher G explained her strategy:

> I take a few minutes, I turn the Price is Right on in the classroom, I shut the door, and I eat my lunch and I look at the Price is Right. Because, if a student has done something that’s particularly irritating in the morning, and difficult to deal with, it’s important that I let it go and move past it so that I'm really there and relaxed and calm going into the second half of the day.

These teachers found support not only from others but within themselves as well.

**Summary of Qualitative Phase**

Eight special educators participated in semi-structured interviews during the follow-up qualitative phase of research. These teachers represented all experience and teaching levels, and as well as the variability across score profiles of the full research sample identified through quantitative analysis. Hypothesis coding using the adaptive expertise framework revealed descriptive examples of the enactment of adaptive problem solving in teachers’ practices. Special educators’ spoke most frequently about the cognitive skill of *thinking flexibly*, while the metacognitive skill of *reflecting on learning* was noted least often. Co-occurrences across adaptive expertise codes suggested links among indicators, particularly in relation to the cognitive skill of *thinking flexibly*. Special educators who recognized the world of teaching in special education as *complex* also spoke of their cognitive flexibility. The most common coding co-occurrence was between the disposition of *working at limits* and *thinking flexibly*.

Other themes emerged outside of the adaptive expertise framework. Though teachers provided illustrating examples from their teaching practice of their problem solving approaches in use, many also noted that the application of particular approaches were dependent upon other contextual factors. Special educators discussed their relationships with administrators, their passion for persisting in the field, and the role of their early experiences or perspectives on the benefits of cumulative experience for problem solving. Unprompted, these teachers also discussed their own personal characteristics that they felt helped shape their problem solving approaches.

Interview transcripts provided insight into special educators' perspectives on their supports for problem solving as well. Within the adaptive expertise framework, teachers discussed their dispositions towards seeking feedback and learning, which related to the enhancement of strategies available in their "bag of tricks" as represented through their cognitive flexibility. Interviewees also spoke in general terms about their supports from colleagues and from within themselves.

Responses to open-ended priming questions on the SEPSAS by all study participants provided insight into perceived challenges and supports. Challenges most often cited included lack of time and student variability while special educators felt their colleagues and administrators were their greatest source of support.

## Mixed Methods Analysis

Following the sequential analysis of quantitative and qualitative data, the mixed methods stage of data analysis required the mixing of data to uncover further nuances of special educators' problem solving approaches and further inform measure development. This phase addressed the final research question: How do examples from special educators' real world teaching practice relate to their perceptions of their problem solving approaches as measured by the SEPSAS? The researcher used several joint data displays (Creswell & Plano Clark, 2011;

Sandelowski, 2003) that linked interview participants to their SEPSAS item-level and subscale level scores, as well as related interview data and applied coding for this analysis.

**Special Educators and their Score Profiles**

To establish an overall context for mixing quantitative and qualitative data, the researcher began the mixed methods analysis by first examining the SEPSAS subscale scores of each of the eight special educators who participated in the qualitative phase of research. Four teachers were among those whose Adaptive or Routine Tendencies subscale score deviated from the mean score for that subscale by more than two standard deviations. Teachers B and D had Routine Tendencies scores that positively exceeded two standard deviations from the mean (8.75 and 9.00, respectively), while Teacher G's score for this subscale was more than two standard deviations below the scale mean (2.25). Teacher H's Adaptive Tendencies subscale score was different from the mean (5.00), much lower than that of most participants. Figure 4 highlights the plotted subscale scores of each teacher and notes these teachers with outlier profiles.

Three special educators, Teachers A, G, and E represented participants with Adaptive Tendencies subscale scores greater than their Routine Tendencies subscale scores, the latter of which were below the scale midpoint of 5.0 (*This sometimes applies to my problem solving approach*). Teachers B and H exhibited a somewhat inverse profile, with greater Routine Tendencies subscale scores, though their Adaptive Tendencies subscale scores were greater than and at the scale midpoint, respectively. Unlike these five special educators, Teachers C, D, and F had subscale scores that fell within the references lines depicted in Figure 4, indicative of scores that were less than two standard deviations (or 1.72 around x = y, based on the overall SEPSAS mean) apart from one another. Though the Adaptive Tendencies subscale score was higher for Teachers C and F while Teacher D had a higher Routine Tendencies subscale score, paired scores for these three teachers were more balanced than those of the other five teachers who were interviewed.

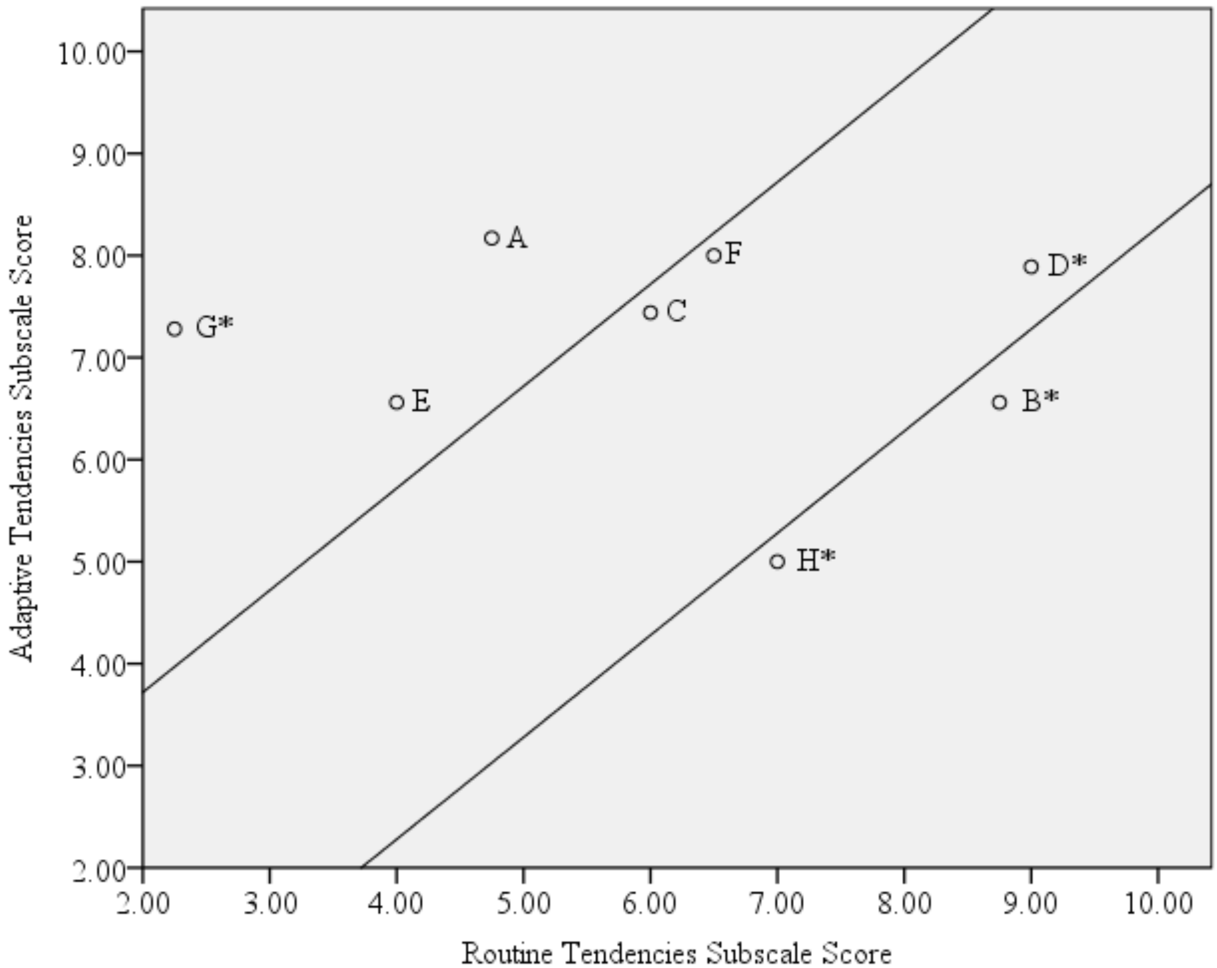


*Figure 4*. Scatterplot of paired subscale scores by interview participant. * = Teachers with one score greater than two standard deviations from either subscale mean.

For all teachers, analyzing their subscale scores in relation to each other and in relation to their interview data helped clarify the broader picture of their problem solving approaches. In addition, comparisons across teachers with similar and dissimilar score profiles added to this understanding. Overall, teachers' interview data reflected their numeric profiles.

**Adaptive problem solving profiles.** The five special educators with Adaptive Tendencies subscale scores that exceeded their Routine Tendencies subscale scores (Teachers A, C, E, F, and G) spoke of seeking and using the feedback of others, the desire to learn new approaches and expand their skill sets, varied approaches to meeting the needs of diverse students, and reliance on data to drive decision-making. In comparison to teachers with higher Routine Tendencies subscale scores, these teachers discussed their reflections on their own problem solving approaches to a greater extent and viewed data favorably as a valuable and continual aspect of their problem solving.

Though Teacher F had twice as many years of teaching experience as Teacher C and was National Board Certified, these two special educators had subscale scores that were the most similar across participants interviewed. Item-level comparisons of their SEPSAS data indicated similar perceptions of problem solving, with only three Adaptive Tendencies items differing by two points, and all others only one away or an exact match. This pattern was similar across Routine Tendencies items as well, with one of the four items differing by 2 points, and the others one away or an exact match. Narrative data across both special educators portrayed further similarities. For these teachers, input and ideas from colleagues are important aspects of problem solving. Teacher F described the collaborative nature of her teaching context as "very cooperative in this environment here, so we're always sharing stuff" while Teacher C explained a detailed example of a team approach for brainstorming strategies to try with a particular child based on the collective knowledge of all members of the team. Both teachers also elaborated on the importance of data for driving decision-making and the need for new approaches. Though both teachers described situations where they made choices to apply new problem solving strategies, Teacher F specifically referred to the role of her considerable experience: "I have a lot of experience so I do call on my experience, my previous experience as well as my educational background, because it's pretty extensive." This nuance of reliance on experience was evident across the item *think about my past successes with challenges* where Teachers C and F rated themselves at an 8, and the Routine Expertise item *rely on what I already know*, where Teacher C gave a 5 and Teacher F was more apt to call on her experience, with a rating of 7.

Of the teachers with greater Adaptive Expertise scores, Teacher G's Routine Tendencies subscale mean (2.25) was the lowest, and well over two standard deviations from the mean for all participants (5.41; *SD* = 1.28). This score represented a value closer to the extreme lower end of the scale (*this never applies to my problem solving approach*) than the scale midpoint (*this sometimes applies to my problem solving approach*), which more closely aligned with the overall mean for the subscale. This low Routine Tendencies subscale score related to one of Teacher G's lower rated Adaptive Tendencies items, *choose between approaches that I know have worked before and new, innovative approaches as appropriate* based on the way she discussed her problem solving in action. Though a score of five indicated she sometimes relied on strategies that have been known to work in the past, Teacher G felt it was between sometimes and never that she relied only on what she already knew. Theses excerpts from her interview explain the nuances of her approach:

> I rarely create my own stuff. I usually pull from what's already out there. So when it comes to behavior charts, I've made so many for the last 15 years that I almost never have to make a new one from scratch. I usually take an old one that I've done before and adjust it to fit my current student's needs. So it's basically repurposing a lot of things. Sometimes it's things that I've tried in the past. Sometimes it's things that they're doing at home, sometimes it's something that they're trying at an outside therapy that I might

be work, have like a release to talk to their therapist and get some ideas from them and try it. …I really do a bunch of different things to figure out how to solve the problem.

Teacher E had the same overall Adaptive Tendencies subscale score as Teacher B (6.56); however, unlike Teacher B, Teacher E's Routine Tendencies subscale score was lower than her Adaptive Tendencies score, and it was lower than the scale midpoint. Despite a subscale score commonality, consideration of each special educator's Routine Tendencies score and related narrative data points to a distinction between the two teachers' overall problem solving orientations. For Teacher E, data are an important part of her problem solving and decision-making when teaching young children with disabilities. Further, her openness to and excitement for new ideas were reflected in her rating of 2 for the Routine Tendencies item *want to avoid having to develop new approaches*. The following comment captures the essence of Teacher E's more adaptive orientation to problem solving: "So the way we solved that problem was to give up some of what we had been doing for so many years and try something new, and research some different options." Teacher B, whose more routine problem solving profile is discussed in more detail next, did not use such language when discussing her problem solving in action.

**Routine problem solving profiles.** Though all special educators exhibited some indicators of adaptive expertise through their SEPSAS scores and interview data, data from Teachers B and H in particular, suggested a stronger orientation to routine problem solving. These teachers' descriptions of their teaching practice substantiated their numeric profiles of an imbalance in SESPAS subscale scores in favor of Routine Tendencies. Teacher B had a Routine Tendencies subscale score (8.75) not only higher than that of her Adaptive Tendencies subscale score, but also more than two standard deviations higher than the mean for the Routine Tendencies subscale overall. Teacher B's more routine orientation was evident in the way she discussed "the way I do it" of how she approaches problem solving in relation to students' learning. She explained that "what [she has] been using has worked, but every once in a while you might see something" that is a new approach to incorporate into her work with middle school students with disabilities. In response to a direct question about how she uses data in relation to her problem solving, Teacher B provided a brief explanation: "So we take a lot of data with their behavior, what works, what strategies work and what does not, and that helps us decide, well, should I give him that particular work to do or should I modify." Yet, she rated the item *use data to guide my decision-making* a 3, indicating that this only applied to her approach somewhere between never and some of the time. When speaking of her own development as a professional, Teacher B said, "You'll try to find ways to make [teaching in special education] easier for yourself." Taken together, these comments support her high ratings (mean of 8.75) on Routine Tendencies subscale items regarding use of existing familiar and efficient approaches while avoiding the need to innovate.

Though her Routine Tendencies subscale score (7.00) was not as high as Teacher B, Teacher H also exhibited a stronger orientation towards routine expertise across her SEPSAS and narrative data. She described problem solving on her own, rather than in collaboration with others, and cited her many years of teaching experience and self-perception of being a gifted teacher. In addition, her narrative data provide inverse evidence for SEPSAS items comprising the Adaptive Tendencies subscale, thus suggesting a more routine expertise-based approach. For example, relevant to her rating of 4 for the SEPSAS item, *use data to guide my decision-making*, Teacher H explained that she hated data and "probably should use it more," indicating that she did not often use it to drive her instructional or problem solving decisions. An Adaptive Tendencies subscale score of 5.00 further supports Teacher H's more routine approach to problem solving. This score was more than two standard deviations below the subscale mean in comparison to all study participants, and it is at the scale midpoint (*this sometimes applies to my problem solving approach*).

Closer examination of Teacher H's item-level responses showed that she rated more than 25% of Adaptive Tendencies items as less than 5, and almost another 40% at 5. Teacher H had the most years of teaching of those interviewed at 25 years and mentioned her age and proximity to retirement during her interview. Teacher H also revealed her perceived isolation for problem solving due to her role as a self-contained teacher of students with a low incidence disability. Though she described some feedback and collaboration with colleagues and administrators, Teacher H relies on her own expertise and years of experience for addressing the challenges she encounters when teaching. In her own words, "I don't really encounter like an academic problem that I couldn't solve on my own." These narrative data corroborate her rating of 2 for the item *seek feedback from others* and the rating of 7 for *rely on what I already know*.

Similar to Teacher B, Teacher D also had a high Routine Tendencies subscale score; in fact, her score was 9.0, indicative of ratings of 9 (*this always applies to my problem solving approach*) for all four items within the subscale. This subscale score was greater than two standard deviations from the subscale mean. Though her SEPSAS scores reveal a perceived importance of drawing from existing skills and knowledge for solving problems in teaching (evidence of routine expertise), Teacher D's interview data balance this orientation with a desire to "keep things fresh" and learn about new instructional approaches, such as Reggio Emilia and Montessori. In addition, examination of Teacher D's item-level ratings revealed ratings on every Adaptive Tendencies item above the scale midpoint, 67% of which were ratings of 9, except for one item that she rated as 1. This low rating applied to the item *use data to guide my decision-*

*making*, and indicated Teacher H's view that this statement never applied to her problem solving approach. Like Teacher H, Teacher D referred to her proximity to retirement age, though as a career-switcher, she had fewer years of teaching experience (11 years).

**Role of Experience**

Mixed methods analysis revealed nuances related to special educators' experience. As noted in quantitative analyses, special educators' experience levels (novice, experienced, accomplished) were not systematically related to SEPSAS score profiles. This finding was reflected in the score profiles across the novice, experienced, and accomplished teachers interviewed as well. However, in some instances, the way special educators discussed the role of experience aligned with their score profiles. Teacher H, an accomplished special educator, referenced her own cumulative experience as a benefit because she had been working with the same low incidence population of students "for such a long time." She also identified that "even after 20-25 years in the field, something [can come] up that's a little bit out of your comfort zone and you sort of have to step back." These comments pointed to the overall stability of her teaching context across time, where the scope of students' disabilities is narrowly focused and only occasionally does a situation arise that is outside of the routine.

Teacher F, another accomplished special educator, also referred to the benefit of her cumulative experience as a resource for problem solving; however, unlike Teacher H, Teacher F referenced expanding her skill set by seeking out new teaching experiences with students with emotional disabilities. Though these accomplished special educators had similar Routine Tendencies subscale scores (7.00 [H] and 6.5 [F]), Teacher F had a much higher Adaptive Tendencies subscale score (8.00) than her counterpart (5.00). Teacher A, a novice special educator, had the highest Adaptive Tendencies subscale score among those interviewed (8.17).

Rather than referencing teaching experience, she spoke of her personal schooling experience as a student with a learning disability as a driving force behind her problem solving orientation towards flexibility.

**Measure Development**

Interviews provided special educators with the opportunity to further explain their particular approaches to problem solving. As noted through participants' feedback on the SEPSAS, some special educators wanted the opportunity to explain their SEPSAS item ratings. For example, one participant who did not engage in an interview stated:

> Problem solving strategies are not cut and dry, each one is individualized and there are not single answers for approaches to solving problems, you may use a little old with a little new. Collaborating with other people the student encounters is crucial to strategies to implement and consistency for using the strategy. A likert (sic) scale is not able to capture the type of response necessary to complete the survey.

Another participant used the SEPSAS feedback field to directly explain one of her item responses:

> I rated myself in the middle for question 21 because if I needed more ideas I would research or go to a teammate. I didn't mark close to never, but going to the other extreme sounded like I was doubting myself all of the time.

Therefore, examining SEPSAS item-level data in relation to special educators' narrative accounts of their problem solving further informed measure development by revealing how teachers may have interpreted survey items. Of note, the interview protocol was not designed with the purpose of prompting teachers' discussion of information relative to each SEPSAS item. Thus, it was not expected that any interviewee's narrative data set would illustrate each aspect of the SEPSAS measure. The nuances of two aspects, in particular, were clarified through this analysis: teachers' perspectives on (1) the role of data and, (2) the timing of response to challenges and speed of problem solving.

**Role of data.** As discussed previously, some special educators who were interviewed felt data were an important part of their day-to-day problem solving whereas others felt data "played no role." For most teachers, these general feelings toward data were reflected in their ratings on the SEPSAS item *use data to guide my decision-making*. Five of the special educators rated this item at an 8 or 9. Teachers D and H, who directly voiced their disdain for data, rated this item at 1 and 4, respectively. Teacher B similarly rated this item below the scale midpoint, giving it a 3, but her narrative data were somewhat mismatched: "So we take a lot of data with their behavior, what works, what strategies work and what does not, and that helps us decide, well, should I give him that particular work to do or should I modify." However, in contrast to others with positive narrative perspectives on data, this brief comment constituted the extent of Teacher B's explicit thoughts on data. Other teachers explained in more detail their data collection approaches ("I usually put a piece of masking tape on my leg and I walk around with a pen…") and examples of their data-driven decision-making ("it's helped me to see areas where one of my kids is not making progress in reading and we're starting other strategies because of it").

A more detailed look at interview responses revealed that all teachers used data when making decisions about their instruction with students with disabilities, though their conceptualizations of what constituted "data" differed. For example, when asked about the role of data in understanding the effectiveness of her approaches, Teacher D explained how standardized testing data "Didn't show [her] one thing" and that it was "a waste of time." Though these comments align with her SEPSAS item rating of 1, Teacher D described using formative and anecdotal data as a means of gauging whether her approaches were effective with students. She referred to this as "listening to wherever the kids are at." Teacher H also referred to relying on anecdotal data, "taking notes on the things you see," in addition to her "intuition." When not asked directly about data, Teacher B explained her strategy of using an "exit check" at the end of each class period so that she knows "what do they remember and what am I going to have to reteach the next day." This discussion was similar to that of Teacher A, who rated the SEPSAS data item at 8 and described how she uses a lot of formal and informal assessments to check for understanding.

**Timing of response to problems.** Exploratory factor analysis suggested items related to taking time to problem solve as well as addressing challenges quickly and efficiently both comprised the Adaptive Tendencies factor. Interview data in relation to item-level scores help provide additional clarity about problem solving nuances related to time. Several special educators spoke of situations that called for either quick or more thought-out problem solving. For example, Teacher G, who rated the item *try to solve a problem quickly and efficiently* as *sometimes* (5), explained that "If something comes up on the spot, [she] address[es] it." On the other hand, she felt more strongly that *take my time to solve the problem* almost always applied to her approach (8), explaining that she tries "a couple of different things and see if they work and test[s] them for a bit."

Like Teacher G, Teacher A discussed the differences between quick and slow problem solving, though for this beginning teacher, she felt both approaches were often applicable to her overall approach. She explained that often she will create a game for students "out of the blue" as a means of motivating and engaging students which related to her item-level rating of 8 for *quickly address the challenging situation*. When asked directly about the difference between quick problem solving versus taking her time to address a challenge, Teacher A said:

> I guess I go back and forth, there's definitely times when I ask the student to step outside of the classroom, I think that's where I'm trying to take time to problem solve whereas if I'm in a moment where I know the class is not going directly the way that I want it to go, I'm already kind of problem solving in my head. You know, what can I do to make this lesson go the way that I want it to go? So it varies from situation to situation definitely.

Thus, this interview selection supported her similar ratings on items that related to being quick and efficient as well as taking more time when problem solving.

Special educators interviewed had many examples of needing to solve problems quickly simply due to the nature of the problem. Teacher F used humor with a student for whom other strategies had failed to work, and described this decision as "off the cuff" rather than planned out. In another instance, she described a child whose behavior was impeding the class from going on a field trip, which necessitated a quick response. Though she rated the *take time* SEPSAS item highly, she likewise used ratings of 7 and 8 for Adaptive Tendencies items related to quick and efficient responses to challenges.

**Summary of Mixed Methods Analysis**

Mixed methods analysis revealed the complexity of understanding special educators' problem solving approaches through the lens of adaptive expertise, and the value of mixing quantitative and qualitative data for informing research on this topic. Close consideration of SEPSAS score profiles, item-level ratings, and interview data across the eight participants interviewed revealed the nuances of adaptive and routine expertise orientations to problem solving. Though five special educators had greater Adaptive Tendencies subscale scores and three had greater Routine Tendencies scores, these did not dictate the overall problem solving profile for each teacher. Instead, each teacher's lower score contributed to their profiles as well. Though there were no direct relationships between teachers' experience levels and their score profiles or interview data overall, some special educators referenced the influence of their years of experience and varied experiences across those years on their problem solving approaches.

The results of mixed methods analysis inform the development of the SEPSAS measure as well. Teachers understood "data" differently, with SEPSAS item scores reflecting an understanding of data described through interview responses as based on standardized testing or quantitative measurement for some. Qualitative data also helped explain efficient and quick responses to challenges in comparison to when special educators took their time to problem solve as represented by three items on the Adaptive Tendencies subscale of the SEPSAS. In some situations special educators needed to respond quickly due to the nature of the challenge at hand; at other times, more deliberate problem solving over time was necessary when teachers needed more time to think through problems or to try out various strategies.

**Summary**

In this study, quantitative and qualitative data were analyzed sequentially and together to address research questions on the validity of a researcher-developed measure of adaptive expertise and the nature of special educators' problem solving practices in the context of teaching students with disabilities. Exploratory factor analysis clarified a two-factor structure of the SEPSAS measure, with 18 items comprising an Adaptive Tendencies subscale and four items representing Routine Tendencies. The 162 participants who completed the SEPSAS exhibited varying score profiles, with most having greater Adaptive than Routine Tendencies subscale scores. No statistical relationship was found between experience, in terms of years teaching or status as a novice, experienced, or accomplished teacher, and participants' subscale scores.

Eight special educators participated in semi-structured interviews related to their problem solving approaches and supports. Interview data revealed descriptive examples of the indicators of adaptive expertise across dispositions, metacognitive, and cognitive skills. Special educators spoke overwhelmingly about their cognitive flexibility in response to student variability and through incorporating feedback from others. This adaptive expertise indicator was noted to co-occur at least once with every other hypothesis code. Outside of the adaptive expertise framework, special educators discussed their perceptions on the roles of administrators, their passion for teaching in special education, and the role of experience in influencing their problem solving approach. Most explained that their approaches were not always the same, that they depended on other factors present in their teaching contexts. Feedback from colleagues was perceived as particularly supportive. Special educators' also found supports within themselves through their self-driven pursuit of learning and strategies for tending to their mental health.

The mixing of quantitative and qualitative data during mixed methods analysis enhanced understanding of the nuances of special educators' problem solving, specifically through the lens of adaptive expertise. SEPSAS subscale scores, considered separately, explained only part of how teachers' adaptive or routine orientations to problem solving manifested in practice based on their narrative descriptions. Teachers interviewed spoke of the role of experience in shaping their problem solving approaches though overall there was no statistical relationship between experience level or years of teaching and SEPSAS scores. Finally, mixed methods results informed SEPSAS development by clarifying how special educators differentially define data and what they perceive as its role in problem solving. In relation to time-oriented items on the

Adaptive Tendencies subscale of the SEPSAS, interviewees also discussed how they may problem solve quickly or take their time depending on the context of the challenge at hand.

Chapter V

## Discussion

Though the number of students identified with disabilities has decreased in recent years, demand for special educators continues due to persistent shortages of qualified personnel (Boe, 2014; Boe & Cook, 2006; McLeskey et al., 2014; Scull & Winkler, 2011). High quality special educators who remain committed to teaching students with disabilities are essential for alleviating these shortages and ensuring positive outcomes for learners. Yet, teaching in the field of special education has many challenges that reflect its ever-changing and highly individualized landscape. Thus, teachers of students with disabilities must be equipped with the adaptive dispositions and skills to help them effectively negotiate these dynamic challenges and persist in their roles as special educators.

The purpose of this study was to investigate how diverse special educators problem solve in their teaching practice in the face of these day-to-day challenges as viewed through the lens of adaptive expertise. Addressing this research purpose allowed for empirical understanding of the theoretical significance of adaptive expertise for special educator development. The researcher used an explanatory sequential mixed methods design consisting of quantitative data collection and analysis followed by qualitative data collection and analysis. Data from 162 special educators who responded to a researcher-developed survey measure (Special Educator Problem Solving Approaches Survey [SEPSAS]) were used to understand survey validity and the extent of special educators' adaptive and routine orientations to problem solving. Then, during the qualitative phase, the researcher conducted semi-structured interviews with a purposive sample of eight special educators from the quantitative phase of the study. Through interviews, the researcher sought descriptive examples of problem solving in practice. Mixed method data analysis following each research phase combined quantitative and qualitative data to reveal additional nuances of special educators' problem solving and inform survey measure development.

**Summary of Results**

As outlined in Appendix J, this study addressed five research questions through analysis of quantitative, qualitative, and mixed data. Research question one, and its three sub-questions, concerned the validity of the SEPSAS measure:

> Does the Special Educators Problem Solving Approaches Survey (SEPSAS) measure special educators' adaptive expertise?
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> a. Does the SEPSAS differentiate special educators' adaptive or routine problem solving approaches (Bransford et al., 2005)?
> b. Does the SEPSAS differentiate special educators' adaptive dispositions, cognitive skills, and metacognitive skills (De Arment et al., 2013)?
> c. What is the relationship between participants' responses to the SEPSAS and the Adaptive Beliefs Survey (adapted from Fisher & Peterson, 2001)?

The SEPSAS measures adaptive expertise as a function of the relationship between adaptive-oriented and routine-oriented subscale scores. Exploratory factor analysis using principal axis factoring and oblique rotation revealed a two-factor structure that differentiates between adaptive and routine problem solving approaches. This model reflects the Bransford et al. (2005) conceptualization of adaptive expertise. Six items were removed from the original SEPSAS due to low communalities and factor loadings, resulting in an 18-item Adaptive Tendencies subscale and 4-item Routine Tendencies subscale. The theoretical literature and evidence from mixed methods analysis supported the appropriateness of each factor label. Cronbach's alpha confirmed the reliability of each subscale. The SEPSAS does not differentiate special educators' dispositions, cognitive and metacognitive skills as identified by De Arment et al. (2013). There was a moderate, positive correlation between the overall SEPSAS and a related measure, the Adaptive Beliefs Survey - Adapted (ABS-A; Fisher & Peterson, 2001), with a high, positive correlation between the Adaptive Tendencies subscale and the ABS-A in particular, and a small, negative correlation in relation to the Routine Tendencies subscale.

The second research question asked: To what extent are special educators' perceptions of their problem solving approaches as measured by the SEPSAS characteristic of adaptive and/or routine expertise? Examination of descriptive statistics including range and means revealed Adaptive Tendencies subscale scores were negatively skewed, with only one participant having a subscale score below the scale midpoint of 5. Routine Tendencies subscale scores were spread more evenly around the scale midpoint, and spanned almost the full scale. Most participants had greater Adaptive Tendencies subscale scores, and of those, most had Routine Tendencies subscale scores that were greater than the scale midpoint. Calculation of z-scores identified three participants with Adaptive Tendencies subscale scores greater than two standard deviations below the subscale mean and nine participants with scores that deviated from the Routine Tendencies subscale mean (three below and six above) by more than two standard deviations. A scatterplot of participants' paired subscale showed similar numbers of participants whose Adaptive and Routine Tendencies scores were relatively balanced or whose Adaptive Expertise scores were greater than two standard deviations (based on the overall SEPSAS mean) higher than their Routine Tendencies subscale scores. Only a few participants had imbalanced score profiles in favor of Routine Tendencies.

To answer research question three (What relationships exist between special educators' teaching experience and their perceived problem solving practices?), the researcher used quantitative, qualitative, and mixed method data analysis. Participants across experience level groups (novice [1-2 years teaching], experienced [3+ years teaching], and accomplished [3+ years teaching and National Board Certified]) had similar subscale means and standard deviations. Because of these similarities and unequal group sizes, analysis of variance was not used to statistically investigate relationships between experience level groups and SEPSAS scores. Instead, the researcher calculated the correlation between years of teaching experience and SEPSAS scores, and found no significant correlations for either subscale. Chi-square test of independence similarly found no association between experience level and the likelihood of balanced or imbalanced score profiles. Therefore, quantitative data analysis suggested no relationship between experience and perceived problem solving practices as measured by the SEPSAS.

Analysis of interview data through coding and theme development, however, revealed special educators' early experiences helped shape their approaches to problem solving and many expressed the value of accumulated experience for addressing the challenges of practice. Combining data sources through mixed method data analysis highlighted additional nuances of the relationship between special educators' teaching experience and problem solving approaches. Similar score profiles resulted from teachers with an eight-year difference in teaching experience, though the teacher with greater experience indicated on the SEPSAS and in her interview responses that she was more likely to rely on what she already knew when solving problems than her counterpart. In addition, years of experience were perceived as important across SEPSAS and interview data for a special educator whose teaching context remained relatively stable while another teacher with a similar Routine Tendencies but much higher Adaptive Tendencies subscale score explained the benefit of seeking out new experiences.

The researcher analyzed interview data from eight special educators and responses to SEPSAS priming questions from all study participants to answer the fourth research question: How do special educators describe their problem solving and supports in their teaching practice? All teachers interviewed described indicators of adaptive expertise in their approaches to problem solving, most often explaining their flexible thinking in response to instructional challenges. Responses to SEPSAS priming questions revealed lack of time and student variability were common challenges, both of which were supported by interview data. Though some special educators were more reflective in response to interview questions than others, teachers' reflection on their own learning was noted least across interview data. Coding co-occurrences centered on connections between dispositional indicators of adaptive expertise and the cognitive skill of thinking flexibly. Themes outside of the adaptive expertise framework emerged as well. Special educators discussed how their application of problem solving approaches varied because they were dependent on contextual factors and for some, their own personal characteristics. Across interview and SEPSAS priming question data, special educators emphasized their relationships with colleagues and administrators. For some, these individuals were sources of support; for others, support was found more from within themselves than from a reliance on others' feedback and input.

Data from both study phases were mixed to address the fifth and final research question: How do examples from special educators' real world teaching practice relate to their perceptions of their problem solving approaches as measured by the SEPSAS? Qualitative data helped clarify score profiles across participants, as teachers with similar scores on one subscale did not necessarily approach problem solving in the same manner; the other subscale score exerted influence over the overall problem solving approach. In addition, the higher subscale score did not necessarily dictate the overall problem solving orientation; rather the balance or disparity between subscale scores provided greater indication of a teacher's overall approach. Therefore, consideration of scores on each subscale in relation to each other, coupled with interview data, portrayed a more complete representation of problem solving in action for each special educator.

SEPSAS item-level analysis through consideration of examples from special educators' real world teaching practices revealed other problem solving nuances related to measure development. First, teachers understood "data" differently; for some this term signaled standardized test scores and jumping through administrative hoops while for others "data" referred to regular formative assessment of students' responses to instruction and progress towards meeting IEP goals. Though those interviewed all discussed evidence of using data to drive instructional decisions, some rated their use of data on the SEPSAS as less than *sometimes* applicable to their approach. Second, narrative data explained how special educators applied approaches in practice related to SEPSAS items about speed of response to challenges. Depending on the context of the issue at hand, quick responses to challenges were sometimes necessary while at other times, special educators took their time to problem solve around a challenge.

**Interpretation of Results**

To address the purpose of the present study, the researcher investigated the utility of a new measure of special educators' adaptive expertise and uncovered how adaptive expertise manifests in the problem solving approaches of practicing special educators. Thus, results first are interpreted in light of measure development followed by interpretation of findings related to special educators' adaptive expertise.

**Measure development.** Study results inform the development and use of the two main measures used to gather data on special educators' problem solving approaches: the SEPSAS and the semi-structured interview protocol.

***SEPSAS.*** Research questions one and five informed refinement of the SEPSAS measure through establishing validity evidence and uncovering nuances of adaptive expertise as understood through special educators' perceptions and narrative descriptions of problem solving in teaching practice. Findings have particular implications related to the underlying factors comprising SEPSAS subscales, item design, and the contribution of narrative data to understanding the scope of special educators' problem solving approaches.

Initially, the SEPSAS contained 28 items targeting the adaptive and routine dispositions, metacognitive skills, and cognitive skills comprising a literature-based operationalization of adaptive expertise. Despite the aim to uncover two and three-factor structures aligned to Bransford et al. (2005) and De Arment et al. (2013) to respectively account for these theoretically significant adaptive expertise components, exploratory factor analysis revealed only a two-factor structure among items. Nonetheless, these factors were representative of a full literature-based conceptualization of adaptive expertise.

Though originally intended to represent aspects of routine expertise, five of these items loaded with 13 other adaptive expertise-focused items to comprise the Adaptive Tendencies subscale of the SEPSAS. Despite seeming contradictory, the grouping of these 18 variables within a single factor is appropriate within the adaptive expertise framework. As noted by others, adaptive experts draw from existing knowledge and skills when addressing challenges and thoughtfully select between the tried and true and innovative approaches (Crawford & Brophy, 2006; Hatano & Inagaki, 2005; Schwartz et al., 2005). This supports the inclusion of the items *think about my past successes with challenges*, *modify approaches I already know*, and *think about what I have learned in my teacher training that works for this type of problem* within the Adaptive Tendencies subscale.

In addition, the other two items loading on this factor that were originally intended as indicative of routine expertise are supportive of adaptive expertise by qualitative data. Special educators who were interviewed explained instances where they needed to problem solve in a way that *quickly address*[ed] *the challenging situation* and where they *tr*[ied] *to solve a problem quickly and efficiently* not because a quick and efficient approach was necessarily known and familiar but because the context of the problem situation required a quick response. Given the inherent complexities of teaching in special education and the varied and exceptional needs of students with disabilities, it is not surprising that special educators would often find a quick and efficient approach necessary.

In response to open-ended priming questions at the start of the SEPSAS, participants indicated lack of time as a significant challenge encountered when teaching. This finding mirrors previous research on the challenges of special education teaching practice (e.g., Brunsting et al., 2014; Conderman & Katsiyannis, 2002; DeMik, 2008; Hillel Lavian, 2015; Kaff, 2004). Though Crawford et al. (2005) identified problem solving that takes place more slowly and deliberately as characteristic of adaptive expertise, her work with biology teachers on a contrived problem solving task is not likely to have required speed due to the nature of the problem context. For special educators, continual demands for their time may necessitate speedy problem solving more often than not.

Although this nuance of adaptive expertise may not be representative of only special educators' approaches to problem solving, it is important to recognize this distinction as another aspect of what sets teaching in special education apart from teaching in general education contexts. Further, special educators' extensive knowledge of students as individual learners may support their deeper understanding of a given problem space despite quick responses to problems; therefore, a quick response may not necessarily indicate a limited view of a challenge as Crawford et al. (2005) suggest is characteristic of routine expertise. In a recent review of the literature on teachers' innovative behavior, Thurlings, Evers, and Vermeulen (2015) note quick decision making can actually stimulate teachers' innovations. Thus, quick and efficient problem solving appears not to be a hallmark indicator of routine expertise for special educators; rather, findings from this study suggest it is an integral aspect of special educators adaptive expertise.

Theoretical literature and research findings also support the Routine Tendencies label for the second factor resulting from exploratory factor analysis. In this case, four items focused on reliance on known approaches in lieu of innovating loaded on the second factor. Unlike the five items loading on the Adaptive Tendencies factor originally conceptualized as indicators of routine expertise, these four items represent Hatano and Inagaki's (1986) discussion of selecting strategies from a limited repertoire of well-practiced, standard approaches characteristic of routine expertise. Routine experts draw from what has worked in the past when approaching challenges (Bransford, 2004; Crawford et al., 2005) and this was evident in how special educators with stronger routine expertise orientations to problem solving spoke of their problem solving in practice.

This simplification of a complex construct into two prominent factors was similarly noted in adaptive expertise measure development research reported by Bohle Carbonell et al. (2015). The factor structure in their Adaptive Expertise Inventory included a five-item Domain-Specific Skills factor and a five-item Innovative Skills factor; together, these ten items comprised a measure of respondents' adaptive expertise. The initial measure included items targeting metacognitive skills as well; however, as in the present research, no factor representing this aspect of adaptive expertise emerged. Unlike the present study where nine of ten items developed to represent adaptive and routine metacognitive skills were retained within the broader factor structure, items targeting metacognitive characteristics were removed from the Bohle Carbonell et al. (2015) measure.

Other key differences distinguish the SEPSAS from the Adaptive Expertise Inventory (Bohle Carbonell et al., 2015). The latter was developed to measure adaptive expertise across work domains, including those where professionals received a high degree of feedback on accuracy and efficiency of performance (high-validity environments) such as construction and manufacturing, a medium level of feedback (medium-validity environments) such as public administration and finance, or a low level of feedback (low-validity environments) such as social work, scientific, and educational domains. The SEPSAS, on the other hand, was devised with a very specific, highly variable and low-validity environment in mind: teaching in the context of special education. The importance of this distinction is unclear because although Bohle Carbonell et al. (2015) expected their measure to capture differences among respondents from environments of varying validity, the Adaptive Expertise Inventory was only able to distinguish high-validity environments from medium- and low-, but not able to differentiate medium- and low-validity environments from one another. Though similar in overall intent, the underlying factors comprising each measure signify unique conceptualizations of adaptive expertise and thus require unique interpretations of the resulting scores.

Unlike other measures of adaptive expertise, the composite SEPSAS score has little meaning in comparison to consideration of the relationship between subscale scores. Because the Adaptive Beliefs Survey (Fisher & Peterson, 2001) and Adaptive Beliefs Inventory (Bohle Carbonell et al., 2015) measure only indicators of adaptive expertise and not its counterpart routine expertise as well, their subscale scores retain meaning when aggregated or averaged. In contrast, aggregating or averaging the two SEPSAS subscale scores results in an overall score that can mask the relative strength of one orientation over another. For example, Teacher B and Teacher G had similar SEPSAS total scores of 6.95 and 6.36, respectively; however, their score profiles and approaches to problem solving were quite different. Though their Adaptive Tendencies subscale scores were both above the scale midpoint and within one point of each other, their Routine Tendencies subscale scores differed by more than six points. In this example, adding Teacher B and Teacher G's SEPSAS subscale scores would indicate a difference between the two teachers, but interpretation of these scores would not be possible without first knowing their individual subscale scores.

Though the bulk of SEPSAS validity evidence (AERA et al., 2014) was amassed through quantitative data analyses (e.g., factor analysis, reliability, correlation with other measure, etc.), in this research narrative data added to understanding of the utility of the SEPSAS and interpretation of teachers' SEPSAS score profiles. Narrative data also addressed the desire of some participants to add explanations to their SEPSAS item ratings. Unlike quantitative SEPSAS data, these data allowed the researcher to distinguish among adaptive dispositions, metacognitive skills, and cognitive skills evident in special educators' discussion of their problem solving in action.

Interview data also suggested improvements to the SEPSAS. In particular, participants differentially considered what was meant by the term "data." On the SESPAS, the data item stated *use data to guide my decision-making* but did not define data specifically. Interview data suggested some special educators understood "data" as formative and systematic, but not anecdotal or summative. Some teachers negatively associated data solely with high-stakes and standardized testing. In some cases, narrative data were somewhat mismatched to ratings for this SEPSAS item. For example, a special educator explained formative assessment and anecdotal data collection but rated the SEPSAS data item as never applying to her problem solving approach. This mismatch suggests the need for defining what is meant by data or providing examples of types of data within this particular item to help inform participants' uniform interpretation of this SESPAS item. On the interview protocol, asking generally about use of data elicited discussion of data in some form from all participants in this phase of research. Therefore, it may not be necessary to clearly define data within the interview protocol unless asked to do so specifically by the individual being interviewed.

Despite these nuanced understandings, it is not yet clear how the SEPSAS captures the magnitude of special educators' perceptions about their problem solving approaches, and how scores can be compared across teachers. In the present study, the researcher examined subscale scores relative to the scale midpoint (indicating a statement was *sometimes* applicable to the respondent's problem solving approach) and relative to each other (i.e., the balance between subscale scores) at the individual level. Narrative data to supplement SEPSAS scores allowed for meaningful comparisons across teachers. Nonetheless, the difference between some score profiles such as matching subscale scores of 5, indicating both adaptive and routine expertise indicators *sometimes* apply to problem solving and matching scores of 9, indicative of both orientations *always* applying to problem solving remains unclear. Though no participant had the former score profile, one did have identical Adaptive and Routine Tendencies subscale scores at a mean of 9, reflecting her rating all SEPSAS items at a 9. Unfortunately, this participant did not respond to a request to be interviewed, so the opportunity to explore an interpretation of this score profile was not available. Given that more needs to be understood about how to interpret the make-up of and comparisons across score profiles, utility of the SEPSAS would ultimately be enhanced by the development of scoring and interpretation guides that are tailored to the type of user (i.e., other researchers, administrators, special educators). These are discussed in more detail through implications for practice and policy and future research.

***Interview protocol.*** Previous research suggests intentional prompting of teachers' reflections on their instructional practices and decision making can promote novice development of adaptive expertise (Hayden, Moore-Russo, et al., 2013; Hayden, Rundell et al., 2013; Janssen et al., 2008; Soslau, 2010, 2012). In the present study, the researcher's intent was aligned to prior research that prompted for examples of the indicators of adaptive expertise in the existing practices of special educators (Wetzel et al., 2015). The researcher's analytic memos while interviewing and throughout mixed methods data analysis reflect upon how it was difficult to prompt special educators to think more deeply about their general problem solving approaches if they did not naturally discuss their problem solving deeply on their own. This may relate to findings by Crawford et al. (2005) that intentional prompting to examine or re-examine details of a problem scenario did not alter biology teachers' existing adaptive or routine orientation to the information. In addition, the interview protocol may have been more successful at prompting special educators to discuss certain indicators of adaptive expertise to a greater extent than others. For example, all teachers were asked to explain the role of data within their problem solving approach unless they naturally discussed this in response to other questions within the interview protocol. As a result of this specific question, all teachers provided some indication of how data fit into their work with students with disabilities, though to varying degrees. The interview protocol may have been less effective at eliciting examples of adaptive expertise indicators that represent deeper reflection on practice such as teachers' reflection on their learning and causal reasoning.

This nuance of the interview protocol is evident in comparing item-level data from the SEPSAS and special educators' narrative data as well. The interview protocol, by design, did not exhaustively prompt special educators to explain instances of each indicator of adaptive expertise represented on the SEPSAS. Across all SEPSAS items, those that represented thought processes (e.g., *think about how I understand the problem* or *consider what I learn from new situations and challenges*) rather than more specific actions (e.g., *monitor how a student responds to my approach and make changes accordingly* or *seek feedback from others*) were paired with fewer illustrative examples from teachers' discussions of their problem solving during mixed methods data analysis. Again, some special educators naturally spoke in a highly reflective manner about their problem solving approaches, while others provided a more surface-level analysis and description of their problem solving in action.

Unlike the SEPSAS measure, the interview protocol was able to distinguish the underlying dispositions, metacognitive skills, and cognitive skills of participants' adaptive expertise. However, analysis of qualitative data for these more fine-tuned indicators of adaptive expertise reaffirmed the difficulty of unraveling the construct into its constituent parts. The percentage of coding agreement between the researcher and a second coder was not strong, though it did improve across subsequent dual coding sessions. During coding meeting discussions, both coders noted the complexity of coding for adaptive expertise indicators in terms of distinguishing cognitive from metacognitive skills and knowing when to code interview data based only on what was said or also on what was implied given the context of the comments.

Though exploratory factor analysis suggested the underlying dispositions and skills of adaptive and routine expertise are not statistically important as distinguishable factors, they may have practical importance for mapping the general patterns of strengths and weaknesses across an individual's problem solving profile. Use of a mixed methods approach, whereby interview data and survey data are sequentially and collectively analyzed, enhanced the understanding of special educators' problem solving to a greater extent than what either measure could have revealed independent of the other. Again, implications for practice and policy, and suggestions for future research provide further elaboration on the practicalities for use and supports necessary for scoring and interpretation across both measures.

**Special educators' adaptive expertise.** Teaching in special education is complex, and variable, fraught with challenges, and distinct from teaching in general education. Findings from this study reaffirm these conclusions identified across the literature (e.g., Benedict et al., 2014; Billingsley et al., 2009; Kaff, 2004; Sindelar et al., 2014) and confirm the theoretical significance of adaptive expertise as peak professional teaching performance (Bransford et al., 2005). For special educators, an understanding of the relevance and expression of adaptive expertise must be couched in these research-identified characteristics of special education teaching practice.

Overall, findings suggest special educators tend to be more adaptive than routine oriented, and that their adaptive expertise manifests in varying degrees across the continuum of experience and setting. However, the relationship between adaptive expertise and experience is not systematic, and may be related more to teachers' unique contextual characteristics and perceptions of experience than actual years of teaching or advanced credentials. Supports identified by special educators offer entry points for encouraging their progress along the trajectory towards adaptive expertise, and ultimately their retention in the field.

***Context.*** Considering qualitative evidence from both the SEPSAS open-ended questions and participants' responses to interview probes, findings suggest special educators' teaching contexts play a role in how their problem solving approaches are applied. Therefore, across different challenging situations, school settings, or administrators, a special educator's response may vary. This finding extends well-established prior research on the challenges of teaching in special education that suggests context, comprised of disabilities served, degree and type of administrator support, and availability of resources, to name a few factors, influences how special educators perceive problems (Billingsley et al., 2014; Collins, 2007; Fall & Billingsley, 2011; Kilgore & Griffin, 1998; Major, 2012). The SEPSAS rating scale aimed to capture special educators' variable or conditional responses to these contextual aspects of their problem solving by allowing a range of responses from *never* to *always*, with a midpoint at *sometimes*. But it is their interview data, their voices describing and explaining what their teaching practice looks like, that capture the context through which their overall problem solving approaches can be best understood.

Evidence from one special educator in particular, Teacher H, suggests that the nature of disabilities served within a teaching context relates to how problem solving approaches manifest.

In this instance, Teacher H described teaching students who were deaf or hard of hearing, a very specific low incidence disability category. Teacher H emphasized her isolated problem solving due to the nature of teaching this distinct population of students, where knowledgeable colleagues, administrators, and parents were not available as resources. Instead, this routine-oriented teacher relied on her own accumulated knowledge and skills for knowing how to address teaching challenges. Though she did not overtly explain the stability of this teaching context, Teacher H's comments suggested her teaching context was predictable due to the specific needs of students with deafness or hearing impairments. Therefore, as Hatano and Inagaki (1986) explain, more routinized rather than adaptive approaches to problem solving would be appropriate for a stable context.

***Retention.*** While this study did not connect adaptive and routine-oriented profiles to student outcomes or other direct measures of teacher efficacy, indicators of adaptive expertise are central to the narrative of teacher quality across the literature (i.e., Darling-Hammond, 2000; Darling-Hammond & Bransford, 2005; De Arment et al., 2013; Hatano & Oura, 2003; Mason-Williams et al., 2014). Results suggest some special educators may be more or less equipped to persist in teaching students with disabilities based on their overall approach to problem solving. Given that special educators must be "the Jane of all trades" as one participant put it, they may have no choice but to adopt adaptive tendencies in order to effectively address problems of practice. This conclusion is supported by the congruence of adaptive expertise indicators with professional standards for special educators (CCSO, 2013; CEC, 2012a; CEC, 2012b; NBPTS, 2011).

Measure development research by Bohle Carbonell et al. (2015) found low validity work domains (such as education) and fields with greater task variety (such as found within special education) related to greater adaptive expertise. Not only is the conclusion that special educators necessarily need to possess the indicators of adaptive expertise supported by qualitative data on the challenges of practice and problem solving in action in the present study, quantitative results suggest special educators tend to be more adaptive than routine oriented. Thus, the salient indicators of special educators' adaptive expertise, as identified by this study, may be considered indicators that identify those teachers who are better suited to address student variability, and thus find long-term success in teaching students with disabilities. In turn, these teachers should be targeted for retention in the field and thus help alleviate chronic shortages of quality special educators (Boe, 2014; Boe & Cook, 2006).

***Trajectory towards adaptive expertise.*** Juxtaposing this study's findings against the trajectory towards adaptive expertise (Bransford et al., 2005; Schwartz et al., 2005; see Figure 1, Chapter II) emphasizes the importance of understanding the interplay between teachers' adaptive and routine tendencies as a function of their overall degree of adaptive expertise. Some special educators may rely too heavily on innovating and pursuing new learning opportunities, reflecting the position of the "frustrated novice" despite their degree of teaching experience. While these adaptive dispositions and skills are essential for addressing variable and changing student needs, overreliance may lead to frustration and ultimately burn out because of significant demands on special educators' time and energy across cumulative years of teaching. Thus, a more balanced approach to problem solving, represented in this study by teachers' perceptions of roughly evenly emphasized adaptive and routine tendencies, would set special educators on the trajectory towards idealized adaptive expert status. In addition, this balance would support longevity in the field.

However, more needs to be understood about teacher presence in what Bransford et al. (2005) refer to as the "optimal adaptability corridor" (p. 49), or a trajectory towards idealized adaptive expert status representing the balanced relationship between a teacher's degree of efficiency and innovation. In this study, plotting participants' Adaptive and Routine Tendencies subscale scores provided a visual representation of problem solving orientations across the study sample, and offered a context for understanding the narrative accounts of those interviewed. The researcher purposefully imposed reference lines to create a corridor within which participants' with balanced subscale scores would appear. As in the present study, Crawford (2007) plotted participant data following the Bransford et al. (2005) conceptualization. In this case, axes represented percentages of participants' think aloud text units coded as *knowledge building* and *efficiency* oriented, in relation to a balanced pathway toward adaptive expertise. Though there were far fewer participants in Crawford's (2007) research ($N = 13$), teachers similarly presented with varying adaptive expertise profiles in reference to a balanced trajectory of knowledge building and efficiency.

What remains unclear from prior literature and the present study is whether there is a meaningful width of the corridor leading to adaptive expertise. Bransford and colleagues use the term "optimal," yet there is no guidance offered for how similar, or balanced, an individual's degree of innovation and efficiency need to be in order to be considered optimal. Crawford (2007) overlaid an optimized corridor among data but did not explain the criteria for how these reference lines were placed. Without more specific guidance from theoretical or empirical literature, the researcher determined the criteria for applying the trajectory to adaptive expertise among this study's data (i.e., +/- two standard deviations around x = y based on the overall SEPSAS mean as depicted in Figures 2 and 3 in Chapter IV). However, these lines are based on professional judgment rather than definitive evidence of optimal special educator problem solving. Therefore, it is possible that teachers with score profiles near the reference lines were wrongly included or excluded from the balanced trajectory.

***Experience.*** Though statistical analysis of experience through multiple approaches revealed no significant relationships with SEPSAS scores, qualitative findings suggest special educators perceive experience as important to their problem solving approaches. These findings echo earlier research that, taken together, suggest a complex relationship between teachers' experience and adaptive expertise. While some studies linked greater experience to greater adaptive expertise (Hayden, Moore-Russo, et al., 2013; Hayden, Rundell, et al., 2013; Wetzel et al., 2015), others found the opposite (Hayden & Chiu, 2013) or like the current study, found mixed profiles of expertise across experienced teachers (Crawford, 2007; Yoon et al., 2015; Yoon et al., 2014). In this study, participants' own words offer insight into these complexities. Special educators spoke of the influence of their early teaching and personal experiences as shaping their problem solving approaches, and referenced their own cumulative experience and experienced colleagues as supportive of their problem solving. These nuances highlight the individualized nature of teachers' problem solving approaches, and underscore the value of the SEPSAS for identifying individual adaptive expertise profiles over assumption that increasing special education teaching experience leads to increasing adaptive expertise. At the same time, these findings suggest the need for professional development for fostering adaptive expertise across the continuum of in-service experience.

In addition to the perceived support of their own experience and personal characteristics, special educators in this study identified administrators and colleagues as supportive of their problem solving. This is significant because these supportive others can serve as key entry points for promoting special educator development of adaptive expertise. Previous research with teachers and from other disciplines suggests that adaptive expertise can be nurtured through thoughtful and specific prompting, whether one-on-one (Hayden, Rundell, et al., 2013; Soslau, 2010, 2012) or in group or class contexts (Anthony et al., 2015; Martin et al., 2015; Martin et al., 2005; Martin et al., 2006; Pandy et al., 2004) by colleagues or more experienced others. Thus, as discussed later through implications related to practice, these supportive others can be leveraged to promote special educators' adaptive expertise.

**Limitations**

Despite extensive steps taken to ensure quality and rigor across study design and implementation and ultimately interpretation of results through use of Tashakkori and Teddlie's (2008) integrative framework (see Table 5, Chapter III), this research has several limitations. Being the first extensive study of a new measure of adaptive expertise with a population represented in only one prior study (Wetzel et al., 2015), interpretations of research findings are far from conclusive and point to many avenues for future research (discussed below).

This research is limited by the survey and interview approaches used to understand special educators' adaptive expertise. Though the survey aimed to measure participants' adaptive and routine expertise, responses were based on participants' perceptions and self-reported approaches to problem solving rather than the direct observation of their problem solving in action. Self-reports via surveys can be problematic if participants do not know how to respond to items due to confusion or do know how to respond but choose to respond differently for reasons such as perceived social desirability or demand characteristics (Fowler, 2009; Mitchell & Jolley, 2010). To address these issues, the researcher sought, reviewed, and addressed participant feedback on the clarity of items. In the survey introduction and information sheet (Appendix C), participants were informed of the research purpose as a general understanding of how special educators address problems to help alleviate potential bias resulting from participants assuming a particular answer was desired or preferred. Also, participants were informed that their survey data would be kept confidentially and reported in aggregate form to encourage honest responses.

In this research, interviews provided select participants with the opportunity to explain their thinking processes and problem solving approaches; these informed survey responses and allowed for a more thorough understanding of special educators' problem solving. However, there are limitations to interview approaches to data collection as well. Similar to survey methods, interviews in this study relied on special educators' self-report about their problem solving in practice rather than on direct observation of problem solving in action. Again, self-report can contribute to response bias due to participants responding in a certain way to please the researcher or due to the perception that a certain response is desired or more desirable than another (Mitchell & Jolley, 2010). In this study, special educators' interview data, considered alone, suggested a stronger inclination towards adaptive expertise than their survey data. Thus, it is possible interview respondents were influenced by having to talk directly with the researcher about their problem solving. To alleviate this limitation, the researcher informed each participant that her candid perspectives were of interest rather than any particular answers and that responses to interview questions would not be linked to their names, schools, or school districts. Mixing of qualitative interview data with quantitative SEPSAS data also serves to strengthen the research in this regard because each data source informed interpretation of the other in line with the integrative efficacy criterion suggested by Tashakkori and Teddlie (2008) for strengthening interpretive rigor.

Interviews with a small selection of participants from of the overall study sample limit the generalizability or transferability of the results because the views of these few special educators may not represent the full study sample, nor the population of licensed special educators in the state. However, the purpose of this research was not to yield generalizable conclusions, but more to inform understanding of special educators' adaptive expertise and SEPSAS measure development. In addition, the sample of special educators who participated in interviews represented a broad range of adaptive expertise profiles as uncovered by quantitative analysis of survey data.

Sampling bias is another limitation of this research. To avoid systematic inclusion or exclusion of participants from the study, the researcher used multiple recruitment approaches to include a broad range of special educators from across the state. However, the researcher could not control who chose to respond or not respond to survey, as well as who agreed or declined to be interviewed. The response rate to the online survey was low, with more than 85% of those who were asked to participate declining the invitation. While those who did opt to participate represented 24 school districts as well as all targeted experience levels and teaching levels, group sizes were unequal. Nonetheless, many more teachers participated in this study than in prior research on teacher adaptive expertise. It is unclear whether there was a systematic reason for why certain special educators chose or did not choose to participate. Though it is not surprising that Adaptive Tendencies subscale score results were negatively skewed, it is possible that those who chose to respond to the survey were also those who were more likely to have perceptions of their problem solving approaches aligned to the indicators of adaptive expertise.

Recruitment for the qualitative phase of research was based upon special educators' score profiles identified through quantitative data analysis. Although the researcher strived to recruit teachers whose SEPSAS scores represented the diversity of responses across the overall participant pool, several participants of interest declined to participate in the follow-up interview. Thus, it is possible that some meaningful information was not captured within the perspectives of those who were interviewed.

A final limitation of the study is researcher bias. Given the study's research aims and the complexity of the adaptive expertise framework, this research is limited by use of a single researcher. Though concern for researcher influence over data is of greater concern within the qualitative tradition, the researcher aimed for objectivity throughout all aspects of this mixed methods study. In an effort to eliminate personal bias and improve interpretive rigor (Tashakkori & Teddlie, 2008), the researcher used reflexivity through writing analytic memos while analyzing both quantitative and qualitative data to self-disclose and reflect upon assumptions, inferences, and values (Bogdan & Biklen, 2007; Brantlinger et al., 2005; Saldaña, 2013). Quantitative, qualitative, and mixed methods results were examined in relation to the researcher's reflections throughout the study. In addition, use of a second coder during qualitative data analysis helped control for researcher bias by supporting the dependability and credibility of the coding scheme. Throughout data analysis and interpretation, the researcher also used peer debriefing with members of the dissertation committee to support interpretive agreement (Tashakkori & Teddlie, 2008).

**Implications**

Results from this study inform practice, including how adaptive expertise can be supported and nurtured in in-service and pre-service special educators, and policy, with emphasis on areas of teacher quality and evidence-based practices.

**Practice-based implications.** Findings from this study have implications for the continuum of special educator development and teaching practice. In-service teachers, supported from within themselves and by colleagues and administrators, and pre-service teachers, guided by teacher education faculty and supervisors, can pursue a balanced trajectory towards adaptive expertise. Purposeful design of professional development and pre-service experiences within a community of learners can facilitate development of the adaptive skills and dispositions reflected in professional special education teaching standards (CCSO, 2013; CEC, 2012a; CEC, 2012b; NBPTS, 2011).

***In-service special educators.*** For practicing special educators, intentional design of in-service supports coupled with supportive administrators and colleagues may help enhance adaptive expertise, regardless of teachers' initial orientation toward problem solving. Through self-evaluation using tools such as the SEPSAS and responding to structured prompts for reflection on practice, a tailored approach to professional development and use of collegial support could alleviate over-reliance on a set repertoire of approaches for addressing instructional challenges for routine orientated teachers. Intentional prompting to consider multiple perspectives and pursue new learning could facilitate more effective problem solving. Likewise, for teachers with initially stronger orientations toward innovation and adaptation, professional development could focus on honing a broad set of skills, implementing evidence-based practices with fidelity, and reflecting on how circumstances might call for a more routine or more adaptive approach.

At a broad level, special educator professional development opportunities built around the framework of challenge- or problem-based instruction can, as recent research with teachers has shown (e.g., Martin et al., 2015), support special educators' development of adaptive expertise alongside growth in skill development. Unlike the multi-week summer program studied by Martin et al. (2015), professional development for special educators can be enhanced through use of the IRIS Center's existing, high-quality online modules based on the STAR Legacy Cycle (IRIS, 2013). These modules for improving practices with students with disabilities can be accessed at the individual or small group level, and challenge users to apply the principles of adaptive expertise while learning new information, considering multiple perspectives, and basing decisions on sound evidence. Additionally, cohesive use of other resources available via the IRIS Center's website (http://iris.peabody.vanderbilt.edu/) such as webinars, case studies, information briefs and the like, could provide the foundation of more structured professional development for promoting the adaptive expertise of wider audiences.

As in prior research (Billingsley, 2004; Boyer & Lee, 2001; Fall & Billingsley, 2011; Gehrke & Murri, 2006; Gersten et al., 2001; Major, 2012, Youngs et al., 2011), participants in this study identified administrators as key sources of support through their responses to SEPSAS open-ended questions and interview probes. Thus, administrators are an important part of the equation for promoting in-service special educators' adaptive expertise. At a minimal level, administrators can make professional development opportunities available and help special educators problem solve particular challenges. Expanding this basic support could include promoting individualized professional growth aligned to adaptive expertise indicators generally, or more specifically to areas of need as identified through teacher self-evaluation using the SEPSAS. By establishing a working climate that values teacher collaboration and shared ideas and places trust in teachers for taking managed risks in applying new approaches (Hatano & Inagaki, 1986), administrators can further support special educators' adaptive expertise.

In a given special education teaching position, teachers may have little control over the types of external supports available to them for addressing the problems or challenges of practice such as supportive administrators and colleagues or professional development opportunities. Thus, self-driven support such as an internal drive toward adaptive expertise may be of particular importance because of its potential availability in any given teaching context. The "resourcefulness of self," as termed by Gehrke and McCoy (2007, p. 494), encapsulates how some special educators exhibit initiative, creativity, and reflection on their teaching, evaluating not only their students' progress but their own development as well. In this study, interview data revealed personal characteristics, such as these, that special educators felt were integral to their problem solving approaches. These adaptive characteristics embody the call by Benedict et al. (2014) for special educators to continually pursue growth and greater expertise by "taking charge of [their] professional learning" (p. 147). This does not necessarily mean that special educators problem solve in isolation; as noted in the present research, a teacher in isolation relied heavily on her existing knowledge, did not seek and share perspectives with others, and had a stronger orientation toward routine expertise. Instead, the inner drive toward adaptive expertise in the absence of formal structures for support would promote special educators to seek out colleagues and others for collaboration, shared ideas, and feedback during problem solving.

To be useful as a self-evaluation tool for special educators, the SEPSAS should include guidance to help promote consistency in interpretation of items across time points. Of primary importance is alleviating variability of teachers' application of problem solving approaches as captured through the *it depends* code across narrative data. Therefore, when completing the SEPSAS initially, special educators should be prompted through the introduction and instructions for completing the measure to think of a specific problem solving instance that represents a common challenge encountered within their teaching practice, and record a brief narrative description of that scenario. Then, they should be instructed to use that instance as a reference point for responding to SEPSAS items. In subsequent self-evaluation using the SEPSAS, teachers should refer back to their initial problem solving context as recorded, and again use that scenario as a reference point for completing items. By responding to the SEPSAS across time in this way, the resulting score profile can more accurately represent how special educators' perceptions of how they apply problem solving approaches change across time.

In addition to clarified instructions, a scoring and interpretation guide would assist special educators' understanding of the results of their SEPSAS self-evaluations. This would need to include instructions for how to obtain AT and RT subscale scores as means of their constituent items, and guidance for how to plot scores in reference to a balanced trajectory toward adaptive expertise. As suggested by the results of this study, special educators need to understand their overall orientation to problem solving as a function of the balance of their subscale scores as well as interpretation of which subscale is more strongly representative of how they approach problem solving. Further, a scoring and interpretation guide could offer item-level elaborations for why a certain approach would be applicable or beneficial and how teachers might strengthen their problem solving approaches in that area. Explicit links between adaptive and routine expertise indicators represented across SESPAS items and professional standards would aid these understandings.

***Pre-service special educators.*** Nurturing these internal orientations toward adaptive expertise can, and should, begin within pre-service preparation programs. Rather than focus solely on pedagogical knowledge and characteristics of disabilities within pre-service preparation, prospective special educators must be made aware of the variability they can expect to encounter and how, in the broadest sense, flexible and adaptive approaches will be required to effectively address that variability. Alongside experiences to build their teaching proficiency, novices should simultaneously be challenged to recognize the complexities of "real world" teaching practice, consider multiple perspectives, justify instructional decisions, and pursue new learning grounded in quality research. Like in-service special educators, teacher education faculty can engage pre-service teachers with IRIS modules to structure experiences grappling with hypothetical challenges. Within a preparation program cohesively aligned to the framework of adaptive expertise, novice special educators may be set on the trajectory towards lasting careers as high quality and highly effective professionals (Darling-Hammond & Bransford, 2005; De Arment et al., 2013).

Previous literature offers many suggestions for creating learning environments that nurture the development of adaptive expertise. Case studies and early and frequent opportunities to engage in fieldwork can set the stage for translating theory and research to real world practice (Leko, Brownell, Sindelar, & Murphy, 2012). Simultaneously, faculty and supervisors can strategically prompt and guide prospective teachers' critical consideration of nuances and variations within those contexts, and push them to justify decisions and approaches applied (Soslau, 2012). Use of reflection prompts, such as those comprising the interview protocol used in this study and that of Wetzel et al. (2015), those focusing on positive teaching experiences (Janssen et al., 2008), or prompts focused on student responses to instructional approaches (Anthony et al., 2015), to name a few, can push novices to think critically and deeply about their evolving practice.

Results from this study also suggest the importance of promoting prospective teachers' fluency with formative assessment and use of data to drive the selection and implementation of evidence-based practices for students with disabilities. Embedded within field experiences and critical reflections, pre-service special educators need opportunities to investigate and apply options for formative assessment and data collection. By systematically investigating how students respond to particular instructional approaches, pre-service special educators can develop their skills data-based decision making and causal reasoning, cognitive indicators of adaptive expertise (De Arment et al., 2013).

Though the role of experience manifested in complex ways in this study, results suggest early experiences play a role in shaping the problem solving approaches, and thus the adaptive expertise, of special educators. Therefore, pre-service preparation through novice years of teaching may be a particularly critical period to nurture internalized adaptive expertise. Using evidence from past research as a guide, teacher education faculty and those responsible for professional development for in-service special educators can conscientiously design learning experiences that promote adaptive expertise.

**Policy-based implications.** Policy topics of relevance to the current study are teacher quality in special education and emphasis on implementation of evidence-based practices. Within the duration of this research, a new iteration of the Elementary and Secondary Education Act (most recently called No Child Left Behind [2002]), was signed into law: the Every Student Succeeds Act (ESSA, 2015). Though regulations are forthcoming, the text of the law places the burden for defining and measuring teacher quality on states and stresses the need for prominence of evidence-based practices and evidence-based decision-making across the US education system. Study findings are considered relative to these two policy-based topics.

***Teacher quality.*** Though ESSA reflects the importance of evaluating teacher quality and effectiveness, this new law rejects the “highly qualified” designation of its predecessor and instead requires states to define how teachers are evaluated and against what criteria. Without a federal mandate for how teachers are evaluated or federal acknowledgement of the unique circumstances of teaching in special education, states may rely on restrictive measures of teacher quality, such as value-added models, that misrepresent the quality of special educators. One special educator specifically mentioned this concern when asked about her challenges of practice on the SEPSAS: "Additionally, with teacher evaluations being tied to student progress, special education teachers are at a disadvantage due to the academic challenges special needs students experience that negatively affect their performance on state assessments." Therefore, research such as this is useful for informing state-level decisions about teacher evaluation and teacher quality specific to special educators as distinct from other types of teachers.

Findings from this study support the call from the Council for Exceptional Children (2012) and others to use a tailored approach and measure special educator quality in multiple ways. Though this research did not link special educators' adaptive expertise to objective measures of student performance resulting from problem solving approaches in action, it did address other suggested measures of teacher quality such as evidence of teachers' dispositions (Hodgman, 2012) and reflective practice (Amobi, 2006). Further, evaluating special educators' adaptive expertise using the SEPSAS is one way to measure dispositional and action indicators of teacher quality as outlined by Benedict et al. (2014), and as reflected in professional standards (CCSO, 2013; CEC, 2012a; CEC, 2012b; NBPTS, 2011). As a self-assessment tool, the SEPSAS (enhanced in the aforementioned ways) can support the development of individualized plans of professional growth, and thus help enhance teacher quality, when used to systematically inform ongoing, independent pursuit of learning and improvement (Benedict et al., 2014). At the same time, the SEPSAS has potential as a screening tool for administrators when hiring new special educators, particularly in hard-to-staff or high-turnover schools. In this use as a measure of the potential quality of applicants, administrators would similarly benefit from a scoring and interpretation guide that instructs the plotting of subscale scores in reference to the scale midpoint and a balanced trajectory towards adaptive expertise broadly speaking. At a more specific level, clear links between professional standards and SEPSAS items may help administrators identify particular skills and/or dispositions that are especially relevant to their school context or that would enhance or harmonize with the overall skill set of an existing special education or collaborative team.

Status as a National Board Certified Teacher (NBCT) has been studied by some as evidence of teacher quality (e.g., Bond et al., 2000; Goldhaber & Anthony, 2004; Park et al., 2007; Scheetz & Martin, 2006; Vandevoort et al., 2004; Wasburn et al., 2012). In this study, the researcher specifically sought National Board Certified special educators as a subgroup of the overall participant sample to investigate whether NBCT status related to a certain profile of adaptive expertise for special educators. As a group, NBCTs' SEPSAS score profiles did not distinctly differ from those of novice or experienced and not Board-certified special educators. However, interviews with three NBCTs, provided insight into these teachers' perceptions of their own efficacy as special educators and professional growth as a result of the certification process. Though teachers' NBCT status was revealed via a demographic question on the SEPSAS, the researcher did not purposefully ask special educators about this credential in relation to their problem solving approaches. Nonetheless, all three NBCTs interviewed brought this credential to their discussion of their problem solving and supports. Therefore, as noted in previous research on teachers' perceptions of National Board Certification (Vandevoort et al., 2004) this advanced certification was perceived to be important and relevant to their problem solving and effective approaches to navigating challenges.

Like teacher licensure in special education (Sindelar et al., 2014), National Board Certification as an Exceptional Needs Specialist is a similarly broad designation. The latter takes teachers' instructional context into account within the certification process; however, because the certification is adaptable and highly individualized in this way, there may not be a distinct pattern of adaptive dispositions and skills for NBCT special educators in comparison to their non-NBCT colleagues. The three NBCTs interviewed presented with differing adaptive expertise profiles as understood through their SEPSAS scores and narrative data. Findings overall suggest that certification status is not necessarily indicative of a more adaptive orientation to problem solving despite National Board Certification being commonly considered as rigorous (and voluntary) professional development (Cohen & Rice, 2005; Goldhaber & Anthony, 2007; NRC, 2008) and despite the highly reflective nature of the certification process. Research with special educator NBCTs is limited, and more needs to be understood about how teacher quality indicators manifest specifically for this population in comparison to their non-NBCT special educator peers.

***Evidence-based practices.*** While prior and existing legislation emphasizes accountability for student outcomes through use of approaches drawn from scientifically based research (IDEA, 2004; NCLB, 2002), ESSA requires the use of evidence-based practices for improving student outcomes (ESSA, 2015). Though evidence-based practices have been part of the accountability narrative prior to the enactment of ESSA, use of "evidence-based" over "scientifically based" within the text of the law institutes more stringent criteria for the nature of instructional practices endorsed and required by federal mandate. Thus, more than ever before, special educators must not only understand what is meant by the term evidence-based practices and how to identify and access such practices, they must also know how to implement them with fidelity while also adapting and responding to the unique needs of their students with disabilities (Cook et al., 2009; De Arment et al., 2013; Kretlow & Blatz, 2011; Mason-Williams et al., 2014).

Two teachers interviewed in this study showed evidence of overcoming the well-documented research-to-practice gap in special education (Boardman et al., 2005; Cook et al., 2009; Kretlow & Blatz, 2011; Kutash et al., 2009) by discussing their use of research to determine new approaches to try when addressing challenges of practice. However, most interviewed did not refer to the role of research for informing how they overcome challenges and ensure students' learning. Some teachers referenced their own professional wisdom based largely on anecdotal evidence as the main source of knowing what works in their special education context. Findings suggest some special educators have a skewed or misinformed understanding of how systematic data collection and analysis are critically important to their work as special educators. This threatens the integrity of a legal mandate for use of evidence-based practices, and more importantly, threatens the learning progress of students with disabilities. Students with disabilities, in particular, stand to benefit greatly from teacher use of systematically identified practices that work (Cook et al., 2009). Without understanding of and experience in using formative assessments and methodical data collection approaches that are linked to instructional decision-making, the research-to-practice gap will persist in special education.

Across state, district, and school levels, special educators would benefit from education and training around evidence-based practices. At an introductory level, this needs to begin with a clear and consistent message of what qualifies a researched approach as evidence-based. At the same time, administrators and other special education leaders should help teachers identify and access evidence-based practices that would be relevant for their students, and then train them in the concept of implementation with fidelity. However, given the nature of teaching in special education, after this foundation in evidence-based practices, training and support must shift to how teachers can adapt them to meet the individualized and variable needs of students without compromising treatment fidelity (Cook et al., 2009; De Arment et al., 2013; Kretlow & Blatz, 2011; Mason-Williams et al., 2014). Capitalizing on special educators' flexibility and reasoning about what works for their students, the adaptive expertise framework can further support teachers' data-based decision making for the selection, use, and thoughtful adaptation of evidence-based practices.

**Recommendations for Future Research**

This research was exploratory in nature and comprised measure development and the first in-depth examination of special educators' problem solving approaches through the lens of adaptive expertise. As a result, many questions remain about use of the SEPSAS as a measure of special educators' adaptive expertise as well as the nature of special educators' adaptive- and routine-oriented problem solving approaches. These questions, combined with consideration of this study's findings and limitations, point to several important directions for future research.

**Measure development.** Though this research established initial validity evidence for the SEPSAS according to recognized standards (AERA et al., 2014), more research is needed to strengthen the measure. Of primary importance, future research should be used to confirm and/or further refine the factor structure identified through this study through confirmatory factor analysis. Though all 28 original SEPSAS items should be investigated, future research should particularly tend to two SEPSAS items that were at the margins of inclusion in the refined 22-item measure of this study, and one item that results suggest should be clarified. First, the factor loading of *take my time to solve the problem* was right at the cut-off for inclusion in the first factor labeled Adaptive Tendencies. Though theoretical literature and qualitative data support its inclusion, future research should continue to investigate the saliency of this aspect of adaptive orientations to problem solving for special educators. Second, future research should take note of the item *want to avoid having to develop new approaches*. In the current study, deletion of this item would have improved the reliability of the Routine Tendencies subscale, though marginally. However, the researcher proceeded conservatively and did not delete this item, largely because doing so would have resulted in a potentially unstable three-item Routine Tendencies subscale. Finally, study results suggest refinement of the item *use data to guide my decision-making* to include clarification or examples of what are meant by the term "data." Doing so would help ensure uniform interpretation across participants. Future research should more closely explore these items through use of a new, but similar sample of diverse special educators.

After the researcher initiated the present study, Bohle Carbonell et al. (2015) offered a new measure of adaptive expertise, similarly investigated and refined through exploratory factor analysis. Though conceptualizations of the adaptive expertise construct differ somewhat, Bohle Carbonell et al.'s (2015) Adaptive Expertise Inventory is worthy of future study in relation to special educators' outcomes on the SEPSAS. Future research incorporating both the SEPSAS and Adaptive Expertise Inventory could enhance SEPSAS validity evidence in relation to other variables (AERA et al., 2014) and enhance interpretation of SEPSAS results.

Until a solid research foundation has been established for the validity of SEPSAS score interpretations, it will be beneficial for future research to combine qualitative data detailing illustrative examples of problem solving in practice with quantitative data resulting from SEPSAS administration. Coding of this qualitative data should engage at least two researchers, as this research and prior research (Wetzel et al., 2015) has noted the complexities of adaptive expertise indicators are best identified through negotiated coding. Use of qualitative data to supplement quantitative data also will help future researchers understand how best to interpret participants' item ratings and resulting subscale scores in comparison to one another. Among other questions, these investigations could address how teachers with SEPSAS subscale score profiles at or near 5/5 and 9/9 differ. As aforementioned, there is much potential for practical application of the SEPSAS; however, depending on how it is used (whether for teacher self-evaluation or as a hiring/screening tool used by administrators), future research in the area of measure development needs to address specific enhancements for strengthening instructions for use and for how scores are obtained and interpreted.

**Special educators' adaptive expertise.** A key step in gaining better understanding of special educators' adaptive expertise will be replication of this study with more special educators. In particular, future research should target a greater sample of teachers with more balanced numbers across subgroups to allow for statistical group comparisons. Future replication research also should focus on understanding how adaptive expertise manifests for certain groups of special educators, such as those who work with low incidence populations and may have more stable teaching context as suggested by this study. Future research also should continue to explore the adaptive and routine orientations of NBCTs in comparison to non-NBCTs.

In an effort to help explain variations across special educators' SEPSAS score profiles and resulting orientations toward problem solving, future research should account for additional variables beyond those collected in the present research as well. The proliferation of alternate routes for special education teacher preparation and the murky research literature on the effects of different routes on teacher quality and retention (Connelly, Rosenberg, & Larson, 2014) suggest the need for future research to account for special educators' pathways into the field. Looking more closely at teachers' preparation for careers in special education, future research should further address whether aspects of student teaching experiences, such as number and duration of practica or the nature of support and feedback provided by supervisors, relate to teachers' problem solving approaches. The current study also suggests some special educators' may have other significant early career experiences that shape their approaches to problem solving. These details about teachers' preparation and novice years have the potential to inform a predictive model for the development of problem solving orientations that could then inform how special educators should be prepared and supported through induction efforts.

Other variables reflecting in-service special educators' contexts and personal characteristics would help explain SEPSAS score profiles further. Given that many teachers in this study felt their approaches to problem solving were context-dependent, future studies should aim to capture more detailed information about specific teaching contexts. This may include details about the availability of resources at schools, presence or absence of formal support structures (such as induction and mentoring programs or teacher professional learning communities), special education service-delivery models, and perceived degree of administrator support. Finally, researchers should collect data that measure special educators' grit (Duckworth & Quinn, 2009; Duckworth, Quinn, & Seligman, 2009) and/or degree of burnout (Brunsting et al., 2014) so that more can be understood about how these variables related to effectiveness and longevity in the field also relate to teachers' adaptive expertise.

The present research relied on teacher self-report through survey and interview responses. While valuable, these perspectives represent part of the full picture of special educators' problem solving practices. Future research should combine SEPSAS data with direct observation of teachers in action. Development of an observation guide that links adaptive expertise indicators with examples of teachers' observable behaviors could help enhance understanding of special educators' problem solving. However, because many indicators of adaptive expertise are not overtly visible, coupling structured observation with teacher think alouds, i.e., prompted explanations and justifications for decisions made and approaches used during the observation, would further connect perceptions of adaptive expertise to enactment of adaptive expertise. Then, these findings could be compared to SEPSAS data to identify additional nuances or points of discrepancy between perceptions and actions.

Other future research should investigate special educators' development along the trajectory towards adaptive expertise across time and in response to contextual variations encountered throughout years of teaching practice. Longitudinal research could address questions such as: What is the difference in special educators' adaptive expertise from the beginning to end of the school year? How does special educators' adaptive expertise change over time? How do changes in adaptive expertise over time relate to contextual factors such as setting (school to school, self-contained to inclusive classrooms), administrator, and student (by disability, by caseload) characteristics?

In addition to and in combination with longitudinal research, future studies of special educator adaptive expertise should investigate the effects of strategically designed professional development efforts on teachers' problem solving, such as those suggested here. Given implications for the importance of early experiences in shaping special educator problem solving approaches, longitudinal and intervention research should extend to study of pre-service special educators and features of their preparation programs as well.

## Conclusion

Through rigorous methodology, this mixed methods research offers a tool to measure adaptive expertise and contributes to understanding about the theoretical and practical significance of adaptive expertise for special educators. This study reaffirmed what previous researchers have identified as the complexities of teaching in special education and suggests special educators must possess some measure of adaptive expertise in order to address the inherent challenges of practice. Though some teachers may naturally orient more adaptively to problem solving than others, prior research suggests adaptive expertise can be promoted in teaching professionals across the continuum of experience. Whether at the individual level, or through more structured professional development targeting groups of special educators, prompting for adaptive expertise must be thoughtfully planned and intentional.

At the forefront of this research were the perspectives and voices of special educators themselves. As key stakeholders in education and critical factors influencing the academic success of students, the views and experiences of teachers are of paramount importance in any research seeking to improve the business of teaching. In special education, special educators are the front lines of improving outcomes for students with disabilities. They are gatekeepers for students' access to evidence-based practices. Yet they must negotiate a highly demanding and highly variable work environment—and in the face of these challenges, many leave special education teaching positions. Special educators must be supported if they are to persist, and this support includes being heard by researchers, policy makers, and teacher education faculty.

Although this study extended previous research to include a full conceptualization of adaptive expertise and focused solely on special educators' adaptive expertise, there is much work left to be done. What is apparent, is that the disposition and skill indicators of adaptive expertise are relevant, and arguably necessary, for special education teaching practice. Thus, through focused support of special educators' adaptive expertise from pre-service to in-service contexts, high standards of teacher quality and professional practice can be realized. These efforts stand to improve retention and recruitment of high quality special educators, thus ameliorating long-standing shortages. Combined, these outcomes have the potential to significantly strengthen the field of special education.

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Appendix A

Research Diagram

| Phase | Procedure | Product |
| --- | --- | --- |
| QUANTITATIVE Data Collection | · Web-based survey with convenience sample ($N$ = 186) | · Numeric survey data |
| Quantitative Data Analysis | · Exploratory factor analysis ($N$ = 162)<br>· Correlation, reliability<br>· Range, means<br>· Chi-square test of independence | · Model<br>· Pearson's r, Cronbach's alpha<br>· Descriptive statistics, z-scores, scatterplot<br>· Pearson chi-square, residuals |
| Case selection; Interview protocol refinement | · Purposive, maximum variability sampling of participants by experience and teaching level<br>· Refining interview protocol based on participant survey responses | · Cases<br>· Refined interview protocol |
| Qualitative Data Collection | · Individual interviews with selected participants | · Interview transcript data |
| Qualitative Data Analysis | · Coding and thematic analysis<br>· Within-case and across-case theme development<br>· Cross-thematic analysis<br>· Atlas.ti qualitative coding software | · Codes and themes<br>· Data display matrix |

| | | |
|---|---|---|
| Integration of Quantitative and Qualitative Results | · Interpretation and explanation of quantitative and qualitative results | · Joint data display combining quantitative and qualitative data<br>· Merged analysis display highlighting nuanced results |

Appendix B

Email Solicitations to Participants

Dear ___________________________,

My name is Serra De Arment and like you, I am a National Board Certified Exceptional Needs Specialist in Virginia. I found your name in the NBCT directory and I am contacting you with the hope that you are willing to give a small amount of time to a research project I am engaged in. Having been a special educator for 10 years, I am now working towards a Ph.D. in Special Education from Virginia Commonwealth University in Richmond. Your perspectives about your special education teaching practice are not only valuable to me but also to the larger academic community and politics surrounding teacher quality. **Our voices as special educators need to be heard**--that is the most important part of my research.

If you would be willing help a fellow special educator and NBCT by participating in an online survey about your problem solving approaches, **please click the link in this email**. The survey should take about 15 minutes to complete and begins by providing you with more information about my research. If I have not heard from you within two weeks, I will send a follow up email inquiring about your willingness to participate.

**I greatly appreciate your time** in considering this opportunity to help advance our profession. **As a thank you for your participation in my research, you will be entered into a random drawing to receive one of four $50 gift cards to Amazon.com.**

Please feel free to contact me directly by replying to this email or by calling XXX-XXX-XXXX with any questions.

Sincerely,

Serra De Arment, M.T., NCBT
ECYA-ENS 2009
Doctoral Candidate
Virginia Commonwealth University
Richmond, Virginia

Dear ___________________________,

You were recommended to me by _________________________________________ as a potential participant in my research on the problem solving practices of special educators.

My name is Serra De Arment and like you, I am a special educator in Virginia. Having been a special educator for 10 years, I am now working towards a Ph.D. in Special Education from Virginia Commonwealth University in Richmond. Your perspectives about your special education teaching practice are not only valuable to me but also to the larger academic community and politics surrounding teacher quality. **Our voices as special educators need to be heard**--that is the most important part of my research.

(*Or if necessary*, "My name is Serra De Arment and like you, I am a special educator in Virginia. I found your name listed as a special educator on your school's website and I am contacting you with the hope that you are willing to give a small amount of time to a research project I am engaged in. Having been a special educator for 10 years, I am now working towards a Ph.D. in Special Education from Virginia Commonwealth University in Richmond. Your perspectives about your special education teaching practice are not only valuable to me but also to the larger academic community and politics surrounding teacher quality. **Our voices as special educators need to be heard**--that is the most important part of my research.")

If you would be willing help a fellow special educator by participating in an online survey about your problem solving approaches, **please click the link in this email**. The survey should take about 15 minutes to complete and begins by providing you with more information about my research. If I have not heard from you within two weeks, I will send a follow up email inquiring about your willingness to participate.

**I greatly appreciate your time** in considering this opportunity to help advance our profession. **As a thank you for your participation in my research, you will be entered into a random drawing to receive one of four $50 gift cards to Amazon.com.**

Please feel free to contact me directly by replying to this email or by calling 804-477-6444 with any questions.

Sincerely,

Serra De Arment, M.T.
Doctoral Candidate
Virginia Commonwealth University
Richmond, Virginia

Appendix C

Study Information Sheet

Special Educator Problem Solving Approaches Survey (SEPSAS)

Introduction:

Special education is a field characterized by variability and the need for individualizing educational experiences for exceptional learners. Special education teachers must deal with the unique complexities and challenges associated with their teaching roles. These may include collaborating with other professionals, instructing children across a wide range of disabilities and content areas, and finding appropriate instructional materials. The purpose of this survey is to understand the problem solving approaches special educators use to address those challenges of practice. Data gathered through the survey will contribute to research being used to inform teacher preparation in special education and teacher quality policy.

This survey should take approximately 15 minutes to complete. You will be asked to complete 4 sections. For the first section, you will provide short written responses. In the second section, you will respond to 28 items by rating the extent to which a statement describes how you approach problems (on a scale of 1 to 9). In the third section, you will provide brief information about your teaching characteristics. In the final section, you will give your level of agreement with 42 additional items (on a scale of 1 to 6).

Completing this survey is voluntary. You may skip items or exit the survey at any time. If you have questions or concerns about the survey, please feel free to contact Serra De Arment at dearmentst@vcu.edu or XXX-XXX-XXXX.

Appendix D

Email Solicitation for Follow Up Interview Participation

Dear ___________________________,

Thank you again for your completing the survey associated with my research on the problem solving practices of special educators in Virginia. As a thank you, your name has been entered into a drawing for a $50 gift card to Amazon.com.

I am writing to ask if you would be willing to participate in a follow up interview, by phone or in person, about your problem solving approaches. I am interested in learning more about how you address day-to-day instructional challenges with the students you teach. The interview would take approximately 30 minutes and can be scheduled at your convenience.

For your participation in the phone interview, you will receive a $15 gift card to Amazon.com.

If you would like to participate, please reply to this email (dearmentst@vcu.edu) or call me directly at XXX-XXX-XXXX so we can schedule a time to chat.

Thank you for your time in considering this opportunity and again for your support of my research!

Sincerely,

Serra De Arment
Doctoral Candidate
Virginia Commonwealth University
Richmond, Virginia

Appendix E

Special Educator Problem Solving Approaches Survey (SEPSAS)

Part I: Open-Ended Response

1. Please provide a few examples of particular challenges you have encountered as part of your special education teaching practice.

2. What is your greatest challenge in your role as a special educator?

3. What support(s) have you found to be most helpful in addressing these challenges?

Part II: Closed Response

Think about your experiences as a special educator when things did not go as you planned and you were challenged about how to respond. On a scale from 1 (This never applies to my problem solving approach) to 9 (This always applies to my problem solving approach), indicate how often each statement applies to your approach to problem solving to address those unexpected challenges.

| | When I encounter a problem, I… | This never applies to my problem solving approach. ← | | | | This sometimes applies to my problem solving approach. | | | | → This always applies to my problem solving approach. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | ask questions. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2. | take risks to solve the problem. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 3. | try approaches that I know how to do efficiently. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 4. | seek feedback from others (e.g., other grade level teachers, content | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | specialists, other special educators, etc.). | | | | | | | | |
| 5. | think about my past success with challenges. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 6. | work on my own to figure out a solution. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 7. | modify approaches I already know. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 8. | engage in self-assessment. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 9. | think about what I have learned in my teacher training that works for this type of problem. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10. | avoid approaches that might involve making mistakes. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 11. | think about what I know and what I don't know. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 12. | consider multiple perspectives (e.g., what parents/ students/ other teachers think about the problem). | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 13. | monitor how a student responds to my approach and make changes accordingly. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 14. | think about how I understand the problem. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 15. | remind myself that I know what I'm doing. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 16. | rely on what I already know. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 17. take my time to solve the problem. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 18. want to avoid having to develop new approaches. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 19. think about what I know about myself as a problem solver. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 20. stick with what has worked before. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 21. use data to guide my decision-making. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 22. consider what I learn from new situations and challenges. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 23. tolerate the challenge, knowing that it will pass. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 24. decide what to do based on approaches with which I am familiar and/or comfortable. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 25. invent new procedures and ways for solving problems. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 26. try to solve a problem quickly and efficiently. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 27. choose between approaches that I know have worked before and new, innovative approaches as appropriate. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 28. quickly address the challenging situation. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

<u>Part III</u>: Additional Information

1. Are you licensed in your state to teach special education? Yes/No

2. Indicate which best describes your teaching level: Early Childhood (preschool)/ Elementary (kindergarten to grade 5)/ Secondary (grade 6-12 or age 21)

3. Indicate which best describes your school setting: rural/suburban/urban

4. Indicate the disability or disabilities of students you teach: autism/ deaf-blindness/ deafness/ emotional disturbance/ hearing impairment/ intellectual disability/ multiple disabilities/ orthopedic impairment/ other health impairment/ specific learning disability/ speech or language impairment/ traumatic brain injury/ visual impairment

5. Indicate your years of special education teaching experience. If you have not yet completed a full school year of teaching, indicate zero. _____________

6. Are you a National Board Certified Exceptional Needs Specialist? Yes/No

Please take a moment to provide feedback so this survey instrument can be further refined for use with other special educators.

Which survey items, if any, were unclear to you?

Please explain what was unclear in particular.

Appendix F

Adaptive Beliefs Survey (adapted from Fisher & Peterson, 2001)

Please respond to each statement using the following rating scale:

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| (strongly disagree) | | | | | (strongly agree) |

1. I think of several potential solutions to a problem in teaching to see which one I like best.
2. I often try to monitor my understanding of the problem in teaching.
3. Most knowledge that exists in the world today will not change.
4. I rarely consider other ideas after I have found the best answer.
5. As I learn, I question my understanding of the new information.
6. Facts that are taught to me in class or through professional development must be true.
7. When I consider a problem in teaching, I like to see how many different ways I can look at it.
8. I feel uncomfortable when I cannot solve difficult problems in teaching.
9. Experts in teaching are born with a natural talent for their field.
10. Usually there is one correct method in which to address a problem in teaching.
11. When I struggle, I wonder if I have the intelligence to succeed in teaching.
12. There is one best way to approach a problem in teaching.
13. Although I hate to admit it, I would rather do well on my performance evaluation than learn a lot about teaching practice.

14. Knowledge that exists today may be replaced with a new understanding tomorrow.

15. I am open to changing my mind when confronted with an alternative viewpoint.

16. I seldom evaluate my performance on a teaching-related task.

17. Existing knowledge in the world seldom changes.

18. I tend to focus on a particular way of solving a problem in teaching.

19. One can increase his/her level of expertise in any area if s/he is willing to try.

20. Poorly completing a project is not a sign of a lack of intelligence.

21. I have difficulty in determining how well I understand a given teaching situation.

22. I find additional ideas burdensome after I have found a way to solve the problem.

23. Scientists are always revising their view of the world around them.

24. I cannot evaluate my own understanding of new information.

25. Challenge stimulates me.

26. I solve all related problems in the same manner.

27. Educational theory slowly develops as ideas are analyzed and debated.

28. I feel uncomfortable when unsure if I am doing a problem the right way.

29. For a new situation, I consider a variety of approaches until one emerges superior.

30. Experts in teaching are born, not made.

31. I rarely monitor my own understanding while learning something new.

32. Knowledge about best practices in teaching is discovered by individuals.

33. Even if frustrated when working on a difficult problem, I can push on.

34. When I know the material, I can recognize areas where my understanding is incomplete.

35. To become an expert in teaching, you must have an innate talent for teaching.

36. Knowledge about best practices in teaching is developed by a community of researchers.

37. I am afraid to try tasks that I do not think I will do well.

38. I monitor my performance on a task.

39. Progress in the field of education is due mainly to the work of sole individuals.

40. Expertise can be developed through hard work.

41. As I work, I ask myself how I am doing and seek out appropriate feedback.

42. When I solve a new problem, I always try to use the same approach.

Appendix G

Problem Solving Approaches Semi-Structured Interview Protocol

1. Describe a specific example from your work teaching young children/students with disabilities of how you applied your approach to problem solving.
    a. What options did you consider? Why?
    b. Did you encounter anything unexpected?
    c. Did you change your plans? Why? In what ways?
    d. What made this effective? How did you know?
    e. Did you get feedback from colleagues or family members?
    f. What role did data play in understanding the effectiveness of your approach?
2. How did you develop your problem solving approach? Where did you learn about it?
3. How does the variability across your students influence your plans and problem solving?
4. What other aspects of your teaching context affect your approach to solving problems?
5. What are your best resources for solving problems in teaching?
6. What has contributed most to your development as a teacher?

Appendix H

Follow Up Email Reminder

Dear ____________________________,

A couple of weeks ago I contacted you about participating in an online survey about your problem solving approaches. Please consider taking about 15 minutes of your time to complete the survey by clicking the link in this email. Your perspectives as a special educator are very valuable to my research and to the field of special education.

Again, **I greatly appreciate your time** in considering this opportunity to help advance our profession. As a reminder, **for your participation in this survey you will be entered into a random drawing for a $50 gift card to Amazon.com**.

Please feel free to contact me directly by replying to this email or by calling XXX-XXX-XXXX with any questions.

Sincerely,

Serra De Arment, M.T., NCBT
ECYA-ENS 2009
Doctoral Candidate
Virginia Commonwealth University
Richmond, Virginia

Appendix I

Phone Script for Interview

Hi, ______________________________. This is Serra De Arment calling about your participation in a short interview as a follow up to the survey you completed about your problem solving approaches as a special educator. Thank you so much for agreeing to participate in this phase of my research as well. It is very important to me to capture the perspectives of special educators who are currently working in the field and managing the many challenging aspects of teaching in special education.

If it is okay with you, I would like to audio record our conversation so that I know I am accurately capturing your perspectives. I will use these audio recordings to make transcriptions of our conversation so that later I can go back and look for key ideas and themes across participants' answers to my questions. Once the transcripts are complete, the audio recording will be permanently destroyed. Do I have your permission to audio record our conversation?

Thank you. At any time during the interview please feel free to ask questions. You may also choose not to answer any of my questions or stop the interview at any time. I am not looking for any particular answers; understanding your perspectives as a special educator is what is most important to me. Please feel comfortable in providing your honest and candid perspectives throughout the interview. Your responses will not be tied to you or your school or district in the way I discuss and report the results of my research. I will give each participant a pseudonym so that any direct quotes I report will stay anonymous. Is this okay to you?

Thank you. Do you have any questions before we begin?

I will now start the recording.

[Interview will follow the semi-structured interview protocol.]

I will now stop the recording. Once I have completed the transcription of our conversation, I will share it with you so you can review it to make sure what I have written accurately reflects your perspectives. You will be able to withdraw or make changes to any of your responses.

Thank you so much for your time and help with my research. And thank you for being a special educator!

Appendix J

Alignment of Research Questions, Data Sources, and Analyses

| Research Questions | Data Sources | Analyses |
| --- | --- | --- |
| 1. Does the Special Educators Problem Solving Approaches Survey (SEPSAS) measure special educators' adaptive expertise? | SEPSAS, Adaptive Beliefs Survey-Adapted (ABS-A) | Correlation, exploratory factor analysis |
| a. Does the SEPSAS differentiate special educators' adaptive or routine problem solving (Bransford, Derry, Berliner, & Hammerness, 2005)? | SEPSAS | Correlation, exploratory factor analysis |
| | Interview data | Merged analysis display highlighting problem solving nuances |
| b. Does the SEPSAS differentiate special educators' adaptive dispositions, cognitive skills, and metacognitive skills (De Arment, Reed, & Wetzel, 2013)? | SEPSAS | Correlation, exploratory factor analysis |
| c. What is the relationship between participants' responses to the SEPSAS and the Adaptive Beliefs Survey (adapted from Fisher & Peterson, 2001)? | SEPSAS, ABS-A | Correlation |
| 2. To what extent are special educators' perceptions of their problem solving approaches as measured by the SEPSAS characteristic of adaptive | SEPSAS | Descriptive statistics |

| | | |
|---|---|---|
| and/or routine expertise? | | |
| 3. What relationships exist between special educators' teaching experience and their perceived problem solving practices? | SEPSAS | Descriptive statistics; correlation; chi-square |
| | Interview data | Hypothesis coding; themeing; data display matrices |
| 4. How do special educators describe their problem solving and supports in their teaching practice? | SEPSAS priming questions<br><br>Interview data | Hypothesis coding, open coding; themeing; data display matrices |
| 5. How do examples from special educators' real world teaching practice relate to their perceptions of their problem solving approaches as measured by the SEPSAS? | SEPSAS, interview data | Joint data displays; merged analysis display highlighting problem solving nuances |

Appendix K

Codebook

Hypothesis Coding Based on Adaptive Expertise Conceptual Framework

This hypothesis coding scheme is based directly on the adaptive expertise literature. Two articles, in particular, inform the assignment of codes to data. First, De Arment et al. (2013) provides substantive background information and a comprehensive operationalized definition of adaptive expertise across dispositional, metacognitive, and cognitive skills. Second, research by Wetzel et al. (2015) documents application of the adaptive expertise framework to coding of interview data. Participants in this research responded to an interview protocol based on that used by Wetzel et al. (2015). Taken together, these two articles provide other researchers with adequate context to inform application of the adaptive expertise-based codes outlined in the codebook.

*When using this codebook, other researchers should be mindful of applying codes based on what the teacher says directly within the overall context of the interview, rather than what might be implied. Codes may be applied to short phrases, single sentences, or multiple sentences; the unit for data is not fixed. Also, codes may co-occur. To distinguish between units of data that may be descriptive rather than evidence of adaptive expertise indicators, other researchers are encouraged to reread data multiple times against the code definitions, clarifications, and examples provided.*

| Code | Relevant Definitions from Adaptive Expertise Literature | Researcher Clarification | Example |
|---|---|---|---|
| Adaptive Dispositions: *As defined through the conceptual framework of adaptive expertise, dispositions include the habits of mind, learning orientations, and epistemologies of special educators in relation to how they approach problem solving in teaching* | | | |
| Epistemic Distance | • Maintaining an epistemic distance between prior knowledge and the model of a case or problem at hand<br>• Willing to abandon previously held understandings and to replace prior | • Acknowledgement of "anything can happen" idea; things not going according to plan<br>• *Lesson plans developed but then abandoned*<br>• *Worldview relative to teaching special* | "I told her that he changed the way that I teach, that I gave up a lot of my things that I really was holding on tightly to and I've started looking at teaching a lot differently since then." |

| | | | |
|---|---|---|---|
| | assumptions | *education* | |
| Complexity | Having an epistemic stance that views the world as complex, messy, irregular, dynamic, etc. | • Description of aspects of teachers' roles as special educators or the field of special education as always changing and/or as having many contextual factors that exert influence<br>• *Worldview of special education as complex* | "Every class is different and every situation is different, and some years you just have to redefine your classroom." |
| Working at Limits | • Expressing comfort or willingness to reveal and work at the limits of one's knowledge and skill<br>• Willing to ask questions<br>• Seeking out feedback from others<br>• Willing to take managed risks that may result in mistakes | Wanting to try out a new strategy to see if it works; trial and error | "*[I like to try out things that are new that I haven't seen before and]* see if they work for me." "So I mean, it takes from me, when I can't think of something because I'm in the middle of the situation, for me it's better to reach out to all of my colleagues and to say, hey, I need help with brainstorming some ideas and I need to know what have you used that I haven't used already." |
| Learning | • Never satisfied with current levels of understanding<br>• Opportunistic<br>• Curious<br>• Motivated to problem solve<br>• Prepared to learn from new situations | • Expressing the desire to learn more, learn something new (not the examples of what is learned themselves; inclination to expand learning and understanding is of focus)<br>• Expressing a desire to figure out a solution to a problem or effectively address a challenge<br>• Taking advantage of opportunities and circumstances to | "I feel personally that, you know, everything is a learning opportunity." "And then just the programs that I've selected to be a part of, both undergraduate and graduate programs, then the constant, I mean, I constantly love going to conferences and figuring out what can I do better, as a teacher, how can I problem solve better, so always doing that type of a thing." |

| | | | |
|---|---|---|---|
| | | enhance problem solving. | |
| Metacognitive Skills: *Teachers' inner thoughts about their teaching practices made "visible"; their thinking and reflections on their thinking about their own learning and problem solving.* | | | |
| Reflection on Learning | • Questioning current levels of expertise<br>• Self-assessment<br>• Systematic understanding of the self as a learner<br>• Assessing the adequacy of current knowledge for solving the case/problem at hand | • Acknowledgement of not knowing how to address a problem or challenge and needing more information or expertise<br>• Discussion of own characteristics/traits as a learner | "I'm the person that's hands on. Tell me, show me, make me do it. Then I'm okay. But if you give me job stuff, here it is and this is how you do it, I'm not going to remember it, if you just make me take a few notes, it doesn't mean that you've touched every situation. Work with me, teach me." |
| Reflection on Problem Solving | • Seeking and analyzing feedback about problem solving processes and outcomes<br>• Systematic understanding of the self as a problem solver<br>• Monitoring performance and results of problem solving processes<br>• Modifying existing procedural skills | • Reflection on the problem solving processes, implementing the approach itself and its results<br>• How feedback from others is incorporated<br>• How an approach is modified or affected | "Then I know I need to change my approach, because it's not the break that impacted the student which is what I thought it was to begin with, it's a big change at home that's very upsetting to the student and so my correcting that behavior as if it was just the break wasn't going to be successful. I needed to adjust how I was dealing with his problems. So that was a really good realization." |
| Cognitive Skills: *The thinking processes that relate to actions employed by special educators when problem solving* | | | |
| Thinking Flexibly | • Cognitive flexibility<br>• Responding to variability in the classroom<br>• Accounting for multiple perspectives<br>• Inventing new procedures<br>• Balancing efficiency | • "Toolbox" and "bag of tricks" metaphors<br>• Discussion of how teachers address student variability (i.e., application of strategies) within the complexities of teaching in special | "Or they'll come to my class and observe for a little while and talk to me about the situation that they see from their viewpoint..."<br>"So I have the challenge, of course, of meeting everybody's needs in the |

| | | | |
|---|---|---|---|
| | and innovation | education; not just description of multiple levels, content areas, disabilities, etc. which is captured under the Complexity code | class. And I have one assistant and a second assistant who's particularly there for one child, one kindergartener. So my challenge is to make sure everyone gets seen, everyone gets teacher time, you know, we try to have some independent activities and I set up my room particularly this year in the stations, you know, hands on stations…" |
| Causal Reasoning | Causal reasoning; developing an underlying model or set of contributing factors | • Discussion of X happens because of Y *relative to students' learning, behavior, responses to instruction/strategies, etc.*<br>• *"If….then…." statements relative to students* | "We've really stepped back from some of the more structured art activities and sensory activities and let them explore every day and it's been really interesting to see what they come up with and how that increases their language and they really want to participate." |
| Using Data | • Data-driven forward reasoning (hypothesis-based reasoning)<br>• Selection of routine or adaptive approach based on data and hypotheses | • Discussion of how data are collected (formally or informally) and what is learned as a result or how a teacher responds as a result<br>• Informed decision-making and choosing among strategies | "And then I try a couple of different things and see if they work and test them for a bit, and if they don't work, I stop trying them and I move on to something else." |
| Codes Across Metacognitive and Cognitive Skills | | | |
| Justifying Decisions | Explaining decisions and justifying outcomes of metacognitive and cognitive processes | • Explanation of reasoning behind application of a problem solving approach or strategy<br>• *Addressing the "why" behind teacher decision about or* | "Because these kids are not readers anyway, and so you have limited time to try to get them to read, so you may as well read worthwhile material, so I personally, like I buy Scholastic because, first |

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| | | *choice of a strategy or approach*<br>• I use X because…<br>• I use X so that… | grade Scholastic because it's relevant, that's a lot of information in short sentences, then the kids will engage in the Scholastic magazine." |

Open Coding

*Codes included here are the result of the researcher's determination of open codes while reading and re-reading the interview data associated with this study. Other researchers are encouraged to apply their own open coding to data, though this codebook may be useful as a reference.*

*Codes may be applied to short phrases, single sentences, or multiple sentences; the unit for data is not fixed. Also, codes may co-occur with one another or with hypothesis codes applied from the adaptive expertise framework. Unlike the hypothesis coding scheme, the codes may be applied to data that are descriptive and lack evidence of teacher reflection, reasoning, or justification.*

| Code | Definition | Example |
|---|---|---|
| It Depends | • Use of the word "depends" directly or expressing the idea that application of a strategy (or other) is dependent on something else (student characteristics, parent, context, content, etc.) and therefore a "one size fits" all is not applicable<br>• *More contextualized to teacher's situation than complexity code in adaptive expertise framework*<br>• *May or may not cooccur with complexity code* | "You know, what can I do to make this lesson go the way that I want it to go? So it varies from situation to situation definitely." |
| Personal Characteristics | Discussion of personality traits or characteristics (i.e., "I'm this kind of person") that, in teacher's perspective, influences performance of special education teacher role or problem solving approach | "I'm good at making stuff as I go along, but if you're not, this really wouldn't be the job for you." |
| Early Experience | Reference to early career (or other) experiences that influenced ways of thinking, teaching, problem solving, etc. | "I had a great mentor/teacher in Seattle Public Schools, we taught students with autism. He gave me some great tips to get me started and since then I have paid close attention to what other teachers are doing." |
| Experience | • Citing experience as a resource or vehicle | "You can have as much |

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| | for becoming a better or more skilled teacher<br>• Reference to experience leading to increased skill set across accumulated years of teaching<br>• *Subtle reference to passage of time using phrases like "over time," "across the years" etc.* | training and as much education but you really have to experience and learn for yourself what's going to work for you and what your best skills are." |
| Passion | Expression of emotions relative to commitment to teaching in special education or working with students with special needs | "I think the biggest thing here is to love what you do. If you like what you're doing and you want to get better at it and you're all motivated, of course, you'll try to find ways to make it easier for yourself, to make it easier for the students, and everyone is going to be happier at the end of the day." |
| Administration | • Citing administration's role in providing support (or not), influencing problem solving, or other comment relative to role of administration relative to teacher (outside of descriptive examples)<br>• *Reference to administration may not be explicit (i.e., using "they" to imply administrators); use the overall context to help inform applying this code*<br>• *Also applies to other educational authority figures (i.e., Department of Education representatives, Central Office or District personnel, etc.)* | "And then the administration definitely, we have a wonderful admin team which is great and they provide us with so much, so many resources and they're always willing to come in and observe and provide feedback which is great. Especially as a new teacher, I love that the administration is so hands on with our classes whenever we need them to be." |
| Negative | Expression of negative feelings relative to performance of special education teaching role or implementation of problem solving approach to include perceived inhibitors to problem solving success | "You see a lot of, you get to see progress, but how could I capture that in a test or in a rubric, I don't know if I had to, if I had to get paid by my proof of growth, it would be tough. It would be very tough, I hope I retire before that happens." |

Vita

Serra Turgay De Arment was born on July 26, 1978 in Ankara, Turkey and is an American citizen. She moved to Richmond, Virginia at two years of age, where she graduated from The Governor's School for Government and International Studies at Thomas Jefferson High School in 1996. She attended the University of Virginia, and earned her Bachelor of Arts degree in Psychology and Master of Teaching degree in Special Education in 2001. Subsequently, she taught children with a variety of special education needs for ten years across Virginia. First, from 2001-2003, she taught kindergarten through third graders at Kent Gardens Elementary School in Fairfax County. Then, from 2003-2007, she taught early childhood special education at Trevilians Elementary School in Louisa County. Most recently, from 2007-2011, she taught kindergarten through fifth graders at Winterpock Elementary School in Chesterfield County. In 2009, she earned National Board Certification as an Exceptional Needs Specialist, Early Childhood through Young Adult. Since 2012, she has co-facilitated the National Board Candidate Support Program offered through the Metropolitan Educational Training Alliance, a partnership between Chesterfield County, Henrico County, Hanover County, the City of Richmond, and Virginia Commonwealth University (VCU). Beginning in 2014, she became instructional faculty at VCU in the Early Childhood Special Education program within the Department of Counseling and Special Education. In this role, she serves as Project Coordinator for a personnel preparation grant from the US Department of Education Office of Special Education Programs.