

Increasing Use of Research-Based Practices: Action Research Report on a College-School Partnership to Support Instruction Aligned to Middle School Common Core Math Standards for Students with Significant Disabilities

Katherine Trela, Ph.D.
Wendy Gladstone-Brown, Ed.D.
Marist College

Norah Merritt, Ph.D.
Dutchess County Board of Cooperative Education Services

Leah Raftis, Ed.D.
Wappingers Central School District

Abstract

Teachers of students with significant cognitive disabilities have expressed the need for additional training and resources to realign instruction to general education standards. At the same time, pre-service teachers preparing to enter the field of special education need to be placed in classrooms where teachers have updated knowledge and skills to deliver grade-aligned instruction to students in this population. In this project, the needs of both groups were addressed through a partnership between an Institute of Higher Education (IHE) and local board of cooperative education services. Specifically, in-service teachers received training in research-based practices to implement grade-aligned math instruction to middle school students with significant cognitive disabilities. Pre-service teachers who received the same training in their college coursework created adapted materials to implement the instruction. Results of the project's effect on in-service teachers, their students, and pre-service teachers are reported. Implications for future directions in professional development are discussed.

Introduction

Prior to the Individuals with Disabilities Education Act (IDEA) reauthorization in 2004 that stated, "all students must have access to and progress in the general education curriculum," pre-service training and in-service professional development for teachers of students with significant cognitive disabilities emphasized use of a "functional curriculum," which targeted a set of isolated skills necessary in daily living. This functional curriculum was often separate and different from the general education curriculum (Trela & Jimenez, 2013). In 2001, the No Child Left Behind Act (NCLB) mandated that all students, including students with significant cognitive disabilities, be assessed annually to measure progress toward grade appropriate academic standards, stipulating that students in this population may participate in alternate assessment to grade-aligned alternate achievement standards. Given both mandates, teachers of students in this population and pre-service teachers preparing for certification in special education faced a dramatic change in pedagogical skills needed to support daily classroom practice. Although both mandates have now been in effect for over a decade, recent surveys reported that in-service teachers of students in this population still question a focus on aligning

instruction to general education curriculum, express hesitation to teach to academic standards without additional training, and continue to state a need for additional resources to implement grade-aligned instruction (Ergul, Baydik, & Demir, 2013; Lee, Browder, Flowers, & Wakeman, 2016; Timberlake, 2014). For school districts that support in-service teachers of students in this population and IHEs that prepare candidates for special education certification, a model of professional development is needed that both updates in-service teachers' knowledge and skills and provides pre-service teacher candidates with relevant pedagogical skills based on the growing body of research in teaching to general education curriculum standards. One way to approach the need for training at both the pre-service level and "renewal" at the in-service level is through partnerships between IHEs and schools with whom they collaborate to create opportunities for professional development and intentional linkages between coursework and experiences in the field-based classroom (Allsopp, DeMarie, Alvarez-McHatton, & Doone, 2006; Prater & Sileo, 2002, p. 325).

Teacher education programs face an ongoing need to establish reciprocal relationships with school districts to provide opportunities for pre-service teachers to connect research and theory from their college coursework to best practices that support students in "real classrooms." The importance of bringing pre-service and in-service teachers together is highlighted by findings from recent research indicating that (1) in-service teachers of students with significant cognitive disabilities found IDEA's expectations to be unrealistic to their students' lives, especially if the teachers began their careers prior to the emphasis placed on access to general curriculum (Goldstein & Behuniak, 2012), and (2) current clinical practice models place teacher candidates in settings where in-service teachers may still question a focus on aligning instruction to general education curriculum or express hesitation to teach to academic standards without additional training (Timberlake, 2014; Ergul, Baydik, & Demir, 2013). It would be logical to assume that, if pre-service teachers are placed with teachers who express hesitation or question a focus on teaching to general education curriculum, then they may take on existing practices that differ from what they learned in their methods courses when placed in local schools (Wilson, Floden, Ferrini-Mundy, 2001). To respond to the need for both renewal and development of knowledge, skills, and dispositions to teach to general curriculum standards to students with significant cognitive disabilities, in-service professional development and pre-service courses can be aligned to provide the same training in translating research to practice. For pre-service teachers, opportunities to "operationalize" that knowledge into lesson materials and hands-on work in the classroom provides logistical support to in-service teachers who can then readily share their expertise in delivering those lessons while supporting individual needs of students. In this action research project, in-service teachers and pre-service teachers received the same pedagogical training to teach to general education standards for middle school students with significant cognitive disabilities. Specifically, training focused on aligning instruction to common core middle school math standards.

Review of Literature

The literature consulted in this project's design included studies that made recommendations for best practices in professional development, IHE-school partnerships, teaching to common core math standards for students with significant cognitive disabilities, including learning characteristics of students with significant cognitive disabilities. A review of the literature

consulted with its implications for the design and implementation of the present action research project will be presented next.

Professional Development for In-Service Teachers of Students with Significant Cognitive Disabilities

Findings from research on professional development for in-service teachers in general have shown that training is most effective when it follows four principles: (1) be ongoing, intensive, and aligned to practice, (2) focus on learning and address specific content, (3) align with school improvements and priorities, and (4) promote teacher collaboration (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009). Additionally, Leko and Brownell (2009) suggested that professional development models for special educators consider addressing the isolation that some teachers experience as they work in settings separated from same age and grade level colleagues. Further, in-service teachers of students with significant cognitive disabilities have reported that they have not received the necessary guidance and support to align instruction to general curriculum alternate achievement standards (Roach et al, 2007; Timberlake, 2014). Although some states have posted alternate achievement standards to provide a framework to which teachers can align lessons, little research has been conducted to evaluate if or how teachers use that guidance to inform daily instruction and ensuring that students have an opportunity to learn the skills against which they are measured. In fact, in a recent investigation of teachers' perceptions regarding accessibility of their state's alternate achievement standards, (i.e., are their students able to learn the skill and concepts addressed in the state's alternate achievement standards?) teachers reported that the skills assessed were "out of reach" (Goldstein & Behuniak, 2012). This finding is aligned with earlier research on teacher perceptions of the "appropriateness" of holding students accountable to learning standards aligned to age and grade level general curriculum standards (Kleinert, Kennedy, & Kearns, 1999; Wehmeyer et al, 2003). In this same (Goldstein & Behuniak) study, the researchers pose the question, "Do these students have sufficient opportunity to learn academic content?" and further suggest that future research address the needs of teachers of students with significant cognitive disabilities to enhance skills to teach to academic content standards. Clearly, teachers of students with significant cognitive disabilities need a collaborative model of ongoing, targeted professional development grounded in current research in order to guide the instructional focus on teaching to general education curriculum standards.

In a response to the need for providing this guidance, two studies were conducted to evaluate the effect of an instructional package that included task analytic instruction, adapted story-based problems, and graphic organizers to teach students how to solve math problems aligned to general curriculum middle school math standards (Browder, Trela, Courtade, Jimenez, Knight, & Flowers, 2010; Browder, Jimenez, & Trela, 2012). In these studies, teachers received training before implementing each unit in their classrooms, and were evaluated by the researchers for adherence to following steps of the task analytic lessons, including use of adapted materials to implement the lessons. Training was delivered by researchers from the partnering university at full day workshops where teachers attended with a general education math teacher from their school. The trainers also provided background knowledge and encouraged dialogue with the general education math partners to clarify how to teach to the specific competency standard (i.e., algebra, data analysis, geometry, measurement). Further, teachers in these studies completed social validity surveys and indicated that the training was fair, the training was feasible to implement in their classrooms, and their students benefited from the lessons they implemented.

Most important, students showed an increase in number of steps completed independently and accurately to solve math problem aligned to grade level standards. These findings suggest that professional development on aligning instruction to general education math standards for in-service teachers of students with significant cognitive disabilities needs to support both teachers' understanding of the standards being addressed and current knowledge of evidence-based practices in designing and implementing instruction that has been shown to support student learning. Specifically, professional development in the use of task analytic lessons and how to develop a task analysis that addresses the essence of the standard, writing adapted story-based problems, and constructing a graphic organizer that supports student understanding and problem solving may provide much needed guidance to in-service teachers of students with significant cognitive disabilities as they refocus instruction and assessment aligned to grade-level general education standards.

IHE-School Partnerships

One approach to provide guidance for in-service teachers is through IHE-school partnerships. In this model, instructors from the IHE work with schools to provide professional development to in-service teachers on updated knowledge and skills based on current research-based practices to implement in their classrooms. In return, pre-service teachers receive the same training in their college coursework and then are placed in classrooms with in-service teachers to support implementation of the research-based practices. For the IHE, the partnership supports opportunities for fieldwork experiences in classrooms with teachers who are renewing their skills at the same time that pre-service teachers are developing the same body of knowledge and skills. This reciprocal relationship between the IHE and school supports educator preparation programs' effort to provide high quality fieldwork and student teaching experiences (i.e., clinical experiences). For IHEs that respond to the Council of Accreditation of Educator Preparation (CAEP) standards, providing high quality clinical experiences is essential to supporting successful development of effective teachers. According to CAEP Standard 2 (Clinical Partnerships and Practice), partnerships between IHEs and P-12 schools "are central to preparation so that candidates develop the knowledge, skills, and professional dispositions necessary to demonstrate positive impact on all P-12 students' learning and development" (CAEP, 2015). Another goal in the formation of clinical partnerships is to "ensure that theory and practice are linked and to maintain coherence across clinical and academic components of preparation" (CAEP, 2015). In other words, it is essential that IHEs work closely with P-12 school partners to intentionally craft opportunities for teacher candidates (i.e., pre-service teachers) to make "linkages" between theory and research from college coursework to practice in real world classrooms (Allsopp, DeMarie, Alvarez-McHatton, & Doone, 2006, p. 20). In their 2006 study to create opportunities for "linkages" between courses and fieldwork experiences, Allsopp et al provided teacher candidates with instruction to support their fieldwork students' behavior in a classroom within the cooperating school. At the same time, cooperating teachers at the school also attended the class to receive the same information and then collaboratively work with teacher candidates to apply the practice in the classroom. Researchers then examined teacher candidates' responses to questions about their fieldwork experience, with one question at mid-semester specifically targeting the connection between coursework and fieldwork (e.g., "Describe the extent to which you are seeing/experiencing meaningful connections between your practicum and the topics covered in your coursework?"). Candidates' responses showed that, from mid-semester to the end of the semester, this model supported their ability to make linkages between coursework and fieldwork. Although this model was situated in

a Professional Development School (PDS) model where pre-service and in-service teachers could physically attend classes and receive the same information together, an important feature is the shared knowledge both groups gained and then applied in their classrooms. The purview of this study did not include responses from cooperating teachers or effects of the practices on students in the classroom. However, the practice of creating opportunities for in-service and pre-service teachers to receive the same training and background knowledge to support application of research-based practices in the classroom is an important finding from this study that may be applied to other models of IHE-school partnerships. Specifically, this feature of an IHE-school partnership has promise to support candidates' ability to more directly link college coursework to fieldwork experiences.

Teaching to General Education Math Standards for Middle School Students with Significant Cognitive Disabilities

Supporting access to and progress toward middle school math standards, including alternate achievement standards, poses a unique challenge for teachers of students with significant cognitive disabilities. One challenge is the variability in math skills that students in this population may bring to middle school. For example, a recent survey in which teachers were asked to characterize their students' math skills reported variations from "no awareness or use of numbers (13%)," to "complete computational problems with or without a calculator (57%)" (Towles-Reeves, Kearns, Kleinert, & Kleinert, 2009 p. 246). An additional challenge for teachers of students at the middle school level is aligning instruction with math standards that place an emphasis on students being able to "engage in metacognitive processes" and "operate at a higher level of abstraction than is typical of the mathematics they have encountered previously" (Kalchman & Koedinger, 2005, p. 353).

Task analytic instruction. One way to promote learning across math content areas is to use task analytic instruction, an evidence-based practice that has supported students' with significant cognitive disabilities' learning in the areas of daily living as well as academic skills (Browder, Wood, Thompson, & Ribuffo, 2014). In their 2012 study, Browder, Jimenez and Trela used task analytic instruction to teach math skills aligned to extensions of one state's secondary general education math standards. In this study, task analytic lessons were delivered using adapted story-based math problems and a graphic organizer. Findings from this single subject study suggested a functional relationship between use of the instructional package (task analytic lesson plans, adapted story-based problems and graphic organizer) and students' increased independent, correct responses to steps of problem-solving task analyses in each of four units aligned to secondary general education curriculum standards. Lessons were designed to promote independent problem solving skills by following a task analysis that introduced students to a problem in a story context, then guided them to find facts in the story to place on a graphic organizer, and finally use a graphic organizer to apply quantitative or spatial reasoning to solve the problem.

Teaching to Middle School Math Standards: Steps to Metacognitive Thought. In the Browder et al study, the problem solving task analyses for two units (Algebra and Geometry) included a specific step that promoted development of metacognitive thinking essential to making progress toward the middle school math standards to which they were aligned. For example, the alternate achievement standard for Grade 8 Algebra stated, "solve simple algebraic equations with one variable using addition and subtraction" (National Governor's Association

Center for Best Practices, 2010). Teaching to this standard, instruction needed to provide opportunities for students to recognize that facts can be represented by both numbers for known quantities and letter symbols for unknown quantities, and to determine the relationship between those facts in order to select an operation to arrive at a solution (quantitative reasoning). In the Browder et al. Algebra task analysis, one step consistently guided students to an awareness that a letter can stand for something unknown, a basic step toward abstract thought (Witzell, Mercer, & Miller, 2003). Once students completed this step, they used a graphic organizer to compose an equation that represented the relationship between the known and unknown quantities in the story-based problem and solve for the unknown quantity.

Similarly, an alternate achievement standard in Grade 7 Geometry stated, “recognize geometric shapes with given conditions” (National Governor’s Association Center for Best Practices, 2010). In the Browder study, one step of the geometry task analysis guided students to construct a geometric shape that did not have any intersecting lines on a map (i.e., the best route to travel from one point to another without backtracking) and then name the shape a plane, using its identified points and line segments in its name. As in the Algebra task analysis, a specific step promoted the application of spatial structuring (i.e., composing a figure with the given condition of no intersecting lines), an example of early abstract thought developed in geometry (Sarama, Clements, Swaminathan, McMillen, & Gonzalez Gomez, 2003).

Results from the Browder and colleagues research clearly showed that use of the instructional package (i.e., task analytic instruction, graphic organizer, and adapted story-based problems) had a positive effect on students’ with significant cognitive disabilities’ learning to middle school math standards. In addition, results suggested a functional relationship between teachers’ receiving training and implementation of the instructional package and number of independent, correct student responses to steps of the task analyses. Although students showed progress in the studies’ four units, only two of those units targeted development of a metacognitive skill (i.e., Algebra and Geometry). Therefore, an important consideration in designing future instruction aligned to middle school math standards is to provide students with opportunities to respond to steps of a task analysis that specifically promote the application of metacognitive skills essential to making progress toward those standards.

Summary of Research

The mandate to realign instruction to grade-appropriate general education standards for students with significant cognitive disabilities has posed a challenge to schools that provide instructional services to this population of students. As shown in the research, in-service teachers have expressed the need for additional support to respond to this mandate, and may continue to question the relevance of teaching to higher standards when their students may demonstrate early numeracy skills. A growing body of research on teaching academics and specifically, teaching to middle school math standards to students with significant cognitive disabilities may provide guidance to schools that support teachers of students in this population.

As in-service teachers work to renew their knowledge and skills to implement instruction to these higher standards, there is also a need to provide the same training to pre-service teachers so that they enter the field ready to respond to the challenge of teaching to general curriculum

standards. Institutes of Higher Education that prepare pre-service teachers to enter the field also need to provide high quality fieldwork experiences in which their candidates can readily link the knowledge and skills learned in college courses to classroom practice. However, unless in-service teachers have received updated training, pre-service teachers may not benefit from fieldwork experiences where there is a disconnect between current research and classroom practice. For these reasons, there is a need to design IHE-school partnerships that meet educational training needs at both levels (i.e., college accreditation standards for clinical practice, pre-service teachers' need to make linkages between college coursework and fieldwork, in-service teachers' need to renew knowledge and skills aligned with mandates, and school's responsibility to provide targeted professional development to their teachers). Research on connecting college courses with fieldwork, principles of effective professional development, and teaching to math standards for middle school students with significant cognitive disabilities may guide the design of a model that supports meaningful clinical practice for pre-service teachers and renewed skills to sustain research-based practices in the classroom for in-service teachers.

Conclusion

The literature reviewed on professional development supported this project's use of an IHE-school partnership to develop and sustain in-service teachers' use of research-based practices to teach grade-aligned math to middle school students with significant cognitive disabilities. In addition, literature on connecting college coursework to practice for pre-service teachers supported research on levels of linkage that pre-service teachers experience when placed in classes with in-service teachers who received the same training in their professional development.

Action Plan

Context

This project was conducted over a 10 month academic year through a partnership between a private college that prepares teacher candidates for state certification in general and special education at the elementary level and the neighboring county's Board of Cooperative Educational Services (BOCES). In this county, school districts may contract with BOCES to provide services to students with significant cognitive disabilities either in their district schools or at a public separate school. Internal Review Board (IRB) approval was obtained from the IHE's IRB committee to conduct research in collaboration with its BOCES partner. Teachers chosen to participate in the study (i.e., those who provided services to students with significant cognitive disabilities at the middle school level) and their students provided signed consent to participate to the IHE instructors before any research activities were conducted. Of the three in-service teachers who participated in professional development, two supported students in self-contained classes at the public separate location and one supported students in a self-contained class within the cooperating school district's middle school.

As shown in Table 1, students ranged in age from 12-13 years and had IQs ranging from 41-57, and qualified for services under IDEA under the disability categories of Autism or Multiple Disabilities. All demographic information was obtained from students' most recent psychological evaluations. All math assessments were conducted by the IHE instructors in the special education classrooms. Teachers implemented the lessons with students grouped by grade level, including students who were not targeted in the study. All names used are pseudonyms.

Table 1
Student Demographic Information

Student Name	Age	Gender	IQ	Test Administered	IDEA Classification	Communication Skill
Bryan	13	Male	>44	WISC	Multiple Disabilities	Verbal
Kyle	12	Male	44	WISC	Autism	Non-verbal, uses assistive technology
Selena	13	Female	57	WISC	Autism	Non-Verbal, uses assistive technology
Lorenz	12	Male	>44	WISC	Autism	Verbal
Miguel	13	Male	56	WISC	Autism	Verbal
Hoang	13	Male	Verbal Intelligence (standard score) 41	RIAS	Autism	Verbal

In-Service Teachers’ Needs Assessment. Prior to implementing the study, the IHE instructor, BOCES administrators, and teachers met to identify priority math standards to target in the instructional units for the following year. From teachers’ input at that meeting, it was decided that extensions of the state’s Algebra, Geometry and Ratios and Proportions (Unit Rate) standards would best support their instructional and assessment plans. In this state, teachers consulted a state website to access the priority standards for the academic year and then planned instruction and progress monitoring toward those standards. Meeting notes also indicated that teachers expressed a strong need for materials that were adapted to meet their students’ needs. To support access to Algebra and Geometry for their students, it was agreed that the lesson task analyses, graphic organizers, and story formats described in the Browder, Jimenez et al study would be used. That is, all stories would be written using considerate text supported with graphics for key vocabulary, problem statements consistently placed at the end of the story, and problems embedded in activities typical to middle school students. Figure 1 shows a math story that was developed by pre-service teachers to depict an activity in which the participating students experienced in their gym class (i.e., using a stationary bike).

To support access to Ratios and Proportions (Unit Rate) , a new unit was needed that would continue to promote development of metacognitive skills in the lesson task analysis. For that reason, the task analytic lesson guided students to first identify the two different measurements that expressed a Unit Rate (i.e., \$2.99 per 1 pound), naming the first value (\$2.99) the “Partner Amount,” and the value per 1 pound as the “Unit Amount.” This first step was designed to support students’ ability to identify the measurement value that changed in the story problem (i.e., purchased 2 pounds). Figure 1 shows the graphic organizer that students used to construct

an equation that showed how a change in one of the measurement values proportionately affected the corresponding measurement value.




 Riding at the Gym




 Joy rides a bike at the gym. She rides **4**  **1** .




 Last week, she rode for a total of **3** hours.




 How many miles did Joy ride ?

8

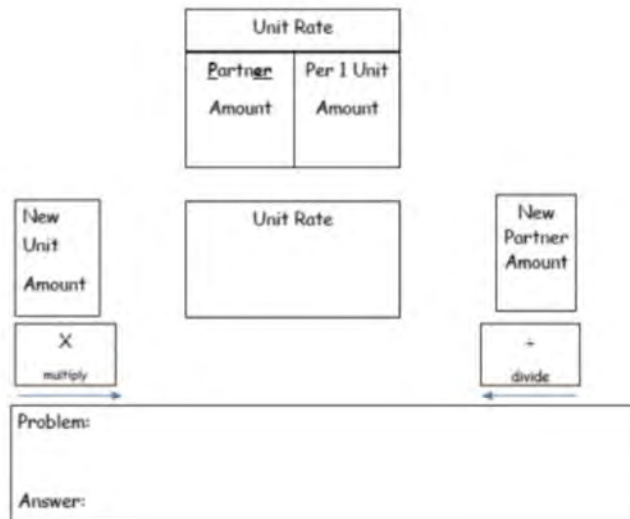


Figure 1. Adapted math story and graphic organizer for Ratios and Proportions Unit (Unit Rate).

In this way, students were consistently guided to “understand proportionality, a turning point in mental development” (Hoffer, 1988, p. 293 as cited in Cramer, Post, & Currier, 1993). As with the Algebra and Geometry units’ task analyses, specific steps were included in the task analysis to promote development of higher order thinking.

Course Feedback at the Pre-service Level. At the same time that in-service teachers provided feedback about which standards to target in this project, teacher candidates enrolled in the IHE’s curriculum strategies for students with disabilities and math methods courses provided feedback to IHE course instructors about course assignments they perceived as strongly aligned to their fieldwork experience. In a survey adapted from Allsopp et al (2006), candidates rated characteristics of course assignment/fieldwork linkage on a scale of 1-5 from “5- a very strong link, 4-a strong link, 3-a noticeable link, 2-a minimal link, and 1- no link .” In the semester prior to the collaborative project, a total of 31 pre-service teachers completed course feedback forms. Of the 31 candidates, 15 were placed in classes that used a text adapted in their course work to support the class’s literacy lessons. Feedback showed 60% of candidates chose “very strong link” to describe the connection between the course assignments (i.e., adapting a grade-appropriate book) to their fieldwork setting. Interestingly, comments from candidates who were in classrooms that did not use the text still noted a strong link, with one candidate recommending use of the adapted text in her fieldwork reflection paper . Using this feedback, course assignments for the semester were created to align with feedback from in-service teachers (i.e., candidates would apply knowledge from course reading to create adapted story-based math problems aligned with the instructional units chosen by in-service teachers).

Research questions:

- 1) Will in-service teachers increase adherence to a research-based practice after they receive professional development in the practice’s background and implementation?
- 2) Will in-service teachers find the intervention practical and supportive of their daily instructional needs?
- 3) Will students in the participating in-service teachers’ classrooms demonstrate increased independent problem solving skills after their teachers receive training?
- 4) Will pre-service teachers placed in the participating in-service teachers’ classrooms report higher “linkages” between college coursework and fieldwork experiences?

Intervention

In this study, three in-service teachers received training in the use of story-based problems, a graphic organizer, and a task analysis for each unit. All training and materials were designed to teach students to solve problems by identifying facts from a math story and placing facts on the graphic organizer. In-service teachers in this study attended three workshops at the IHE conducted by one special education and one math methods instructor. At each workshop, teachers received training and materials to begin teaching the unit in their classrooms. Data were collected on two students from each class for a total of six students throughout the school year. Sixty three pre-service teachers enrolled in the special education instructor’s classes received coursework that included background knowledge and training in the use of story-based problems, a graphic organizer, and a task analysis to solve problems aligned to extensions (i.e., alternate achievement standards) of the state’s middle school math standards. In their coursework, pre-service teachers received training in use of SymWriter™ software to create

adapted text supported with graphics and used this software to create math stories for the in-service teachers to use as they implemented each unit.

Data Collection

Data were collected for four outcomes: two from in-service teachers, one from their students, and one from pre-service teachers. Teachers' adherence to a lesson plan task analysis was examined by IHE instructors and school administrators using an observation checklist, and teacher's acceptance of the intervention was measured on a rating scale adapted from Snyder (2002) to use with teachers. In-Service teachers completed the Teacher Intervention Acceptability Rating Scale at the end of the school year to provide a measure of social validity for this intervention. Data were collected on student outcomes by IHE instructors who conducted probes before and after teachers received training in each unit. In each probe, students' responses to steps of each unit's problem-solving task analysis were recorded by IHE instructors. Finally, pre-service teachers completed an end of course survey on their perception of linkage between their college coursework and fieldwork.

Results

In-Service Teachers' Adherence to Task Analysis

Data collected on teacher use of research-based practices and student responses to steps of the problem solving task analysis were analyzed before and after teachers received training in each unit. Twice before and one time after each training session, teachers were observed to determine percentage of steps followed in the task analytic lesson plan. Percentage of steps teachers followed during the observation was computed as number of steps checked as "observed in lesson" divided by total number of steps.

In-Service Teacher's Social Validity Rating

At the end of the school year, teachers completed the Teacher Intervention Acceptability Scale to provide feedback regarding the value of both the training and intervention to their daily classroom practice. Table 2 shows results of the survey that asked teachers to rate each item on a Likert scale of 1(do not agree) to 6 (strongly agree).

Student Responses

Student responses to steps of each unit's problem solving task analysis were recorded before and after each training session their teacher attended. Three probes on all three unit task analyses (i.e., Algebra, Geometry, and Unit Rate) were conducted before the first unit training (Unit Rate). To collect data, the IHE instructors conducted probes with each student individually at a table in the self-contained classroom. For each probe, the IHE instructors provided the students with a copy of the story-based problem, graphic organizer, calculator, and any manipulatives needed to solve the problem. The instructor read the story aloud, then read aloud each step of the task analysis, waiting 5 seconds for a student response. If the student answered incorrectly or did not answer within 5 seconds, the researcher entered a "0" on the student response form for that step. No instructional feedback or verbal reinforcement for correct responses was provided. Intermittent non-specific verbal praise was given to acknowledge student's attention to the task (i.e., "you're doing a good job paying attention").

After teachers had completed eight of the first unit’s (Unit Rate) lessons in their classes, three probes were conducted by the IHE instructors that followed the same procedure as pre-training probes (i.e., students worked with an instructor at a table in the classroom to complete steps of each unit’s problem solving task analysis). The next training on the second unit (Algebra) was held after all ten lessons from the first unit were completed. After the second training, teachers implemented eight lessons of the Algebra unit in their classrooms before IHE instructors returned to conduct another round of probes. The same probe procedures were followed with all participating students. When all ten Algebra lessons had been implemented, teachers received training and materials to teach the third unit, Geometry. Probe sessions were scheduled after eight lessons of Geometry had been taught in each classroom. After all ten Geometry lessons were completed, IHE instructors conducted a final round of probes to examine if students had maintained any gains made during the year on all three units. Students’ responses were graphed to examine changes in responses before and after their teachers received training. All training sessions and probes were completed by the end of the school year. Pre-service teachers’ feedback on linkages from coursework to fieldwork was collected at the end of the Fall and Spring semester.

Pre-service Teachers’ Perceptions of Linkage to Coursework

On an end of course survey, pre-service teachers ranked the perceived linkage between their college coursework and fieldwork experiences. Responses from pre-service teachers placed in the participating teachers’ classrooms were compared to responses from those placed in non-participating teachers’ classrooms to examine each group’s perceptions of linkage from coursework to fieldwork.

Findings

In-service Teachers Adherence to Lesson Plan Task Analysis

For teacher one, overall steps of the task analyses completed increased from 10% for the two sessions before training to 93% for the three sessions after training. Teacher two increased from 5% before training to 83% after training and for teacher three from 20% before training to 96% after training. Although teachers followed the steps once they received training and materials, anecdotal feedback indicated that the task analysis was sometimes “cumbersome” to use, especially as they tried to collect student data with a small group of students at the same time as they were teaching the lesson.

In-Service Teachers’ Social Validity Rating

As seen in Table 2, all three teachers agreed that the intervention was feasible, fair, and supportive of their teaching as well as their students’ learning.

Table 2
Teacher Intervention Acceptability Rating Scale

ITEM	DESCRIPTION	RATING
1	The lesson plan training was implemented fairly.	100% (6)
2	The training was not too difficult	100% (6)
3	This training helped clarify how to develop lesson plans that access general curriculum	100% (6)
4	The training I received would be helpful for other teachers	100% (6)

5	The training I received was practical	100% (6)
6	The training I received has strengthened my skills as a teacher	100% (6)
7	My students have benefited from my training	100% (6)
8	The lessons aligned with the state's AA-AAS framework	100% (6)
9	The lessons provided opportunities to support students' IEP goals	100% (6)

In addition to the rating scale, teachers were prompted to provide anecdotal comments regarding the intervention. All teachers commented that receiving ready-made materials to implement in the classroom was the most helpful feature of this intervention. One teacher also noted the value of the lessons to promote higher order thinking with the following comment: “The materials developed for the study are easy to use and provide an understandable framework for students to access more abstract concepts.” Another teacher made a recommendation for future intervention studies by commenting, “Perhaps the training could take place in the classroom and the materials can be modeled with a student.” Finally, another teacher suggested that she plans to continue using the materials in her classroom in her comment, “I really like the unit that was able to be expanded into a life skills unit. I felt the students did best with this activity because we were able to approach it from a multitude of angles. I definitely plan to use it again next year.”

Student Responses to Steps of the Task Analysis

Figures 2-7 show the total number of correct student responses across each of three units from pre to post teacher training sessions for each unit. Figures 2 and 3 show responses for students with Teacher 1 (Bryan, & Kyle). Figures 4 and 5 for students with Teacher 2 (Selena & Lorenz) and Figures 6 and 7 for students with Teacher 3 (Manuel & Hoang). Skill maintenance is reported for the first two units taught (i.e., Unit Rate and Algebra). Due to weather-related disruptions in the school calendar during the implementation of the third unit (Geometry), only post-training scores are reported.

Students with Teacher 1. Bryan showed an increase in independent, correct responses across all three units. In the first unit (Unit Rate), he increased from pre ($M=0$) to post-training ($M= 2.6$, range from 0 to 5). For the second unit (Algebra), Bryan increased in correct, independent responses from pre ($M=0$) to post-training ($M= 5.8$, range from 0 to 10). For the third unit (Geometry), Bryan increased in correct, independent responses from pre ($M=0$) to post-training ($M= 4$, range from 1 to 6). Kyle also showed an increase in independent, correct responses across all three units. In the first unit (Unit Rate), Kyle increased from pre ($M=0$) to post-training ($M= 2.9$, range from 0 to 7). For the second unit (Algebra), Kyle increased in correct, independent responses from pre ($M=0$) to post-training ($M= 5.8$, range from 0 to 10). For the third unit (Geometry), he increased in correct, independent responses from pre ($M=0$) to post-training ($M= 3.7$, range from 0 to 6).

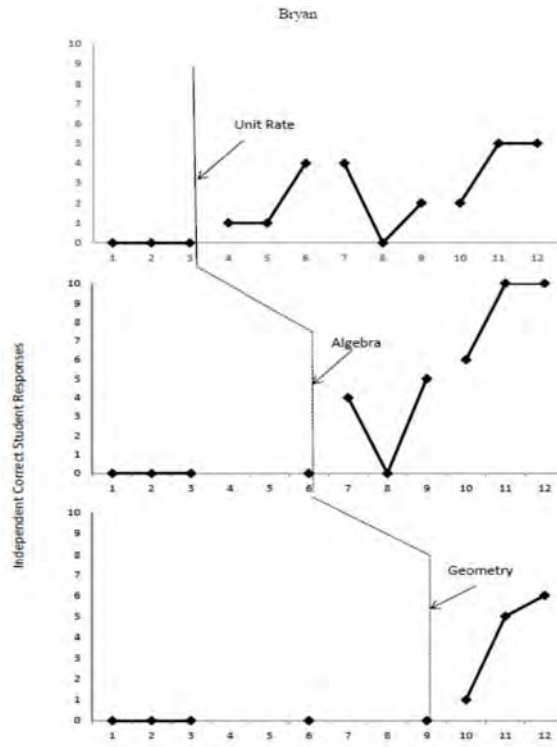


Figure 2. Data for Bryan across math units

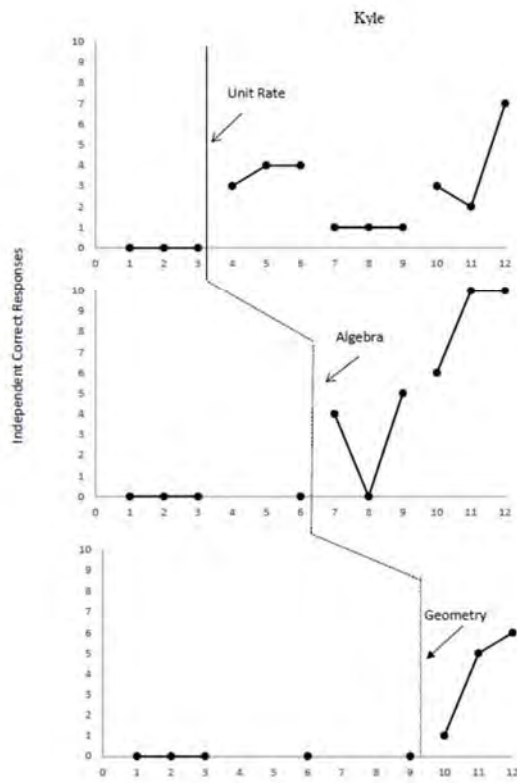


Figure 3. Data for Kyle across math units

Students with Teacher 2. Selena showed an inconsistent increase in correct, independent responses across all three units. In the first unit (Unit Rate), Selena increased from pre ($M=0$) to post-training ($M= 1.1$, range from 0 to 4). For the second unit (Algebra), she increased in correct, independent responses from pre ($M=0$) to post-training ($M= 2.3$, range from 0 to 4). For the third unit (Geometry), Selena increased in correct, independent responses from pre ($M=0$) to post-training ($M= 2.6$, range from 0 to 3). Lorenz showed an increase in independent, correct responses across all three units. In the first unit (Unit Rate), Lorenz increased from pre ($M=0$) to post-training ($M= 1.1$, range from 0 to 4). For the second unit (Algebra), Lorenz increased in correct, independent responses from pre ($M=0$) to post-training ($M= 4.2$, range from 1 to 9). For the third unit (Geometry), he increased in correct, independent responses from pre ($M=0$) to post-training ($M= 3.0$, range from 1 to 6).

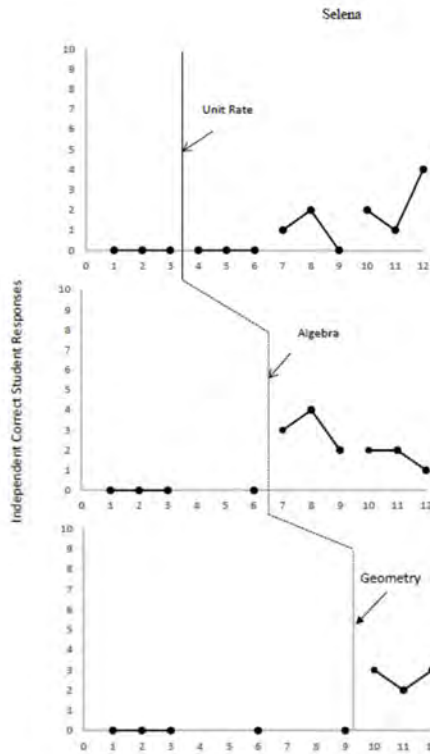


Figure 4. Data for Selena across math units

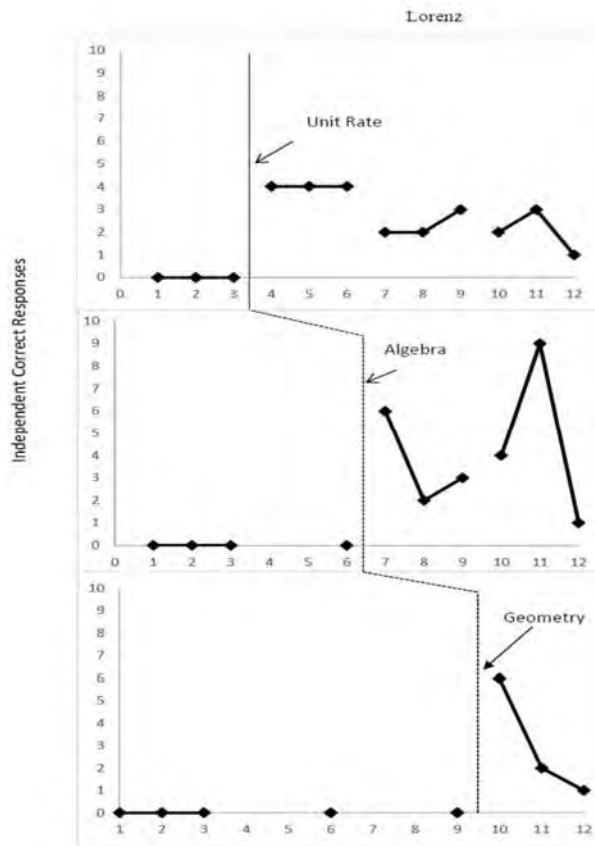


Figure 5. Data for Lorenz across math units

Students with Teacher 3. Manuel and Hoang made the most consistent and marked increases in correct, independent responses from pre to post-training. For the first unit, (Unit Rate), Manuel increased from pre ($M=0$) to post training ($M=9.5$, range from 9 to 10). Manuel maintained these increases 15 weeks after receiving instruction. For the second unit (Algebra), he increased from pre ($M=0.5$, range from 0 to 1) to post-training ($M=10$) and maintained increases 10 weeks after receiving instruction. For the third unit (Geometry), Manuel increased in correct, independent responses from pre ($M=1$, range from 0 to 2) to post-training ($M=8.6$, range from 8 to 9). Hoang increased independent correct responses for Unit 1 (Unit Rate) from pre ($M=1$), to post-training ($M=9.2$, range from 8 to 10). Hoang maintained these increases 15 weeks after receiving instruction. For the second unit (Algebra), he increased independent, correct responses from pre ($M=2.5$, range from 1 to 4) to post-training ($M=10$) maintained increases 10 weeks after receiving instruction. For the third unit (Geometry), Hoang increased in correct, independent responses from pre ($M=0.5$, range from 0 to 1) to post-training ($M=8.3$, range from 8 to 9).

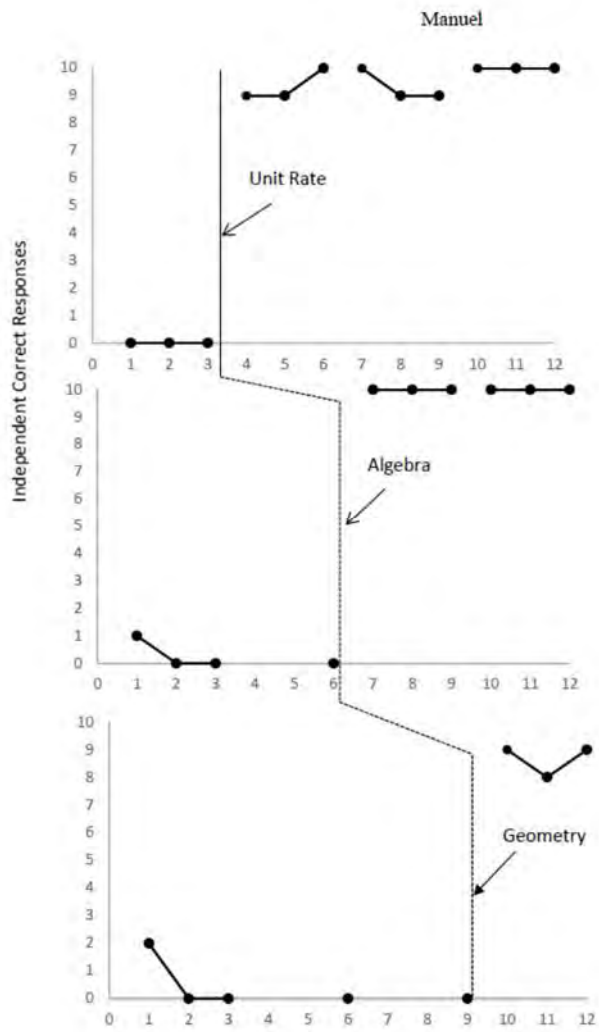


Figure 6. Data for Manuel across math units.

Hoang

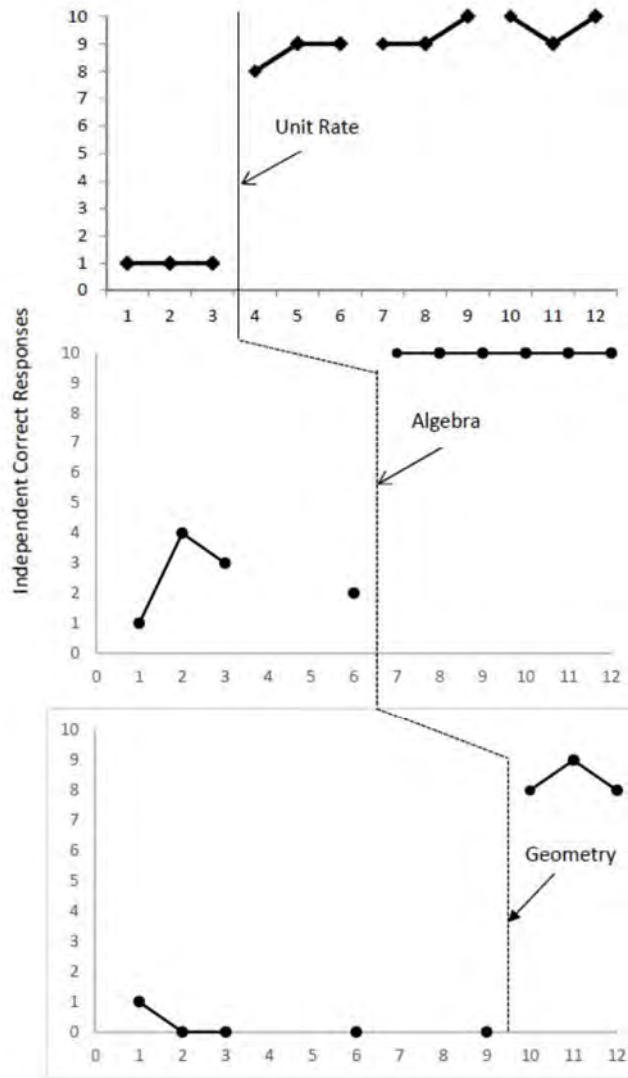


Figure 7. Data for Hoang across math units

These increases in students' correct, independent responses agree with findings from previous studies that examined the use of an instructional package that included training in task analytic lessons, adapted story-based problems, and graphic organizers to teach to grade-aligned math standards for middle school students with significant cognitive disabilities (Browder, Trela et al, 2010; Browder, Jimenez et al, 2012).

Pre-service Teachers Course Feedback: Links to Fieldwork

At the end of each semester, pre-service teachers completed a course feedback form that asked them to rate the connection between course assignments and their fieldwork placements. Table 3 shows responses by candidates ($n=63$) placed in participating teachers' classrooms who received the research-based math training and those not placed in participating classrooms who received one day workshops from the IHE special education instructor on visual supports and using children's literature to provide context for math problems. Although all candidates saw strong links, the choice, "very strong link" was only reported by candidates placed in participating teachers' classrooms.

Table 3

Pre-Service Teacher Reports of Linkage from Coursework to Fieldwork

	Placed with Teachers Who Received Math Training ($n=15$ Fall and Spring)	Placed with Teachers Who Received General PD ($n= 48$ Fall and Spring)
Very Strong Link	81%	0%
Strong Link	8%	69%
Noticeable Link	9%	21%
Minimal Link	2%	9%
No Link	0%	1%

Discussion

In this study, a model of professional development that addressed the needs of in-service teachers of students with significant cognitive disabilities and their students, and pre-service teachers preparing for certification in special education was designed within a college-school partnership. The model was developed and implemented to support in-service teachers' increased knowledge and use of research-based practices to support instruction to their middle school students with significant cognitive disabilities. At the same time, the model provided opportunities for pre-service special education teachers to create adapted materials to support the instructional practices and complete fieldwork in the targeted classrooms. After receiving training in implementing the research-based instructional package (lesson plan task analyses, story-based problems, and graphic organizer), teachers showed an increase in following steps of the task analysis in their classrooms, students showed increases in independent, correct responses to steps of the math task analyses, and pre-service teachers found strong or very strong links between their college coursework and fieldwork placements.

Limitations

Although the increases across measures taken with all groups (i.e., in-service teachers, pre-service teachers and students) is promising, the small sample size limits generalization of this study's findings to the larger population of students with significant disabilities and their teachers. A second limitation is the small number of probes conducted after teachers received training in each unit. Probes were conducted after teachers had implemented 8 out of 10 lessons

in their classrooms. This procedure maintained the typical classroom routine with as few interruptions to students' schedules as possible, as agreed upon by teachers, administrators, and the IHE instructors. Further, no data was collected from parents to discern if students were generalizing vocabulary or concepts from each unit to their everyday activities (i.e., identifying their rate of speed if using a treadmill or stationary bike, noticing unit rate on labels at home or in stores). Finally, although teachers found the training and materials helpful for the three targeted units, it was beyond the scope of this study to examine the extent to which they applied the practices to develop lessons aligned to additional alternate achievement standards targeted by the state's assessment program.

Future Directions

IHE – school partnerships provide a rich resource for both entities as schools respond to higher expectations for in-service teachers and their students, and IHEs respond to higher standards in the selection of clinical experiences for pre-service teachers. In this partnership project, in-service teachers received training and instructional materials appropriate to their students' learning needs. As one teacher added to the Teacher Intervention Acceptability Rating, "...the ready-made materials were most helpful. I appreciated the alignment with standards and functional skills." In addition, school administrators supporting the teachers commented that the "partnership ... offered an opportunity for teachers to receive ongoing, focused training and ready-made materials to implement instruction aligned to extensions of the state's CCSS for math." One implication drawn from this research for future practice is to create more opportunities for pre-service teachers to be placed with in-service teachers who are actively engaged in professional development opportunities with the IHE. As shown in the pre-service teachers' survey responses, being in a classroom where teachers are receiving training and implementing research-based practices provides a "strong to very strong link" to bridge the coursework to fieldwork gap. Another recommendation came directly from in-service teachers' feedback, in which one teacher suggested that IHE instructors work directly in the classrooms with teachers and students to model the practice. This suggestion aligns with research on models of professional development that provide ongoing coaching in the use of research-based strategies (Kretlow, Cooke, & Wood, 2012). In this study, in-service teachers received guidance to teach to three out of a possible total of 18 standards that they need to address in mixed grade level classes. Future studies may need to examine how to generalize skills to create task analytic lesson plans that respond to a wide variety of standards that teachers must address in their classrooms and how pre-service teachers in general education and content area specialists can contribute to that process.

References

- Allsopp, D.H., DeMarie, D., Alvarez-McHatton, P., & Doone, E. (2006). Bridging the gap Between theory and practice: Connecting courses with field experiences. *Teacher Education Quarterly, Winter 2006*, 19-35.
- Browder, D.M., Jimenez, B., & Trela, K. (2012). Grade-aligned math for secondary students with moderate intellectual disabilities. *Education and Training in Autism and Developmental Disabilities, 47*, 373-388.

- Browder, D., Trela, K., Courtade, G., Jimenez, B., Knight, V., & Flowers, C. (2012). Teaching mathematics and science standards to students with moderate and severe developmental disabilities. *The Journal of Special Education, 46*, 26- 35. doi:10.1177/0022466910369942.
- Browder, D. M., Wood, L., Thompson, J., & Ribuffo, C. (2014). *Evidence-based practices for students with severe disabilities* (Document No. IC-3). Retrieved from University of Florida, Collaboration for Effective Educator, Development, Accountability, and Reform Center. Retrieved from: <http://cedar.education.ufl.edu/tools/innovation-configurations>
- Council for Accreditation of Educator Preparation. (2015). <http://caepnet.org/standards/standard-2>
- Cramer, K., Post, T., & Currier, S. (1993). Learning and Teaching Ratio and Proportion: Research Implications. In D. Owens (Ed.), *Research Ideas for the Classroom* (pp. 159-178). NY: Macmillan Publishing Company.
- Darling-Hammond, L., Wei, R.C., Andree, A., Richardson, N., & Orphanos, S. (2009). *Professional learning in the learning profession: A status report on teacher Development in the United States and abroad*. Stanford, CA: Stanford University.
- Ergul, C., Baydik, B., & Demir, S. (2013). Opinions of in-service and pre-service special education teachers on the competencies of the undergraduate special education programs. *Educational Sciences: Theory and Practice, 13*, 518-522.
- Goldstein, J., & Behuniak, P. (2012). Assessing students with significant disabilities on academic content. *Journal of Special Education, 46*, 117- 127. doi: 10.1177/0022466910379156.
- Hoffer, A. (1988). Ratios and proportional thinking. In T. Post (Ed.). *Teaching mathematics in grades K-8: Research based methods* (pp. 285-313). Boston: Allyn & Bacon.
- Individuals with Disabilities Education Improvement Act (IDEA) of 2004, PL 108-446, 20 U.S.C. §§ 1400 *et seq.*
- Kalchman, M., and Koedinger, K.R. (2005). Teaching and learning functions. In S. Donovan and J. Bransford (Eds.). *How students learn: History, mathematics and science in the classroom* (pp. 351-396). Washington, DC: National Academy Press
- Kleinert, H.L., Kennedy, S., & Kearns, J.F. (1999). Impact of alternate assessments: A statewide teacher survey. *Journal of Special Education, 33*, 93-102.
- Kretlow, A.G., Cooke, N.L., Wood, C.L. (2012). Using in-service and coaching to increase teachers' accurate use of research-based strategies. *Remedial and Special Education, 33*, 348-361.
- Lee, A., Browder, D.M., Flowers, C., & Wakeman, S. (2016). Teacher evaluation of resources designed for adapting mathematics for students with significant cognitive disabilities. *Research and Practice for Persons with Severe Disabilities, 41*, 132-137.
- Leko, M.M., & Brownell, M.T. (2009). Crafting quality professional development for special educators: What school leaders should know. *Teaching Exceptional Children, 42*, 1, 64-70.
- National Governors Association Center for Best Practices, Council of Chief State School Officers. *Common Core State Standards for Mathematics*. National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C. Copyright Date: 2010 <http://www.corestandards.org/>
- No Child Left Behind Act of 2001, PL 107-110, Stat. 1425, 20 U.S.C. §§6301 *et seq.*
- Prater, M.A. & Sileo, T.W. (2002). School-University partnerships in special education field experiences: A national descriptive study. *Remedial and Special Education, 23*, 325-334.

- Roach, A., Elliott, S. & Berndt, S. (2007). Teacher perceptions and the consequential validity of an alternate assessment for students with significant cognitive disabilities. *Journal of Disability Policy Studies, 18*, 168-175.
- Sarama, J., Clements, D., Swaminatha, S., McMillen, S., & Gonzalez Gomez, R.M. (2003). Development of mathematical concepts of two-dimensional space in grid environments: An exploratory study. *Cognition and Instruction, 2*, 283-324.
- Snyder, E. P. (2002). Teaching students with combined behavioral disorders and mental retardation to lead their own IEP meetings. *Behavioral Disorders, 27*, 340–357.
- SymWriter 2 [Computer Software]. (2014). <http://www.widgit.com/products/symwriter/>
- Timberlake, M.T. (2014). Weighing costs and benefits: Teacher interpretation and implementation of access to the general education curriculum. *Research and Practice for Persons with Severe Disabilities, 39*, 83-99.
doi: 10.1177/1540796914544547
- Towles-Reeves, E., Kearns, J., Kleinert, H., & Kearns, J. (2009). An analysis of the learning characteristics of students taking alternate assessments based on alternate achievement standards. *Journal of Special Education, 42*, 241-254. doi: 10.1177/0022466907313451
- Trela, K., & Jimenez, B. (2013). From different to differentiated: Using “Ecological Framework” to support personally relevant access to general curriculum for students with intellectual disabilities. *Research and Practice for Persons with Severe Disabilities, 38*, 117-119.
- Wehmeyer, M., Lattin, D., Lapp-Rincker, G. & Agran, M. (2003). Access to the general curriculum of middle school students with mental retardation: an observational study. *Remedial and Special Education, 24*, 262-272.
- Wilson, S.M., Floden, R.E., & Ferrini-Mundy, J. (2001). Teacher Preparation Research: Current Knowledge, Gaps, and Recommendations. Research report prepared for the U.S. Department of Education and Office for Educational Research. Retrieved September 20, 2015 from <http://depts.washington.edu/ctpmail/PDFs/TeacherPrep-WFFM-02-2001.pdf>.
- Witzel, B.S., Mercer, C.D., & Miller, M.D. (2003). Teaching algebra to students with learning disabilities: An investigation of an explicit instruction model. *Learning Disabilities Research and Practice, 18*, 121-131.

About the Authors

Katherine Trela, Ph.D. Dr. Trela is an Associate Professor in Special Education at Marist College in the Education Department. Prior to coming to Marist, Dr. Trela was a special education teacher in New York and North Carolina. She has worked as a Research Associate and Adjunct Professor at UNC-Charlotte and as a Curriculum and Instruction Specialist for Charlotte-Mecklenburg Schools’ programs for students with significant cognitive disabilities. Dr. Trela’s research interests focus on best practices to support access to general education curriculum for students with significant disabilities.

Wendy Gladstone-Brown, Ed.D. Dr. Gladstone-Brown is an Assistant Professor at Marist College in the Education Department. Prior to coming to Marist, Dr. Gladstone-Brown was a teacher in the Rush-Henrietta Central School District in Rush, New York. She worked as an Assistant Principal and Principal for the Webster Central School District. Dr. Gladstone-Brown

then joined the faculty of St. John Fisher College as a Visiting Assistant Professor in 2004 and successfully defended her Doctorate in Executive Leadership in 2008 as a member of the program's first cohort. Her research interests include: Co-teaching in Inclusive Classrooms, Early Childhood Education, Professional Development Schools, and Arts in Education.

Norah Merritt, Ph.D. Dr. Merritt is the Executive Director of Human Resources for Dutchess County Board of Cooperative Services (BOCES). In this position, Dr. Merritt plans, organizes and manages Special Education financial matters for Dutchess County BOCES. In addition, she provides Professional Development to Administrative Staff, District Administration, and Committee on Special Education (CSE) chairs. Before her work in special education leadership, Dr. Merritt was a special education teacher who supported needs of diverse students at Dutchess Alternative High School.

Leah Pollack Raftis, Ed.D. Leah Raftis is currently an Assistant Director of Special Education for Wappingers, New York Central School District. Prior to this position, Dr. Raftis was Director of Special Education Services at Dutchess County Board of Cooperative Education Services (BOCES). Prior to this role, she held the position of Staff Specialist: Special Education, supervising a program for students with autism spectrum disorder and coordinating the New York State Alternate Assessment process for schools in Dutchess County. Dr. Raftis holds a Bachelor of Science degree in general education, a Master's degree in special education, and a Certificate of Advanced Study in school and district leadership. Dr. Raftis successfully defended her dissertation focusing on administrative supports for students with autism in inclusive settings in March 2017.