

Towards Inclusive Mathematics Education: A Case Study of Professional Learning

Paulo Tan and Kathleen King Thorius

Indiana University Purdue University Indianapolis

In today's world and into the future individuals must become increasingly sophisticated in quantitative reasoning in making decisions and addressing issues in one's personal life, on the job, and in matters of public interest; thus educators must develop ways to support students to develop ways to reason and communicate using mathematical ideas and concepts (National Council of Teachers of Mathematics, 2000; Schoenfeld, 2002). Such support involves engaging students in meaningful and rich mathematics curriculum crucial in 21st century economic access and full participation in the civic process (e.g., Moses & Cobb, 2001). Yet, students with low-incidence disabilities continue to have limited access to and achievement in meaningful mathematics curriculum and instruction (Browder, Spooner, Ahlgrim-Delzell, Harris, & Sanders, 2008; Wehmeyer, 2006). Many students with significant disabilities typically engage in mathematics that are of low rigor despite evidence suggesting that they can engage in more rigorous and grade-level mathematics (Browder et al., 2008). Thus, supporting teachers' professional learning in mathematics education that fosters the learning of all students is crucial in advancing equity (Crockett & Buckley, 2009) for students with low incidence disabilities.

In general, professional learning programs have largely been ineffective in addressing teachers' learning in school systems that continue to segregate students with disabilities (Slee, 2010). Waitoller and Artiles (2013) argued that professional learning for inclusive practices must attend to teacher learning that fosters knowledge, skills, contextual, and critical understandings necessary for facilitating high-quality educational opportunities and outcomes for all students. Yet, the professional learning knowledge base in the field of mathematics education predominately focused on student thinking and mathematical and pedagogical knowledge (Borko, 2004) without much attention to contextual factors that foster or hinders learning (Gutiérrez, 2012), or to the power and identity components of equity (Crockett & Buckley, 2009;

Gutiérrez, 2010). Gutiérrez (2002) noted that the field is far from understanding how mathematics educators can consistently practice equity work in their daily practice. When the literature did pay attention to equity in professional learning, it mostly focused on the access and achievement components (Crockett & Buckley, 2009). Moreover, the literature on equity in professional learning in mathematics education paid limited attention to issues specific to students with disabilities (Tan, 2014).

Another gap in the literature relates to the participation structures in professional learning that involve collaboration between special and general education teachers which is crucial to better understanding the advancement of inclusive practices. Current efforts focus on such collaboration around supporting students with high-incidence disabilities with limited attention to students with low-incidence disabilities (Pugach, Blanton, & Correa, 2011). Thus, there exists an urgent need to better understand professional learning opportunities that addresses collaborative efforts between general and special educators in supporting students with significant disabilities in general and in particular in the area of mathematics.

Grounded in these issues around mathematics access, participation, and outcomes for students with low-incidence disabilities, as well as concerns for robust professional learning opportunities that support teacher development to provide inclusive education to students with disabilities, particularly related to mathematics, this study examines the process and content of equity-oriented technical assistance (TA) facilitated by researchers from a U.S. Department of Education funded Equity Assistance Center (EAC). Specifically, we partnered with general and special educators from two elementary schools in a Midwestern urban school district to build and facilitate a teacher learning community focused on inclusive mathematics education of students with significant (i.e., low incidence) disabilities.

Toward a Theory of Inclusive Mathematics Education

In relation to each distinct area within the problem space we articulated in our introduction, the following theoretical tools informed our design of a teacher learning community focused on inclusive mathematics education.

Inclusive Education as a Social Justice Endeavor

We draw from the definition of inclusive education posited by Kozleski and Waitoller to emphasize that the inclusion of students with disabilities, even those with low incidence disabilities is necessary in a socially-just, democratic society where all citizens have the right and freedom of full participation.

Inclusive education is a continuous struggle toward (a) the redistribution of quality opportunities to learn and participate in educational programs, (b) the recognition and value of differences as reflected in content, pedagogy, and assessment tools, and (c) the opportunities for marginalized groups to represent themselves in decision-making processes that advance and define claims of exclusion and the respective solutions that affect their children's educational futures. This notion of inclusive education as a continuous struggle reflects the notion that we exist in dynamic contexts. The margins and centers of our work are in continuous flow producing new margins and centers (Waitoller & Kozleski, 2013, p. 35).

Disability as Difference, not Deficit

Building on the definition of inclusive education we offer above, a theory of inclusive mathematics education frames disability from a disability studies perspective. That is, a perspective that examines the concept of disability as a social construction that results in social exclusion and oppression (Gabel, 2005). Central in this construction of disability is the

understanding that disability is not something to fix remediated in a person; rather, it is a unique individual and shared cultural position that brings with it significant sources of strength and challenge for the person . Yet, this construction also explicitly includes attention to the ways in which people with disabilities experience oppression in their daily lives, including economic, political, cultural oppressions and self-alienation forms of oppression (Charleton, 2006). Applied to educational settings, this perspective means that students with disabilities are viewed as targets for individualized instruction and remedy (Brantlinger, 2005) and uses students' "syndrome" as reason for lowered expectations (Freeman & Van Dyke, 2006).

Mathematics as a Meaningful, Social Activity

Mathematics as a meaningful, social activity means that mathematics expertise is distributed across all students and that the aim of teachers and students is not to just advance equity and social justice in mathematics education but also through mathematics education (Gutstein et al., 2005). That is, equity and social justice is not only about having equitable opportunities in mathematics education but also about how those opportunities are utilized to advance a more just society. In one such endeavor, teachers engage students in projects that utilize mathematics to improve the deteriorating conditions of their urban school (Schultz, 2008).

Universal Design for Learning (UDL) as a Curriculum Framework

UDL is a set of principles for designing curricular goals, methods, materials, and assessments (Rose & Meyer, 2000). A primary goal of UDL is to disrupt ways in which students are dis/abled by curriculum (Edyburn & Gardner, 2009), primarily through ensuring multiple and flexible forms of access to and participation in the general education curriculum. Specifically, UDL provides a frame for attending to the much needed contextual factors that is missing in the

mathematics education literature (Gutiérrez, 2012) that centralizes the full range of student diversity to the process of curriculum development (CAST, 2012).

Toward a Theory of Equity-Focused Technical Assistance

The Current State of TA Models and Research

As U.S. schools strive to improve results for all students in response to large-scale policy changes, several outcomes remain obdurate, including the longstanding issue of educational disparities between students with and without disabilities. Despite a growing focus on early intervening services and efforts in general education classrooms promoted in IDEA 2004 reform, educators' access to learning opportunities that facilitate their creation of inclusive educational environments to address the needs of diverse learners becomes an increasingly important factor in redressing achievement and outcome depressions for students with disabilities.

As a major strategy to facilitate reform, the U.S. Department of Education funds TA centers to examine, facilitate, and assess educator learning communities with the goal of transforming systemic policy and practice. In 2009, investment in TA centers accounted for approximately one third of the more than 56 billion dollars allotted to discretionary federal programs (<http://www.ed.gov/about/overview/budget/history/index.html>, retrieved 1/12/12). Yet, critiques have emerged about the government's reliance on TA to facilitate implementation of policy-driven reform from macro to local contexts. These critiques note a weak research base for traditional TA approaches and question a top-down paradigm for professional learning in which outside experts provide information, link information with practice improvements, and at times, facilitate policy revision to drive new practice (Kozleski, 2004) and support organizational learning and improvement (Trohanis, 1982). Traditional TA approaches neglect theory and

research about adult, and more specifically, teacher learning, focus almost exclusively on content concerned with improvement of technical issues in schools, and neglect critical concerns related to educational equity (Kozleski & Artiles, 2012). As a result, TA often enhances technical operations of current systems without substantively altering systems' cultures to achieve equitable outcomes (Kozleski & Artiles, 2012; McInerney & Hamilton, 2007). This focus, “deflects attention from equity as a core value of a public education system within a democracy.” Moreover, TA recipients “learn to view their work in terms of operational tasks while outcomes that benefit the most oppressed groups of students can become tangential to technical improvements to the system,” (Kozleski & Artiles, 2012, p. 5).

Particularly because of the dearth of research as well as a lack of theoretical grounding for technical assistance as a mechanism for supporting systemic change, Kozleski and Artiles (2012) have critiqued traditional technical assistance approaches as ignoring theory and research about teacher learning, focusing almost exclusively on content concerned with improvement of technical issues in schools, and neglecting critical concerns related to educational equity (Kozleski & Artiles, in press).

TA as Systemic, Critical, and Focused on Activity-Embedded Learning

Building the work of Kozleski and Artiles and colleagues in leading national technical assistance centers funded by the U.S. DOE's Office of Special Education Programs including the National Center for Culturally Responsive Education Systems and the National Institute for Urban School Improvement, the Great Lakes Equity Center continues to develop and refine a number of theoretical features of TA, which we discuss in subsequent sections.

Oriented toward systemic change. Beyond a focus on shifts in individual praxis, TA is concerned with the educational system as the unit of change. While this includes concerns with

improvements to individual educator practice and revision of policies and procedures...(More here).

Concerned with critical inquiry. TA is centrally concerned with critical inquiry about the status quo, including who does and does not benefit from the way things are within the educational system (King, Kozleski, & Artiles, 2009; Kozleski, Gibson, & Hynds, 2012). Examination of individual and group power, privilege, and oppression, as well as equity in learners' social and academic outcomes on the basis of membership in traditionally marginalized and privileged groups (Artiles & Kozleski, 2012; Fullan, 2003) is explicitly featured in all TA activities.

Focused on activity-embedded learning. TA includes as one of its major activities the design and facilitation of participant experiences to stimulate learning ... While learning has been historically theorized as an individual psychological process, central to our model of TA is an orientation that learning is at once social, psychological, and contextual (Koschmann, 2011a). Greeno, Collins, and Resnick (1996) call this conceptualization of learning situative/pragmatist-sociohistoric; as individuals participate in context specific social activity with other learners who share background knowledge and have a history of collaboration, they develop identities in connection with the learning community. (more on CHAT)

Mediated by artifacts. Within these complex systems of activity learning is mediated through the use of cultural artifacts and discourses (Greeno, 2006). As participants engage with artifacts, cognition is distributed as individual knowledge combines to produce new knowledge that then becomes internalized by participants (Jelinek, 2013). The notion of participation is crucial to learning...(little more)

Conceptualized as social design experiments. ...

Methods

Research Questions

For researchers, the theoretical features of TA we have articulated means that attention to the types of activities and mediating artifacts that TA providers design and facilitate, and that participants engage to produce learning and changes in social practice to transform educational systems are important areas of inquiry (Kozleski & Artiles, 2013; Koschmann, 2011b).

Subsequently, this qualitative case study is concerned with the following research question in relation to the teacher learning community that was the major feature of a particular TA partnership:

In what ways did the artifacts and processes of the teacher learning community mediate educators' learning toward inclusive mathematics education for students with low-incidence disabilities?

Project Background and Description

Before detailing our remaining methods of inquiry, we connect the previous theoretical discussions of TA to the current project. The teacher learning community emerged from an existing relationship between the second author and two principals in two elementary schools in one urban district in connection with an Office of Special Education Programs Special Education Program Improvement Grant. From a series of grant-supported professional learning activities aimed at improving the capacity of mentor teachers of special education teaching candidates, the idea for the community arose out of concerns that within these two schools that were otherwise described by educators and community members alike as “inclusive”, existed self-contained classrooms where students with low incidence disabilities spent the majority of their day, and relatedly, had little participation in general education curriculum and with non-disabled students.

Subsequently, these same students had very limited engagement in mathematic learning. The focus on mathematics curriculum was a central feature of the teacher learning community partnership, but more broadly, represented a content area anchor for engaging teachers in job-embedded activities aimed at the transformation of individual and school practices toward the inclusion of students with significant disabilities in general education settings and curriculum. As researchers, we designed and facilitated activities mediated by artifacts meant to introduce disruptions into the current system. Of course, participation also drew from cultural artifacts already existing within the activity system.

Recruitment and Participants

The two school principals recruited teams consisting of special and one general education teachers from their respective elementary schools. Six teachers (4 special educators and 2 general educators) completed the scheduled seven professional learning sessions that occurred once a week for seven consecutive weeks where each session lasted 1.5 hours. All participants were White and female and had professional teaching experiences that ranged from one to 29 years. Table 1 provides a brief description of the participants.

Professional Learning Sessions

In general, sessions focused on (1) examining current practices with equity for students with low-incidence disabilities in mind, (2) imagining new possibilities for their participation and relatedly, teacher practice, and (3) were grounded on the principles of SDE. The general pattern within each session included an introduction of an artifact, use of the artifact to examine a critical issue, and discussion of in-between session application. For instance, one artifact introduced was the Universal Design for Learning (UDL) Self-Check Tool where a team consisting of a general and a special educator, in-between sessions, self-assessed one of their

own math lessons to the degree in which the lesson applied UDL principles to engage all students. During the following session, teams shared the results of their analysis with the larger group of participants and reflected on the conversations that occurred during the analysis.

Data sources, analysis, & validity measures

We met to debrief following each session – comparing field notes and thoughts, reviewed and analyzed the audio-recording of each session. We brought the information that we found from our debrief meetings and the analysis of the audio-recordings back to the teachers as both a way to verify the accuracy of these accounts (i.e., member checking) and as a stimulus for further discussion. As such the main sources of data were the session observations and related field notes and digital audio recordings.

Data analysis involved coding the transcripts from all sessions using qualitative computer software to develop a manageable classification scheme (Patton, 2002) by using both pre-determined codes as well as new codes evidenced in the conversations.

RESULTS

Overall our analysis of the discourse in relation to the engagement with these artifacts through this process resulted in what we term “5 shifts in thinking” - we got at shifts in thinking by examining shifts in teacher discourse that provide preliminary evidence of teacher learning toward our theory of inclusive mathematics education

From teacher to student-centered definitions of success

The first shift involved participants’ conceptualization of success. During the initial sessions, participants’ notion of success seemingly referred to the conventional academic and/or behavior measures defined from the teachers’ standpoint. Under this notion, successful students are able to keep up with the pace during math lessons through normed participating behaviors

(e.g., paying attention by looking at the teacher or peers, completing assignments with a certain level of accuracy). During a conversation in Session #4, Sarah, a special educator illustrated such concept of success as she expressed that for one of her students, success in the general education classroom and curriculum was not possible even with extensive supports: "... [the general education] teacher has to provide additional accommodations and support for her [referring to the student] during the math period, which is so intense that ...she's [the student] often not successful in any way..." In turn, Sarah's comment suggests that participating teachers were the sole determinants of the meaning of success. However, during the subsequent professional learning sessions, participants' discourse around success shifted towards their students' perspectives. For example, during Session #6, Kim, Melissa, and Sarah had the following conversation that surrounded the novelty of having students define their own success:

Melissa: I was thinking about [the facilitation tool] and what does success look like for the whole kid...not in academic alone...?

Kim: Well it might also be interesting to have the kid version of this [referring to the facilitation tool]

Melissa: That is what I was going to say...

Sarah: That's what we do for... when we do behavior plans. We use... a portion when you trying to interviewing the kid, that's a great suggestion!

Kim: Or you know they may not agree or sometimes they think when they're part of this process sometimes it helps to understand the child more too. You could talk to them through some of these [referring to the facilitation guide]

We introduced the dyad facilitation tool, noted by participants in the above excerpt, in order for participants to explore their students' preference for learning. Thus, we posit that the tool was a

factor that facilitated discourse from conventional forms of success towards discourse that sought to solicit students' input of the meaning of success.

From instructional modification to curricular and instructional design

A second shift involved participants' discourse towards a focus on curricular and instructional design in mathematics. In particular, in contrast to the earlier sessions where participants' discourse focused on instructional modifications such as making "math clean" (e.g., using the whole numbers in the problem like \$1 rather than a rational number like \$1.25 to make the problem easier to compute), during the later sessions participants talked more about finding ways to maintain the cognitive rigor of the mathematics activity by the contextualizing the problems as Melissa, a special educator, noted during Session X: "I think part of that [referring to UDL tool chart] is about choice but I think it's also just about making sure even if you don't offer 27 thousand different choices it's just making sure that the ones you do offer are real and purposeful and meaningful to the child." The purpose of the UDL chart tool was to have participants examine their practices with a particular focus on areas of improvement. In the above excerpt, Melissa was responding Kim, a general educator, who became concerned about her ability to provide multiple options for student engagement in the mathematics curriculum. Hence, the UDL chart tool, served to shift participants discourse from a focus on responding to students' needs in mathematics towards participants' thinking about how to design curriculum and instruction that provides multiple options of meaningful engagement.

From mathematical skill deficits to mathematical thinking

Participants also shifted discourse from a focus on students' deficits in mathematics towards learning more about how students' thinking. In particular, discourse during the first of half of the professional learning focused on identifying specific deficits in mathematics skills. To

illustrate, Nancy, a special educator expressed her concerns about a particular student with a disability: “Part of me wants to know where all her holes [are] and I don't really know that yet, she's got a lot, a lot, a lot and that is part of the problem is figuring out where all the holes are.” In contrast, during the second half of the professional learning sessions, the focus of the discourse shifted to learning more about how students made sense of mathematics as Sarah, a special educator, reflected: “So I noticed especially with one of my students that... if you really just take a step back and even if it takes them 15 minutes to solve this problem, you could really see how they're problem solving”

From determining student learning deficits to exploring and understanding preferences in learning

Similar to the previous shift, participants shifted discourse from their students' inability to participate in cognitively rigorous and highly social mathematics activity towards discourse that sought to better understand how their students' preference for learning. In particular, conversations that took place near the beginning of the professional learning program focused on the difficulty and sometimes the impossibility engaging students with disabilities in rich mathematical activities. For example, during conversation that took place in Session #3 after the participants viewed video clips from Turkey Investigations (Dolk & Fosnot, 2005), a commercially available professional development CD for teachers, that showed a third-grade classroom students engaged in a mathematics activity involving students working in pairs in figuring out mathematically how to solve a problem and sharing and listening to different strategies during a whole group congress; the participants in this study expressed skepticism that their students with disabilities would be able engage in such an activity. Teachers talked about their students with disabilities in a generalized and degrading way (e.g., negatively mocking their

students) such that they would not be interested in engaging in a conversation with their classmates and would not be able to effectively problem solve in the same way as the students from the video clips. Liz, a general educator, made the following conclusion: “And I’m trying to think - I can’t think of a single special ed student that would [be interested in the activity].” In contrast, towards the end of the profession learning program, participants discourse focused more on how to engage students with disabilities in learning. For example, two special educators had the following conversation about a student with a disability:

Nancy: ...she's interested in our science project that she's supposed to be working on. She has told me that she's gotten everything ready to go and rock and roll”

Kim: ...she also loves cooking and she's really good with recipes

The above exchange was guided by the Dyad Facilitated Discussion tool that aimed examine student’s preference for learning. As participants began to learn more about their students, participants discourse focused more on the possible pathways to engagement rather than on the roadblocks.

From student to system

Teachers reflect on the original intentions of an existing school process and the importance of understanding the whole child. (RTI and BBT processes). The need for collaborative conversations and teaching as a shared practice.

“...reminds me of the old RTI process...and really what it's doing is which we lost in that old RTI process. It was irritating and painful... but you really broke down what the child the strengths and challenges and where the issues were and really looked at the child...” Liz

IMPLICATIONS

Researchers

Learning appropriated in practice? Limited knowledge on professional learning around UDL; identity work – bridging identities of teachers to inclusive mathematics, including notions of being “good” or “bad” in math; include voices of students with disabilities and their families.

Technical assistance

Participation structures and processes that include school leaders, special and general education teachers in collaborative inquiry that addresses a balance of technical, contextual, and critical issues in mathematics education. Particular tools useful in mediating learning towards equity included the UDL dyad facilitation tool, UDL self-check, and Inclusive Framework for organizing schools.

Practitioners

From remediation to re-mediation (Cole & Griffin, 1993). “Transformation of the learning ecology, including a shift in the way tools and forms of assistance function to incite and facilitate learning” so that all students can be smart (Gutierrez, Hunter, & Arzubiaga, 2009)



References (Partial)

- Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, 33(8), 3-15.
- Browder, D.M., Spooner, F., Ahlgrim-Delzell, L., Harris, A.A., & Wakeman, S. (2008). A meta-analysis on teaching mathematics to students with significant cognitive disabilities. *Exceptional Children*, 74(4), 407-432.
- Center for Applied Special Technology. (2012). What is universal design for learning? , from <http://www.cast.org/udl/index.html>
- Crockett, M.D., & Buckley, L.A. (2009). The role of colection in equity-centered mathematics professional development practices. *Equity & Excellence in Education*, 42(2), 169-182.
- Edyburn, D.L. (2010). Would you recognize universal design for learning if you saw it? Ten propositions for new directions for the second decade of udl. *Learning Disability Quarterly*, 23, 33-41.
- Freeman, B.J., & Van Dyke, M. (2006). Invited commentary: "Are the majority of children with autism mentally retarded?" *Focus on Autism and Other Developmental Disabilities*, 21(2), 86-88.
- Gabel, S.L. (2005). *Disability studies in education: Readings in theory and method*. New York: Peter Lang Publishing.
- Gutiérrez, R. (2012). Context matters: How should we conceptualize equity in mathematics education. In B. Herbel-Eisenman, J. Choppin, D. Wagner & D. Pimm (Eds.), *Equity in discourse for mathematics education: Theories, practices, and policies*. New York: Springer.
- Gutiérrez, R. (2010). The sociopolitical turn in mathematics education. *Journal for Research in Mathematics Education*, 42, 1-32.
- Gutiérrez, R. (2002). Enabling the practice of mathematics teachers in context: Toward a new equity research agenda. *Mathematics Thinking and Learning*, 4(2&3), 145-187.
- Kozleski, E.B., & Artiles, A.J. (2012). *Technical assistance as inquiry: Using activity theory methods to engage equity in educational practice communities*. Retrieved from http://www.academia.edu/1394323/Kozleski_E._B._and_Artiles_A._J._2012_.Technical_assistance_as_inquiry_Using_activity_theory_methods_to_engage_equity_in_educational_practice_communities
- National Council for Teachers of Mathematics. (2000). Principles and standards for school mathematics. Reston, VA: Author.
- Pugach, M. C., Blanton, L. P., & Correa, V. I. (2011). A historical perspective on the role of collaboration in teacher education reform: Making good on the promise of teaching all students. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, 0888406411406141.
- Schoenfeld, A.H. (2002). Making mathematics work for all children: Issues of standards, testing, and equity. *Educational Researcher*, 31(1), 13-25.
- Schultz, B. D. (2008). *Spectacular Things Happen along the Way: Lessons from an Urban Classroom. Teaching for Social Justice*. Teachers College Press. 1234 Amsterdam Avenue, New York, NY 10027.
- Slee, R. (2001). Social justice and the changing directions in educational research: The case of inclusive education. *International Journal of Inclusive Education*, 5(2/3), 167-177.

Waitoller, F.R., & Artiles, A.J. (2013). A decade of professional development research for inclusive education: A critical review and notes for a research program. *Review of Educational Research* 83, 319-356.

Wehmeyer, M.L. (2006). Beyond access: ensuring progress in the general education curriculum for students with severe disabilities. *Research & Practice for Persons with Severe Disabilities*, 31(4), 322-326.

DRAFT

Figures and Tables

*Table 1**Description of Participants in the Case Study*

<u>Participant</u>	<u>Age</u>	<u>Years of Teaching</u>	<u>Professional Role</u>	<u>Grades Taught</u>
Melissa	22	1	Special Education	1-2 & 4-5
Sarah	30	8	Special Education	K-3
Claire	44	4	Special Education	K-3
Liz	44	15	General Education	1-2
Kim	51	29	General Education	4-5
Nancy	50	12	Special Education	4-5