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This brief is one of five perspective briefs developed as part of the Promoting Student Success in Algebra I (PSSA) project that summarize the perspectives of district administrators and math teachers about research on five strategies to help struggling students in Grades 6–9 succeed in algebra. For additional information regarding the project and the products developed, please visit http://www2.ed.gov/programs/dropout/resources.html

Professional Development to Support Teachers of Struggling Algebra I Students

Perspective Brief

This perspective brief offers an in-depth look at how district math leaders and Algebra I teachers think about research on the mechanisms for delivering professional development as a strategy to support student success in Algebra I.

The Promoting Student Success in Algebra I (PSSA) project, funded by the U.S. Department of Education, recently reviewed existing research on this strategy,[1] but the findings from this study may not capture practitioners' perspectives, shaped by their experience in the field. This brief examines whether the research findings resonate with practitioners experience, and if not, why not. It also examines practitioners' perspectives on what program developers and administrators need to consider when supporting the development and implementation of this strategy—the key challenges and barriers to success. Practitioners are uniquely positioned to identify key considerations given their knowledge and experience with this strategy to support struggling students.

The broad term *professional development* encompasses a variety of activities (e.g., workshops, seminars, study groups, and professional learning communities [PLCs]) and areas of focus (e.g., developing content knowledge, using curricular materials and assessments, and implementing teaching strategies). For both the research and the perspective briefs, we define professional development as programs designed to improve the teaching and learning of Algebra I or algebraic thinking. The programs include individual and group learning opportunities for teachers that take place both inside and outside schools, with or without the use of technology (Croft, Coggshall, Dolan, & Powers, 2010). We do not include professional development programs with a predominant coaching component—that is, where coaching makes up more than one third of the intervention—because a separate brief in this series examines coaching.

[1] See http://www2.ed.gov/programs/dropout/resources.html

Providing teachers with quality professional development opportunities is especially critical with the implementation of more rigorous college and career readiness standards in math and the adoption of the Common Core State Standards for Mathematics (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010), which incorporate math standards from h gh-performing countries and raise the bar for both what and how students learn (Kober & Rentner, 2012). As students are being asked to demonstrate a deeper understanding of math, teachers are being asked to create and sustain learning environments that support this level of understanding, heightening the need for professional development programs that reflect the most current research.

To better understand practitioners' perspectives on research on the delivery of professional development, we asked a focus group of four district math leaders (math coordinators, coaches, and instructional leaders) and a focus group of five Algebra I teachers to read the PSSA project's research brief outlining evidence to date—*Professional Development Strategies to Support Student Success in Algebra I: Research Brief*[2] —and discuss whether and how key research findings resonated with their experience. Key findings from the research brief are summarized briefly in Exhibit 1

Exhibit 1. Key Findings From the Review of Research on Professional Development

A review of rigorous research on professional development activities to promote student success in Algebra I suggested the following:

- Professional development can serve as an integral implementation support for broader programs or initiatives designed to improve instruction and student success in algebra, including initiatives to incorporate technology into the classroom.
- Strong algebra- or math-focused professional development programs have tended to do the following:
  - Exhibit features of other high-quality professional development programs, such as providing relevant, intensive, collaborative, and sustained opportunities for teacher learning.
  - Focus on strengthening students' reasoning and conceptual understanding, important prerequisite Algebra I topics.
  - Provide structured opportunities for algebra teachers to collaborate with one another and other experts through multiple mediums (e.g., online).
  - Include explicit connections to the classroom, including the use of video or other technologies that support reflections on teacher practice.

[2] See https://www2.ed.gov/programs/dropout/professionaldevelopment092414.pdf

To ensure that the practitioners' perspectives reflected at least some of the challenges facing both urban and rural educators, each focus group included one representative from a rural district and three or four representatives from some of the 100 largest districts across the country.[3] Both district math leaders and Algebra I teachers were asked to make connections between research and practice by addressing three broad questions:

- *How do the research findings resonate with your experiences in the field?*
- *What challenges do you foresee in implementing recommendations from the research, and what supports are needed?*
- *Are there any important factors to consider that are not addressed in the existing research?*

Analyses of the focus group data indicated that participants largely agreed with the research findings (see Exhibit 1), but o fered additional considerations for translating the findings into practice.

In short, district math leaders and Algebra I teachers suggested:

- Professional development is critical for both the successful launch of an initiative and ongoing implementation. Yet, securing long-term funding, frequent shifts in district priorities, and teacher turnover pose major barriers to sustaining professional development.
- Teachers should have structured opportunities to collaborate, both inside and outside their own schools, including opportunities for vertical articulation of algebraic content with teachers from other grade levels.
- Web-based professional development models can be efficient ways o deliver follow-up training and provide access to expert trainers, especially when teachers are dispersed geographically.

These perspectives of practitioners are elaborated in the following sections, and implications of these perspectives for program development and implementation are highlighted at the end of this brief. Because the perspectives highlighted in this brief represent only nine practitioners, we encourage readers to use caution when drawing conclusions. Nonetheless, these practitioners' voices give depth and richness to the findings in the research brief.

[3] See the appendix of this brief for additional information about the methods used to collect and analyze practitioners' perspectives.

Participants' Perspectives on the Research

The following sections highlight the perspectives of district math leaders and Algebra I teachers that emerged from focus group discussions. Because participants were asked specifically about their perspectives on key findings from the research brief, thei responses are organized around these topics. For each section, we begin with a brief recap of the relevant research findings, followed by an exploration of key themes from the focus group participants' reactions to the research. In the last section, we highlight implications for program developers and administrators.

RELEVANT, SUSTAINED PROFESSIONAL DEVELOPMENT TO SUPPORT BROADER MATH INITIATIVES

Several of the studies reviewed for this project found that professional development was more likely to be useful for teachers if it was sustained and intensive, connected to teachers' daily work, and coherent with other teaching and learning initiatives (Birman, Desimone, Porter, & Garet, 2000; Garet, Porter, Desimone, Birman, & Yoon, 2001; Hawley & Valli, 1999; Wilson & Berne, 1999). Numerous studies also found that professional development demonstrating such characteristics served as an important mechanism for developing the knowledge and skills that teachers need to implement broader programs or initiatives designed to improve instruction and student success in math (Balfanz, Mac Iver, & Byrnes, 2006; Deiger et al., 2009).

These key research findings resonated with focus group participants experience in implementing and participating in professional development. Both district and teacher focus group participants concurred with the research findings that professional development should be relevant and closely connected to teacher practice, indicating that teachers may be more likely to engage with professional learning activities when they clearly can see how the activities relate to their work. "That's really where you get the momentum—when teachers can see how this directly applies to me," one district participant observed. District and teacher participants also agreed with the premise that one way of fostering this sense of relevance is to integrate professional

> *"The [professional development] was 100 percent instrumental… without it, the initiative would have failed."*
> *—Algebra teacher*

development activities within larger initiatives designed to improve student success in algebra. Participants cited numerous examples of professional development programs they had experienced to support the implementation of new curricular programs, new instructional approaches, and, more recently, the Common Core State Standards. One teacher described a professional development series that he attended as "100 percent instrumental" in supporting teachers' implementation of a schoolwide math curriculum, noting how "without it, the initiative would've failed. The books would've stayed on the shelf. The calculators wouldn't have been used."

Both district and teacher focus group participants underscored how professional development can be particularly powerful in promoting the implementation of math initiatives when it involves ongoing support for teachers as they apply new skills or strategies in the classroom, a recommendation that echoes the research findings that professiona development should be sustained long term. One teacher pointed out how—even after he participated in intensive professional development sessions at the beginning of a new math initiative—he did not fully understand what he needed to know about the initiative until he began using it with regularity in his classroom. He explained, "We're experiential animals, and I think you have to have that time to use it and make mistakes and produce." The teacher participants argued that by engaging in follow-up professional learning activities, such as instructional coaching or collaborative meetings with other teachers involved in the initiative, they were able to hone their understanding of the initiative and troubleshoot difficulties they encountered in implementing it.

Professional development support is important both at the launch of an initiative and after teachers have had a chance to try things out in their classrooms.

Challenges in Sustaining Professional Development

Although the research reviewed highlighted the importance of integrating professional development with larger math initiatives (such as new curricular or instructional strategies) in order to improve instruction and student success, it did not focus on the challenges to sustaining professional development. This was, however, a topic discussed among the focus group participants. They cited several challenges. Securing long-term funding emerged as a particularly vexing concern, as did frequent shifts in district policies or priorities. The participants also noted challenges related to teacher turnover because new teachers coming on board may have less familiarity with specific

math initiatives than their veteran colleagues. The teacher participants suggested that new educator institutes, which provide specialized professional development to newly hired educators on the use of local curricular programs or other instructional initiatives, can help reduce some of the knowledge gap between new and experienced teachers.

To offset challenges related to teacher turnover, one district developed a cohort training model to differentiate support for new and experienced teachers.

For instance, one teacher described how her district regularly offered introductory trainings on the district math curriculum, explaining, "If you're new to any curriculum, you can go in the summer to a class specifically for that curriculum You go through the structure of the book, what the expectations are, great activities." A district participant described how his district rolled out a new Algebra I program using a cohort model that accounted for annual turnover in teaching staff. He explained how all teachers received a series of trainings during the initiative's first year to orient them to the program s instructional materials and pedagogical focus. In the following year, teachers who were new to the district—and, therefore, new to the initiative—underwent the same series of trainings while the initial cohort of veteran teachers received a different series of professional development sessions designed to deepen their understanding of the new curriculum and devise ways for them to support their newly hired colleagues who were encountering the curriculum for the first time.

PROFESSIONAL DEVELOPMENT TO SUPPORT THE USE OF TECHNOLOGY

An emerging body of research has highlighted how professional development can support teachers in using new technology in the classroom to promote students' mathematical reasoning skills or connect algebra to real-world situations (Frost & Everett, 2010; Owens et al., 2008; Science and Mathematics Program Improvement, 2012). District and teacher focus group participants generally concurred with these research findings, noting that support for implementation should stress how and when to use technology most effectively in Algebra I instruction.

Participants spoke positively about the value of using classroom technologies, such as interactive whiteboards, graphing calculators, and video, to enhance teachers' math instruction; perhaps not surprisingly, they readily agreed with the research findings about the usefulness of professional development in supporting the implementation of such instructional technologies. One district participant explained that two of their schools recently installed interactive whiteboards, yet some teachers have never turned them on because they were never provided professional development on how to use them.

Similarly, a teacher participant indicated that the complexity of operating new classroom technologies rendered professional development on their use particularly critical. He recalled his own experience learning a new technological device, explaining, "It's not just learning how to use this [technology] but learning the tools that go with this and learning the software, [how to] troubleshoot the software....There's lots of levels of learning that had to go on there."

Although all of the focus group participants agreed on the need for teachers to learn the mechanics of how to operate new technology, they emphasized that technology-related professional development also should feature a strong focus on how teachers can use the technology to promote students' conceptual understanding of math; that is, their comprehension of mathematical concepts, operations, and relations (National Research Council, 2001, pp. 5, 118). Instructional practices that promote conceptual understanding and procedural understanding are covered in detail in separate research and perspective briefs[4] as part of the project, but this set of focus group participants underscored the role of technology in promoting instruction that emphasizes sense making and encourages conceptual understanding.[5]

Teachers need to be trained how to operate instructional technology, but it can't stop there. They also need to be trained how to use that technology to promote student understanding—the ultimate goal.

One district administrator lamented that even though teachers in her district had access to a great deal of technology, she did not see them using it for a specific purpose because they had never received professional development about using it in an instructional way. Another administrator asserted the following about professional development on technology: "It has to focus on why you're using the technology and how the technology is going to support student learning. It's not about pushing the buttons and everything. It's how is that going to make algebra more accessible to students."

The district focus group participants noted that professional development on technology also should address when—and when not—to use technology, warning that students may become overly reliant on technology if teachers fail to make such distinctions. One district administrator cautioned: "It's not just about you do everything with the technology, but what does the technology allow students to do that they can't do otherwise? What are also skills that you want kids to do without the technology? You don't want it to be a crutch, so where is it really supporting their learning and not doing the work for them?"

[4] See https://www2.ed.gov/programs/dropout/instructionalcoaching092414.pdf

[5] See also the 2016 National Educational Technology Plan at http://tech.edu.gov/netp/

While optimistic about technology in the classroom to support algebra instruction and student success, respondents felt that access to new instructional technologies must be coupled with professional development. Teachers need an opportunity to learn how and when to use the technology properly and effectively.

INCLUDING OPPORTUNITIES FOR TEACHER COLLABORATION

Research on math professional development has underscored the benefits of including activities that offer structured opportunities for teachers to collaborate with their peers (Birman et al., 2000; Garet et al., 2001). The reviewed research's emphasis on such activities resonated strongly with both district and teacher focus group participants, who described opportunities for teacher interaction during professional development as an important means of facilitating teachers' immediate and long-term growth. The teacher participants highlighted how having structured occasions to work with their peers—for instance, through regularly scheduled collaboration meetings such as PLCs or designated collaboration time during workshop sessions—can help teachers collectively make sense of professional development content and determine how to apply new knowledge and strategies in their instruction. One teacher mentioned how incorporating time for collaborative teacher planning into professional development workshops allows teachers space to digest what they have learned, bounce ideas off one another, and develop a plan for implementation. The teacher participants also noted how meeting with colleagues from other grade levels or schools helped broaden their understanding of the local educational context beyond their own classrooms. For example, one teacher described how a collaborative professional development session between middle school and high school teachers provided insights into the vertical alignment of math concepts across grade levels. He explained, "We got to see each other's curriculum. We got to talk about, '[If] they're doing that in middle school, then why are we reteaching it? Oh, maybe we shouldn't be...because they already know it.'" This idea of vertical team collaboration and the opportunity it creates for teachers to better understand the content and how it builds is explained further in the perspective brief[6] on curricular alignment.

Teachers find value in structured opportunities to collaborate, which can occur within and across schools and grade levels.

Gathering teachers from different schools may be particularly helpful for teachers in small schools, who have fewer within-school peers with whom to collaborate. For instance, an administrator from a rural district related how she established cross-school teacher

[6] See https://www2.ed.gov/programs/dropout/curricularalignment092414.pdf

collaboration meetings because the K–8 schools in her district each had only one teacher who taught seventh- and eighth-grade math. "They don't have any communication with any other teachers [who] teach what they teach," the administrator explained. "At the district level, I just saw a need for them to have some communication with each other, to share ideas and to have that discussion."

The need for collaboration can be especially salient for teachers in small rural schools.

In addition to facilitating peer-to-peer teacher learning during formal professional development activities, the focus group participants indicated that collaborative professional learning experiences may foster collegial relationships and shared knowledge that contribute to a broader culture of collaboration within teachers' daily work environment. The teacher participants underscored how attending professional development programs with school-level colleagues or as part of an established cohort of teachers gave them access to a network of individuals to whom they could turn for support as they applied their new learning in their classrooms. The district participants also stressed the importance of supporting ongoing teacher interactions to ensure that teachers have peer support for making important instructional decisions. One district participant asserted that professional development needed to be about more than just transmitting new knowledge and strategies to teachers: "You've got to also engage them in this PLC so that when they go back to buildings, that they work with others on [it] there. It's more than just training them. It's how do you help them learn to make good decisions in the moment in classrooms....It's the understanding of why you would want to do this, how you would do it, when you would do it, what are all the decisions that you have to make.... It's building you as a professional and having the school systems and structures in place where you can work with others to really, in the moment, work on that."

In agreement, another district administrator added, "What we really want to shoot for is teacher interdependence—that this is not an individual sport." As detailed next, technology is creating a platform for ongoing peer collaboration as well as expanding access to sustainable and quality professional development.

USE OF WEB- AND VIDEO-BASED TECHNOLOGIES AS DELIVERY TOOLS

Recent studies highlighted in the research brief have shown promise in harnessing new Web- and video-based technology, such as webinars and online teacher forums, to enhance face-to-face professional development activities or allow educators to connect with professional development providers and other teachers without needing to be in the same physical location (Borko et al., 2008; Hill & Collopy, 2003; O'Dwyer, Carey, & Kleinman, 2007a, 2007b). The district and teacher focus group participants saw potential in using such new technologies, particularly as a means of overcoming cost and geographic distance barriers to provide collaborative, sustained, and relevant professional development opportunities. The participants described how Web-based delivery systems can help facilitate professional development that promotes ongoing teacher collaboration by bridging distances virtually between teachers and avoiding the need for travel. In many instances, the participants described the use of such systems as follow-up sessions to initial in-person professional development sessions. For example, one district participant described using webinars to provide teachers with collaborative, follow-up support as part of a districtwide professional development initiative on rigorous mathematical tasks. He explained how the initiative began with a full-day Saturday session and an afterschool meeting, followed by a series of regularly scheduled webinars for which teachers would log onto the computer at their classroom workspace and participate in virtual discussions about rigorous tasks with colleagues throughout the district. By holding these discussions online, the district saved teachers the time required to travel to a centralized meeting location. A teacher participant also touted the benefits of using online teacher forums, citing her experience using one to share instructional materials and tasks with teachers throughout the state. She pointed out how the online system allowed her to regularly collaborate with a teacher who was participating in the same professional development initiative but lived eight hours away.

Web-based professional development can be an efficient, cost-effective way to provide follow-up training, especially for teachers who are geographically dispersed.

One advantage of Web-based professional development over some "train-the-trainer" models is consistent presentation ofthe content.

The focus group participants further explained how Web-based professional development delivery platforms can support teachers' direct and centralized access to expert professional development providers, which otherwise may prove difficult, especially for rural districts in remote locations or urban districts

with teachers dispersed across many schools. For example, one district administrator described how his large, urban district had past difficulty usi g "train-the-trainer" approaches to professional development, in which designated school representatives attend professional development sessions and then share the content they learn with colleagues within their school. He indicated that, under this delivery method, the content of district professional development sessions often was corrupted when trainers transferred it down to the school level, resulting in widely varying understandings of the content. Online professional development systems, such as webinars, allow for broad-based teacher access to a consistent presentation of content, thereby reducing the number of layers through which the content is transmitted.

SUMMARY OF PERSPECTIVES ON PROFESSIONAL DEVELOPMENT

In summary, focus group participants affirmed findings presented in the r earch brief on professional development. However, the experience of district leaders and math teachers gave insight to the challenges of sustaining professional development. Participants saw potential in Web-based delivery as a means of providing sustainable and collaborative professional development, two features emphasized by the research and respondents. In particular, district leaders and math teachers saw collaboration across schools and grades as a valuable strategy for teacher growth. Lastly, respondents recognized the role of professional development in supporting the implementation of larger math initiatives, specifically the use of instructional technologies to promote students' conceptual understanding.

Implications for Program Developers and Administrators

The district administrators and math teachers who shared their perspectives on professional development research for this brief revealed several potential insights for program developers and administrators who are working to improve the quality of algebra teaching and learning through professional development initiatives. Although participants often concurred with the research findings, they did expand on hat research with insights from their own experiences. As program developers and administrators consider implementing professional development, they should consider how the reactions of the participants in this particular project may or may not relate to their own educational context. Exhibit 2 summarizes those insights along with potential implications for local practice.

Exhibit 2. Key Findings From Focus Group Participants' Perspectives on the Research and Implications for Practice

Key Focus Group Findings	Considerations for Program Developers and Administrators
Focus on implementing broader programs or initiatives designed to improve student success in algebra, such as new curricular initiatives or approaches to instruction.	Integrate intensive and sustained professional development opportunities that support teachers in learning, applying, and troubleshooting new strategies or materials designed to support student learning in math.
Focus on implementing technology in ways that strengthen students' reasoning and conceptual understanding.	Provide strong professional development support when introducing graphing calculators or software programs designed to improve algebra teaching and learning. • Ensure that the professional development emphasizes not only the mechanics of operating the new technology but also the ways in which teachers can use the technology to enhance students' understanding of mathematical concepts.
Feature collective teacher participation and structured opportunities for teacher collaboration.	Provide regular opportunities for teachers to collaborate with peers within and outside their school, with the goal of fostering ongoing peer-support networks and a collaborative teacher work environment.
Include both online and face-to-face delivery mechanisms.	• Leverage Web-based technologies to widen teachers' access to colleagues and experts with whom they can collaborate and share instructional materials. • Provide training to teachers and professional development providers to enhance their skill and comfort level in effectively using Web-based professional development tools.

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Appendix

To examine how district policymakers and teachers use and make sense of research on professional development, the project team convened a group of experienced district math leaders (including math coordinators, district math coaches, and other district-level instructional leaders) and teachers of Algebra I to participate in focus group discussions about key findings from the research.

Using a multistep process, we purposively selected focus group participants to include district administrators and teachers on the basis of their degree of knowledge and experience with the strategies of interest as well as to ensure representation of diverse types of educational contexts (e.g., rural and urban settings, middle and high schools). We identified school districts among the 100 largest local education agencies and from a list of all U.S. rural districts with which project team members previously had worked or had been referred to us by external experts as strong candidates for discussions focused on helping struggling students succeed in Algebra I. Making sure we nominated no more than two districts from the same state, we identified 14 initial districts—10 urban and four rural—which we contacted by e-mail with information about the project and a request for an informational interview. Each nominated district was asked to nominate a teacher representative and to share biographical information for both district and teacher representatives. Nominated representatives subsequently participated in a brief interview designed to assess their experience and familiarity with five f cal strategies for the *Promoting Student Success in Algebra* project, as well as their interest and availability in participating in the focus groups, to be conducted as part of a two-day meeting held at the offices of American Institutes for Research (AIR) in Washington, D.C. The U.S. Department of Education's Office of Elementary and Secondary Education (OESE) and AIR ultimately selected seven of the 14 districts (five urban, wo rural) from seven states located in different regions of the United States to participate in the focus groups, including one district and one teacher representative for each district (14 individuals total). District and teacher representatives collectively averaged 15 years of experience teaching math, and teacher representatives averaged nine years of experience teaching Algebra I specificall .

Participants were asked to read the research briefs in advance, and received a series of open-ended questions to guide their reading. For each of the five topic areas of focus in this study, two 90-minute focus groups with either four or five participants were conducted, one with district leaders and one with teachers. This configuration provided space for participants to focus on the issues most salient to the role they play in the district and be forthright in their responses as they were surrounded by their district- or classroom-level peers. The project team ensured that each focus group included at least one participant from a rural district. The facilitators of the focus groups were careful to

ensure that they monitored the time during the focus groups so that they covered all topics during the discussion.

The focus group protocol featured open-ended questions designed to elicit deep conversation about specific research findings from the research briefs. To facilitate conversation, each question was followed by focused probes to ascertain insights into important areas. For example, probes explored questions regarding “how,” “under what conditions,” and “why” to gain a full understanding of participants’ perspectives on each strategy as well as contextual factors that affect those perspectives.

To facilitate data collection, all focus group sessions were audio-recorded and featured a note-taker, who captured information that provided context for the audio-recording (e.g., keeping a record of which remarks came from which participant in case it was difficult to distinguish speakers on the audio-recording). Following the meeting, transcriptions of each focus group were created and content-coded. The study team analyzed and coded data with an initial set of codes based on themes that emerged in the research briefs and, in iterative fashion, codes were combined and/or revised as patterns emerged. Transcripts were double-coded and assessed for interrater agreement, with disagreements resolved to agreement. Findings from these analyses form the basis of this perspective brief, with the goal of documenting key insights from administrators and teachers on the extent to which the research resonates with their own experience and the important factors that are not addressed in the existing literature.

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