April 2011

Bridging Professional Development and Context: Integrating Mathematics and Academic Language in a District Facing Takeover

Patricia Swanson
San Jose State University

David Whitenack
San Jose State University, david.whitenack@sjsu.edu

Bridging Professional Development and Context: Integrating Mathematics and Academic Language in a District Facing Takeover

Introduction

This study examines a Gr. 3-8 professional development initiative focused on the integration of mathematics and academic language development. Research questions focus on (a) whether participating teachers perceived the professional development as beneficial in terms of student learning and feasible in terms of implementation and (b) whether teachers implemented the strategies in their classrooms. Throughout the study, we explore teachers' insights into the tension between (1) content coverage required by pacing guides and high-stakes testing and (2) the development of conceptual understanding in mathematics and content-specific academic language. This inquiry has implications regarding effective design of professional development, and identification of policies that hinder or facilitate teachers' classroom implementation of the professional development in districts serving our neediest students.

A key feature of this study is the context in which it occurs. We provided professional development to a large urban district in which 78% of students are socio-economically disadvantaged (California Department of Education, 2010c) and 97% are students of color (California Department of Education, 2010b). Almost 60% of students are designated as Limited English Proficient (California Department of Education, 2010a). The district faces imminent state takeover if standardized test scores fail to improve. Instruction is rigidly controlled through pacing guides designed to maximize content coverage. Scripted, timed lessons push teachers through the curriculum in preparation for standardized tests. Within this context, we sought to enhance teachers' pedagogical content knowledge in critical foundations of algebra, i.e., fractions, rational numbers, and proportional reasoning (National Mathematics Advisory, 2008), while simultaneously teaching strategies to develop the academic content language specific to mathematics.

Theoretical Framework

Research on professional development, pedagogical content knowledge, and the education of English learners informs this study.

Professional Development

Guskey's (2000) model to evaluate professional development calls for data to be gathered related to five areas: participants' reactions, participants' learning, organizational support and change, participants' use of new knowledge/skills, and student learning outcomes. We focus on three of these areas: participants reactions, use of knowledge and skills, and student learning outcomes.

We sought to incorporate key features, identified from the literature, of

professional development linked to student achievement (Guskey and Yoon, 2009; National Mathematics Advisory Panel, 2008; Yoon, Duncan, Lee, Scarloss, and Shapley, 2007). These characteristics include a focus on implementing research-based instructional practices, involving participants in active learning experiences, and providing opportunities for teachers to adapt instructional practices to their particular classrooms. Effective professional development generally includes at least 30 contact hours, utilizes personnel (experts) from outside the school, provides follow-up, and focuses on specific subject-matter content and pedagogy (Guskey and Yoon, 2009; Yoon et al., 2007). We built each of these features (with the exception of the 30 hour minimum) into the professional development under study.

Pedagogical Content Knowledge and Mathematics Education

We grounded the professional development in the notion of pedagogical content knowledge. Shulman (1987) conceptualizes pedagogical content knowledge as "the blending of content and pedagogy" adapted to the unique needs of the learner (p.8). Ball and Bass (2000) apply this conceptualization to mathematics, exploring and defining the pedagogical content knowledge necessary for teaching mathematics well. Research increasingly supports the link between teachers' pedagogical content knowledge in mathematics and student achievement (Hill, Rowan, and Ball, 2005). We designed the professional development to enhance teachers' mathematical content knowledge and teach specific pedagogical strategies to increase engagement, foster access for diverse learners, and develop academic language.

Academic Language and the Education of English Learners

To achieve academically, English learners must develop language related to specific content areas, in this case mathematics (Goldenberg, 2008). Academic content language includes both vocabulary and language structures (Bailey, 2007; Echevarría, Vogt, and Short, 2010; Scarcella, 2003; Schleppegrell, 2004). Supports for English language learners developing academic language include consistent classroom routines, graphic organizers, additional practice time, multiple representations of key information, emphasizing key vocabulary, extended interactions with teacher and peers, and objectives for both content and language (Goldenberg, 2008; Walqui, 2006).

In this study, we selected language strategies (Echevarría, Vogt, and Short, 2008; Vogt and Echevarría, 2007) that could be easily linked to mathematics content, and strategies that could be embedded in the direct instruction lesson format mandated by the district. They included (1) related content and language objectives, (2) teaching vocabulary in context, (3) pair shares, and (4) structured sentence frames.

Planning Professional Development

A noteworthy feature of this professional development initiative is that we planned it collaboratively with district personnel in an attempt to make teachers' subsequent implementation of strategies more feasible. We met three times with district administrators and resource teachers for mathematics and language to develop the workshop content and foci, becoming familiar with newly adopted mathematics texts,

district pacing guides, benchmark assessments, and key standards. We matched mathematics content to be addressed in the professional development workshops with key topics in the district's pacing guides. Additionally, we developed workshop content by creating examples directly related to the district's mathematics texts. In May 2010, after state testing, we provided three 6.5-hour workshops, one each for Grades 3-4, 5-6, and 7-8, respectively. The Gr. 3-4 workshop focused on developing students' conceptual understanding of fractions. The foci of the Gr. 5-6 workshop were fractions, decimals, and percents. Finally, proportional reasoning, ratio, slope, and linear equations comprised the content of the Gr. 7-8 workshop.

Research Methodology

This study has a quasi-experimental design and uses qualitative and quantitative methods (Gay, Mills, and Airasian, 2006; Glesne, 2006).

Participants

A district-distributed flyer advertised single workshops for Gr. 3-4, 5-6, and 7-8. From among the attendees at the respective workshops, 14 Gr. 3-4 teachers self-selected to participate in our research; 10 Gr. 5-6 teachers and 7 Gr. 7-8 teachers also chose to participate. Participants represented a balanced distribution of experience ranging from first-year teachers to 25-year veterans.

Data Sources

Initial Questionnaire

We administered an initial questionnaire, including both Likert-scale and open-ended responses, immediately after each workshop to determine the degree to which teachers anticipated that the strategies would enhance student learning and prove feasible to implement in their classrooms. We designed the initial questionnaire to capture teachers' perceptions of the utility and feasibility of the mathematics and language development strategies presented. We developed questionnaire prompts to correspond to each specific strategy or content sequence presented during workshops. For each strategy, participants rated the degree to which they felt the strategy would facilitate student learning, rated their level of confidence, and estimated their likelihood of use. The questionnaire also included open-ended prompts probing for factors that would assist or inhibit teachers in implementing the strategies.

Follow-up Surveys

We administered the first follow-up survey (using Survey Monkey) in the summer of 2010, capturing teachers' use of the workshop strategies before the end of AY 2009-2010, and which strategies they favored. We used Likert-scale prompts to probe teachers' perceptions regarding the degree to which the strategy facilitated students' learning, increased engagement, supported their text, and permitted them to keep pace with the district pacing guide. In addition, for each mathematics strategy, we asked the degree to which they incorporated corresponding language development strategies. We also included open-ended prompts on the strengths and challenges of using each new

strategy. We administered the second and third follow-up surveys in the fall of 2010 and followed-up with telephone interviews in early spring of 2011. The survey instrument and interviews utilized the same prompts and captured the degree to which teachers incorporated the strategies when teaching under the pressures of their pacing guides and district benchmark assessments.

Data Analysis

The various data collection instruments that we have used throughout this study provide us with data to triangulate (Glesne, 2006), and deepen our understanding of how teachers use the strategies. We coded fieldnotes that we had taken during planning meetings, initial workshops, and classroom observations. We triangulated fieldnotes with data from the initial questionnaire and follow-up surveys and teacher interviews. We grouped questionnaire and survey responses by grade level and calculated summary statistics for Likert-scale items and indices. We coded open-ended responses, establishing inter-rater reliability at 90%.

Results and Discussion

Findings to date are based on analyses of fieldnotes, the initial questionnaire given immediately following the workshops, and all follow-up surveys and interviews collected through March 2011 capturing the first semester of implementation.

Integrated Mathematics and Language Strategies Perceived as Feasible and Effective

Table 1 provides mean Likert scale (1-5) scores by grade-level cluster of teachers' perceptions as reported on the initial questionnaire. Items measured two related dimensions of feasibility: (1) teachers' confidence in their ability to use strategies, and (2) likelihood that they would use strategies. For each dimension, a score of 1 indicates a low level of feasibility while a score of 5 indicates a high level of feasibility. Initial questionnaire results immediately following the workshops, show that teachers felt confident in their ability to implement the strategies and thought they would use them in their classrooms.

Table 1
Mean Likert Scale Scores of Teachers' Perceptions Before Implementation (Spring '10)

Grade Level (n)	Confidence in Use (1=not confident, 5=confident)				Likelihood of Use (1=not likely, 5=likely)			
	Math		Language		Math		Language	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
3-4 (14)	4.19	0.43	3.84	0.46	4.73	0.45	4.54	0.54
5-6 (10)	4.13	0.43	4.25	0.46	4.53	0.5	4.54	0.43
7-8 (7)	3.86	0.82	4.01	0.33	4.33	0.6	4.5	0.5

Table 2 tracks respondents' classroom implementation of the mathematics and language strategies presented in the professional development workshops. Of the 31 participants, 17 (55%) responded to the survey or interview. Of those who responded 11 (65%) implemented some of the content strategies presented at the workshops. Table 2 also indicates the average number of content strategies implemented by grade level band, showing most teachers had implemented one to two content strategies by March 2011. For each content strategy indicated, teachers integrated on average one to three corresponding language strategies. Most teachers (65% of respondents) were using the mathematics strategies and consistently embedding the corresponding content-specific language development strategies.

Table 2
Content and Language Strategy Implementation '10-'11 School Year

Grade	Number of Participants	Number That Responded to Survey and/or Interview	Number That Implemented Content Strategies*	Average # of Content Strategies Implemented	Average # of Embedded Language Strategies per Implementation
3-4	14	7	4	1.75	2.57
5-6	10	7	5	2	2.2
7-8	7	3	2	1.5	1.67

* 4 participants withdrew from project due to changes in grade level or employment status

Table 3 compares the degree to which teachers felt the new strategies would maximize student learning before implementation (from the initial questionnaire following the workshop), and after strategy implementation in the classroom (from subsequent follow-up surveys or interviews). Teachers' initial belief that the strategies would maximize student learning remained strong after using the strategies in the classroom. They also indicated that embedding the language strategies presented in the professional development workshops improved their ability to integrate mathematics and language development. The consistency with which they integrated language development strategies into math content lessons speaks to its practical feasibility and teachers' belief that the integration of language and mathematics would foster student learning. While we were not able to measure student learning directly in this study,

following implementation teachers' belief that the strategies maximized student learning remained strong.

Table 3

Perceived Improvement in Student Learning and Language Integration

Grade Level (n)	Before Implementation		After Implementation			
	Maximized Student Learning		Maximized Student Learning		Improved Integration of Mathematics and Language	
	(1=inferior, 5=superior)		(1=strongly disagree, 5=strongly agree)			
	Mean	SD	Mean (n)	SD	Mean (n)	SD
3-4 (14)	4.66	0.38	4.92(4)	0.43	4.55 (4)	0.27
5-6 (10)	4.3	0.37	4.55(5)	0.5	4.59(5)	0.32
7-8 (8)	4.43	0.82	4.00(2)	0	4.00(2)	0

Tension Between Teaching Effectively and Following Pacing Guide

Quantitative and qualitative responses to the initial questionnaire show a stark contrast between teachers' belief that the strategies would help them to effectively teach and their belief that they could stay on track with their pacing guides. Table 4 compares mean Likert-scale (1-5) scores on these questions by grade level. For each question, a score of 1 indicates a low level of belief while a score of 5 indicates a high level of belief. Additionally, in their qualitative responses, 72% of teachers noted that the pacing guide moved too quickly, and 34% specifically commented that the guide was not aligned with their students' needs. One teacher commented, "The district's pacing guide has forced me to rush with my teaching and not have time to check for understanding." Another said, "Although the strategies presented were outstanding, I feel if I utilized every strategy, I would fall behind the pacing guide." These comments were echoed repeatedly in the initial questionnaire.

Table 4

Comparison of Mean Scores for Effectively Teaching to Standards and Staying on Schedule with Pacing Guides

Grade Level (n)	Effectively Teach to Standards (1=no belief, 5=great belief)		Stay on Schedule with Pacing Guide (1=no belief, 5=great belief)	
	Mean	SD	Mean	SD
Gr. 3-4 (14)	4.86	0.36	3	1.22
Gr. 5-6 (10)	4.95	0.16	3.75	0.79
Gr. 7-8 (7)	4.78	0.44	3.17	0.61

Table 5 compares responses to the pacing guide prompt from the initial questionnaire (anticipated) to teachers' response following implementation of the strategies (actual). While virtually all teachers expressed concern initially on keeping pace with the district pacing guide, following implementation the level of their concern varied by grade level. Gr., 3-4 teachers, whose workshop focused on developing students' conceptual understanding of fractions, experienced little difficulty with their pacing guide, probably because developing conceptual understanding of fractions is a key emphasis at these grade levels. Those teaching Gr. 5-6, with a workshop focusing on fractions, decimals, and percents, experienced greater difficulty with their pacing guide. Their grade-level standards require students to rely on their previous understanding of fractions and move quickly to more complex computations (i.e., fraction operations and conversions to decimals). One teacher commenting on the strategy of using benchmark fractions close to zero, one-half, or one for fraction comparison stated, "It's a really good supplement if I had time to implement correctly." Another remarked, "It's not the fault of the strategy; it's the fault of the pacing guide. The strategies are fine. It's just the time needed to do them well. [A] one-time shot is going to be next to useless." Only one 7-8 teacher, whose workshop focused on proportional reasoning, ratio, slope, and linear equations, responded to this prompt, giving a score of 1 and commenting "the pacing guide went out the window when the kids arrived not knowing how to subtract."

Table 5

Mean Likert Scale Scores for Anticipated vs. Actual Ability to Stay on Schedule with Pacing Guides

Grade Level	Anticipated (1=no belief, 5=great belief)		Actual (1=not at all, 5=great extent)	
	Mean(n)	SD	Mean(n)	SD
3-4	3 (14)	1.22	5(4)	0
5-6	3.75(10)	0.79	2.5(5)	2.05
7-8	3.17(7)	0.61	1 (1)	0

To a degree, the increasing level of concern by grade level regarding keeping up with the district pacing guide speaks to the degree to which teachers felt the workshop content corresponded with specific lessons in their text book. As the curricular materials moved to increasingly complex concepts and computation, dependent on previous understandings that many student did not have, teachers were torn between the need to revisit foundational concepts or move ahead to cover grade level standards – standards often dependent on poorly understood concepts. Table 6 provides some evidence for this trend comparing by grade level how well teachers felt the workshop strategies supported or supplemented lessons in their grade level text. The degree to which they felt workshop content was well aligned with their text decreased by grade level.

Table 6

Extent to Which Implemented Strategies Supported or Supplemented Adopted Text

Grade Level (n)	Supported or Supplemented Adopted Text (1=not at all, 5=great extent)	
	Mean	SD
3-4 (4)	4.8	0.87
5-6 (5)	3.75	1.27
7-8 (2)	3	0

The Challenge of Time

Qualitative comments from the initial questionnaire indicate that many teachers believed they would need time to practice the strategies to build their confidence, a concern mirrored in the research (Bowers, Fitts, Quirk, and Jung, 2010). Teachers at all grade levels anticipated that lack of time would be the greatest constraint to implementation. While time did not appear to be a constraint for Gr. 3-4 teachers following implementation, it remained a primary concern for upper grade teachers who often commented that they had not implemented as well as they would have liked due to lack of time.

Conclusion

Three conclusions have emerged from this study. First, when professional developers collaborate with district personnel and adapt professional development content to meld with district context, including curriculum, pacing guide, and scheduling, teachers view the presented strategies as feasible and implement them. Second, pacing guides and professional development can work at cross-purposes; strict pacing guides that push teachers through the curriculum may act as barriers to teachers' implementation of professional development strategies and, ultimately, student learning. Finally, teachers see the integration of subject-specific content and academic language development as useful, feasible, and practical in enhancing student learning. Because of the nature of this study, we recognize that these conclusions may be unique to the context in which this inquiry has been situated.

Implications

Implications can be drawn from each of the three above conclusions. First, based on our experience in this study, it seems worthwhile to further study what happens when participants collaboratively plan professional development experiences with those who will deliver it. Additional research could also focus on ways to mediate the tension between teachers' implementation of research-based practices learned during professional development and strict pacing guides that pressure teachers to "cover" curriculum rather than teach it in depth while carefully attending to student learning. Finally, further study is needed on professional development that integrates subject-specific content and academic language development, particularly in light of teachers' experience in this study that such integration is useful, feasible, and practical in enhancing student learning.

References

Bailey, A. L. (2007). Introduction: Teaching and assessing students learning English in school. In A. L. Bailey (Ed.), *The language demands of school: Putting academic English to the test* (pp. 1-26). New Haven: Yale University Press.

Ball, D. L. & Bass, H. (2000). Interweaving content and pedagogy in teaching and learning to teach: Knowing and using mathematics. In J. Boaler (Ed.), *Multiple perspectives on the teaching and learning of mathematics* (pp. 83-104). Westport, CT: Ablex.

Bowers, E., Fitts, S., Quirk, M., & Jung, W. (2010). Effective strategies for developing academic English: Professional development and teacher practices. *Bilingual Research Journal, 33*(1), 95-110.

California Department of Education. (2010a). DataQuest: District enrollment by English learners. Retrieved July 15, 2010 from http://dq.cde.ca.gov/dataquest/

California Department of Education. (2010b). DataQuest: District enrollment by ethnicity. Retrieved July 15, 2010 from http://dq.cde.ca.gov/dataquest/

California Department of Education. (2010c). Free/reduced meals program & CALWORKS data files. Retrieved July 15, 2010 from http://www.cde.ca.gov/ds/sh/cw/filesafdc.asp

Echevarría, J., Vogt, M., & Short, D. (2008). *Making content comprehensible for English learners: The SIOP model*. Boston: Allyn and Bacon.

Echevarría, J., Vogt, M., & Short, D. (2010). Making content comprehensible for elementary English learners: The SIOP model. Boston: Allyn ands Bacon.

Gay, L. R., Mills, G. E., Airasian, P. (2006). *Educational research: Competencies for analysis and applications*, (8th ed.). Upper Saddle River, NJ: Pearson Merrill Prentice Hall.

Glesne, C. (2006). *Becoming qualitative researchers: An introduction* (3rd edition). Boston: Allyn and Bacon.

Goldenberg, C. (2008). Teaching English language learners: What the research does— and does not—say. *American Educator, 32*(2), 8-23, 42-44.

Guskey, T. R. (2000). *Evaluating professional development.* Thousand Oaks, CA: Corwin.

Guskey, T. R., & Yoon, K. S. (2009). What works in professional development? *Phi Delta Kappan, 90*(7), 495-500.

Hill, H. C. (2004). Professional development standards and practices in elementary school mathematics. *Elementary School Journal, 104*(3), 215-231.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal, 42*(1), 371-406.

National Mathematics Advisory Panel (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel*. Washington, DC: U.S. Department of Education.

Scarcella, R. (2003). Academic English: A conceptual framework. University of California Linguistic Minority Research Institute Technical Report 2003-1.

Schleppegrell, M. J. (2004). The language of schooling: A functional linguistics perspective. New York: Routledge.

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1): 1-22.

Vogt, M., & Echevarría, J. (2007). 99 ideas and activities for teaching English learners with the SIOP model. Boston: Allyn and Bacon.

Walqui, A. (2006). Scaffolding instruction for English language learners: A conceptual framework. *International Journal of Bilingual Education and Bilingualism, 9*(2), 159-180.

Yoon, K. S., Duncan, T., Lee, S. W.-Y., Scarloss, B., & Shapley, K. L. (2007). *Reviewing the evidence on how teacher professional development affects student achievement* (Issues & Answers Report, REL 2007–No. 033). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southwest. Retrieved July 7, 2010 from http://ies.ed.gov/ncee/edlabs