Creating a Model for Sustainable Ambitious Mathematics Programs in High-Need Settings: A Researcher-Practitioner Collaboration

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Purpose

This project is a collaboration among researchers, professional development leaders, students, teachers, coaches, and administrators to study an existing, established, and successful ambitious mathematics program in a high-need secondary school. The team seeks to (1) understand the demands created throughout a school or district when implementing an ambitious secondary mathematics program in high-need contexts; (2) identify the resources and organizational dynamics necessary to address the demands and thus sustain the program; and (3) articulate a model of a sustainable ambitious mathematics program that has validity across a range of implementation contexts.

Research Questions

- What are the demands related to implementing an ambitious mathematics program?
- What is the nature of the curriculum and instruction?
- How are demands communicated between groups of stakeholders?
- What resources do stakeholders identify as necessary to address the demands they have identified?
- How are resources identified and allocated? How do stakeholders solicit views on the resources needed to sustain the program?
- How responsive are the decision-making structures to the resource needs of multiple stakeholders?
- How can the organizational structure be modified to better address the demand-resource pairings?
- How valid are versions of the model with respect to multiple contexts?

Select Presentations & Publications

Al, S., Choppin, J., & Zahner, B. (2023). Balancing obligations when adapting mathematics curriculum materials to be culturally relevant. *Paper presented at the 2023 American Educational Research Association Annual Meeting*, Chicago, IL.

Choppin, J., & Merliss, G. (2022). Exploring the impact of COVID on an ambitious mathematics program in a high poverty context. *Paper presented at the 2022 American Educational Research Association Annual Meeting*, San Diego, CA.

Zahner, W., Green, C., Tenney, K., Pelaez, K., Choppin, J., & Al, S. (2021). What is ambitious mathematics teaching? A literature synthesis. In Olanoff, D., Johnson, K., & Spitzer, S. (Eds.), *Proceedings of the forty-third annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 1600-1601). Philadelphia, PA.

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Definition of Ambitious Math Teaching

The goal of AMT is to equitably engage students in mathematical activities that involve essential mathematical ideas and that use participation structures and pedagogy that position students as important and competent intellectual contributors (Lampert et al., 2010; Singer-Gabella et al., 2016). We list our three dimensions of AMT below.

Eliciting and responding to student thinking
Ambitious mathematics teaching is dialogic. Dialogic or collaborative learning environments imply "a joint production of ideas, where students offer their thoughts, attend and respond to each other's ideas, and generate shared meaning or understanding through their joint efforts" (Staples, 2007, p. 162).

Positioning students as sources of mathematical authority
An important outcome of eliciting and responding to student thinking is the development of student autonomy and positioning students as mathematical authorities. The focus on student autonomy rests on the assumption that students possess mathematical competencies on which to develop key disciplinary content; thus, AMT coincides with asset-based perspectives (e.g., NCTM Research Committee, 2018).

Using complex, authentic, high-demand tasks
Ambitious mathematics teaching requires opportunities for students to reason about mathematics while solving tasks that pertain to important mathematical concepts, are non-routine, are accessible, and have multiple solution approaches.

Cross cutting theme: Emphasizing multiple dimensions of equity
Ambitious mathematics teaching has increasingly been described in terms of equitable opportunities for students to learn mathematics. Broadly speaking, the focus on equity has positioned teaching practices in terms of culturally responsive instruction. We interpret this to mean attending to the lived experiences of students, incorporating multiple modes of participation, and recognizing and building from students' social, linguistic, and cultural resources (cf. Moschkovich, 1999).

Demand-Resource Framework

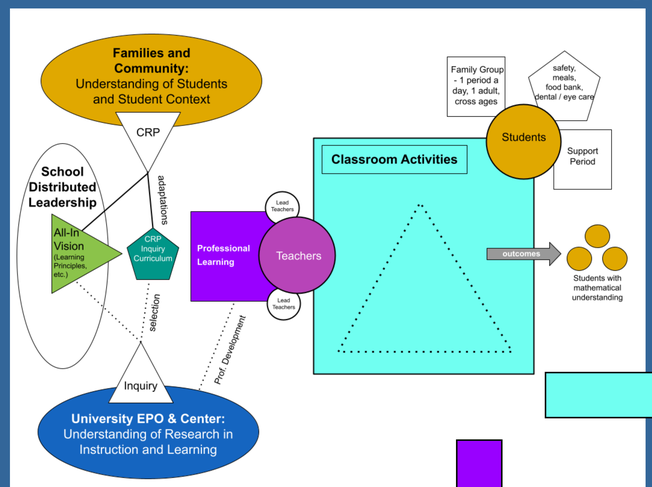
We defined a demand as a requirement for material or human resources that, if left unmet, will impede an instructional reform, including: materials (textbooks, infrastructure, technology); social resources (skills, knowledge, sensitivity); instructional practices (group-worthy tasks, structuring interactions); and organizational routines (decision making protocols; communication protocols).

We conjectured that AMT required **internal demands** beyond those entailed in conventional mathematics instruction and that resources needed to be made available to address those demands or AMT would fail to take hold. We further conjectured multi-layer nested arrangements of demand-resource pairings, in which a demand for one agent in the system (e.g., the demand for a student to participate in a classroom mathematical discussion) induces the need for the provision of resources by another agent (e.g., the teacher must provide resources by creating a classroom where students feel safe participating in mathematical discussions).

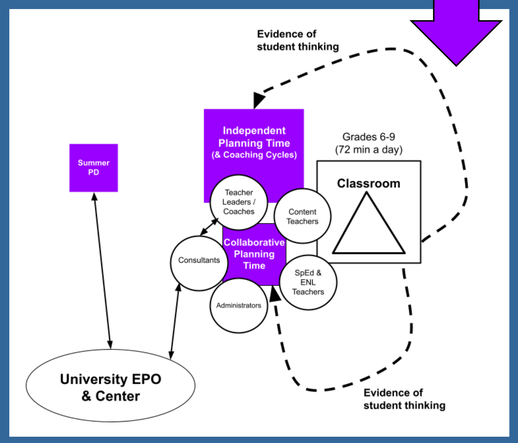
This led us to incorporate **external demands**, which we characterize as demands that originate from outside the classroom and push inward toward the classroom. External demands are generated by educational discourses and related policies voiced by stakeholders at the school, regional, and national levels.

In order to conceptualize the tensions between internal and external demands, we included the notions of alignment, balance, coherence, and buffering in the framework. We then turned back to the literature to flesh out these notions.

Model of Ambitious Mathematics Teaching



Professional Development Model



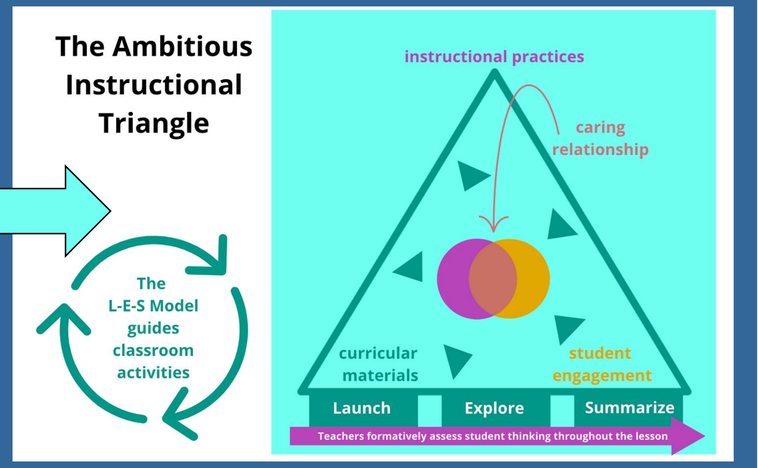
Data Collection & Analysis

We analyzed 45 interviews with a total of 22 teachers, teacher leaders, administrators, and external consultants. We used multiple interview protocols to explore: the development of the mathematics program; the instructional approaches in the mathematics program; the implementation of the program; the resources allocated to the implementation of the program; and the demands placed upon students, teachers, and instructional leaders.

Data Reduction Process
The project research team used a data reduction process using Saldaña's (2016) theming method to develop memos, collective memos, and supermemos. The lead researcher divided the transcripts into over 1500 passages whose lengths varied from 50 to 250 words, and then placed each passage into categories (e.g., implementation; instructional philosophy). After reconciling these memos for each passage into a collective memo, a researcher grouped the collective memos into supermemos, each of which had between 10 to 30 memos associated with it. The memos were intended to be low-inference and parsimonious paraphrases of the original passages, while supermemos were intended to represent themes emerging from the data.

Instructional Triangle Model

Our conception of the instructional triangle is aligned with activity theory, which is reflected in focus on practices and representations of content found in the nodes of our triangle. By focusing on artifacts and practices, we highlight the systemic aspects of classroom instruction. This allows us to focus on the mediating impact of teachers' practices and curriculum materials on the nature of students' mathematical activity, in addition to the overall goals of the system.



Themes from Interview Data Used to Inform Model

Category	Theme
Implementation	The teachers modified the curriculum and instituted routines to enhance accessibility and relevance of inquiry-based mathematics
Implementation	Teachers and administrators struggled to adapt to the new curriculum
Implementation	There was both collaboration and tension at the organizational level
Implementation	There was concern about the alignment between the mathematics program and the Regents and other state-level exams
Implementation	The implementation of the mathematics program resulted in positive outcomes
Implementation	The students were tracked primarily according to their literacy skills.
Implementation	Students faced challenges with the linguistic and cognitive demands of inquiry-based mathematics
Instructional Philosophy	School-wide planning aims for consistent philosophies to ensure success for the John Lewis student population
Instructional Philosophy	Inquiry-based instruction is prioritized over direct instruction
Instructional Philosophy	The Launch-Explore-Summarize model is the inquiry model used in the John Lewis School
Simultaneous Initiatives	The intent and impact of UBD initiative's focus on curriculum design and inquiry-based instruction in mathematics
Simultaneous Initiatives	The initiative of performance tasks competes with other forms of assessment and instruction time
Simultaneous Initiatives	School leaders implemented many initiatives and prioritized them differently
Identification and Selection of Programs	Programs were chosen to align with the instructional philosophy in EPO documents
Identification and Selection of Programs	Tension around the identification and selection of programs
Identification and Selection of Programs	Alignment between the curriculum and state standards was important
Identification and Selection of Programs	Supports were developed for the implementation of the selected programs
Identification and Selection of Programs	Programmatic modifications were made over time.
Resources/Support for Program	Ongoing professional learning opportunities were important for supporting program implementation.
Resources/Support for Program	The consultants from the Center provided ongoing support to teachers and teacher leaders
Resources/Support for Program	Teacher leaders and administrators were important sources of support
Resources/Support for Program	Teachers were given time to meet and plan together
Resources/Support for Program	Partnerships and interactions beyond the school supported professional learning
Resources/Support for Program	There were supports for students to help manage the demands of the program