Abstract Title: Learning to Teach for the Success of Underserved Students

MSP Project Name: The design of a research-in-instruction laboratory (RI-Lab) for transforming education research and practice

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120 word summary:

At the heart of teaching underserved students is getting math class to be a place where students routinely work on mathematics. More than just motivating students, this is about student identity and agency, building trust, teaching students how to learn, and instruction that delivers on its promise that work will lead to progress. We acknowledge that student achievement is the ultimate goal, but we define success in terms of engagement in math class and we use collectively planned laboratory classes to examine how the identification of specific instructional goals and the elaboration of those goals in instructional plans can provide a valuable resource for making this component of the work of teaching more readily observable, study-able, and improvable.

Section 1: **Questions for dialogue at the MSP LNC**.

We begin by proposing two focus questions for our conversations at the Learning Network Conference.

1. What does it take to get students to work in math class — individually and collectively — at both the elementary and secondary levels? In particular, in their sophomore year?
2. As professionals responsible for education, how can we support the ongoing learning of how to teach in ways that get students to work, and ultimately succeed, in math class?

Implicit in these questions is a proposal for using student engagement as a key indicator of student success. This intermediate goal is close enough to the interactions of teaching and learning that it can help us attend to what matters in building success. Below we elaborate our definition of success and explain its value in supporting improvement.

Section 2: **Conceptual framework**.

Many students throughout this country are not served well by the schools they attend. Opportunities to learn are limited, dropout rates are high, and dysfunction is widespread. For certain groups of students, the predictable trajectory across the K-12 years is one of initial hope giving way to an sense of inevitable failure. If you were to walk into a typical math class in a high school with a history of failing to make annual yearly progress (AYP), you are likely to find little or no work being done in many math classes. While acknowledging that student achievement is the ultimate goal, we argue for identifying this intermediate aim (of getting math class to be a place where students routinely work on mathematics) as a strategic focus for improving the teaching and learning of struggling students. One of the most consistent findings of modern education research is the strong positive relationship between time engaged in academic learning and student achievement (Brophy, 1988; Greenwood, Horton, & Utley, 2002). We begin with this initial observation, but deepen the notion of time-on-task to a pedagogically elaborated notion of productive classroom mathematical work and we consider what is involved in making such work happen in the classroom (Ball, Lewis, & Thames, 2008).

The issue takes different forms across the grades. Even in early elementary school, students who are seen as mathematically weak are overwhelmingly members of racially and socioeconomically underserved groups. Getting young children to work — to engage in instructional activities — is in general relatively easy. However, in the early grades students are already beginning to label themselves and one another as more and less able. For many students, their sense of what is within their power to be and do in math class begins to erode. Their impressions of mathematics begin to be of a subject matter that does not necessarily make sense and is not really under their control. In high school, these issues gain momentum and additional urgency. Many freshmen enter high school with high opinions of themselves and of where they are heading, but for far too many students, by the end of their freshman year their bright outlook fades and the realities of their probable futures become ominous. Students in these critical years can be quite resistant. Even the outward appearance of doing the work can be a thin veneer or even non-existent. In many high schools, the starting point of educational improvement is getting students to "buy in" to an agenda of improving their educational opportunities and their prospects for life and of acting on this agenda in their classes. This issue takes on heightened importance during the freshman to sophomore years of high school. It is as if this period is a turning point, where educational success, economic access, and future lives take form. We argue that, if in their sophomore year students regularly approach their mathematics class as a time to learn and do mathematics, then they are likely to learn enough to go on to live out their aspirations — college or otherwise. In other words, as a measure, the sophomore year is a good indicator of overall success. Furthermore, we argue that fifth grade and ninth grade are key turning points for students achieving this goal.

Clearly, getting students to give the appearance of working is not enough to assure success, but what would it look like if students were actually invested. One of the most notable features of teaching college-bound juniors and seniors is that many of them are on a mission, not all of them all of the time, but most of them most of the time have vision of themselves academically that compel them to engage in significant academic work. So, what does it take to create authentic work in math class? In Lampert's (2001) words, what does it take to teach students to be people who study in school? This is not simply a matter of student effort. Many students want to be successful and are willing to work, but when math class stops working for them, year after year, they put their attention and efforts elsewhere. The question of how to get students to work in math class is about enlisting parents and communities in a commitment to help students build their lives. It is about helping students take responsibility for their choices and actions. It is about having resources in place to support students' work. It is about all of these, but it is more centrally about those responsible for students' education — teachers and schools — figuring out how best to establish a situation in which students can and do engage routinely in mathematical work. The problem is fundamentally one of creating instruction that provides an adequate learning environment, that teaches students how to use school as a place to learn, and that engages students in productive learning of mathematics. And, it is about teaching that attends to external factors, as those factors are necessary in helping students engage consistently in work.

We have designed research-in-instruction laboratory classes as sites for collective investigation of the nature of productive mathematical work occurring in classes and of factors contributing to that work. Our "measure of success" is public conviction established through evidence-based debate situated primarily in records of practice and secondarily in studies of the relationship of between students' lab class experiences and other indicators of student success.

However, our larger focus is on the use of collective attention on productive classroom mathematical work as a means to understand and improve teaching and learning. Below, we describe some general findings and then examine more closely the role of detailed lesson plans in supporting collective attention on productive classroom mathematical work. First, though, we briefly describe the overall design of our research-in-instruction laboratory classes.

Researching teaching in the practice of instruction

There is wide agreement that teachers matter for student learning, but a correspondingly wide difference of opinion about strategies needed to supply high quality teaching. One of the biggest challenges we face is the lack of a coherent educational infrastructure: a common mathematics curriculum, coordinated examinations of student learning, systems for supplying skilled teachers to every school, professional training centered on practice, schools that support the improvement of practice, and research that informs practice.

Our research-in-instruction laboratories (the Elementary Mathematics Laboratory (EML) and the Secondary Mathematics Laboratory (SML)) are designed to support: (i) professional training centered on practice; (ii) research situated in practice and purposed to inform it; and (iii) coherence throughout systems of teacher training and throughout systems of support for practice in schools. The design of a research-in-instruction laboratory is analogous to a surgical theater in medical schools, which helps to make expert practice visible and to support collective observation and analysis of both routine and complex professional practice. However, a research-in-instruction laboratory is more than a vehicle for professional education. It is simultaneously an incubator for high-end experimental instructional practice and is structured deliberately to enable both the design of, and research on, elements that constitute that practice.

At the center of a research-in-instruction mathematics laboratory is a two-week math class taught by an experienced classroom teacher skilled at making teaching "visible" to observers. The central goal is to design and implement ambitious, intensive, summer-time instruction to develop "turnaround" by students who are struggling mathematically and to study the instruction in ways that contribute broadly and specifically to the improvement of practice. As an alternative to "remedial" instruction or "intervention," this turnaround instruction combines complex and ambitious mathematics content with deliberate and explicit focus on mathematical practices and practices of studying, while the laboratory environment supports a close analysis of the instruction that enables this learning.

A diverse group of education professionals, including research mathematicians, education researchers, practicing teachers, and student teachers, participate as residents in the laboratory. They are engaged deeply inside the design and detailed planning of each day's class and the analysis of highly specific details of its enactment and of students' learning. These participating residents watch the class daily from special observational galleries and participate in formal pre- and post-class discussions during which they unpack and closely analyze the instruction. In addition, they engage in topic-focused research groups and professional development workshops that use the core lab instruction as a "text." All of this work is supported by careful video, audio, and photographic documentation of the lab class and surrounding satellite activities.

Section 3: **Explanatory framework**.

This section should describe what you are finding, or are set up to learn, about student success, and how it is informing, or will inform, your MSP work.

We first discuss some insights into teaching that we have gained from our work in this area and then describe the role of lesson plans and lesson goals in helping to make teaching and learning visible, study-able, and improvable.

Teaching Students to Work in Mathematics Class

One key component of getting students to work in math class is the building of strong relationships in the classroom, both with students and among them. This includes establishing their trust and a safe environment for their ideas and questions. It requires a communication of respect to each student as a competent learner of mathematics and ground rules for the respectful exchange of ideas in the classroom. It requires clear and careful vision of the strengths, needs, and appropriate workspace for each student and accurate empathy for each of them as a learner. One does not need to be black to teach black children, but one needs to be familiar with the lives of the children one teaches and able to relate meaningfully to one's students.

A second component is about teaching students how to do mathematics, how to *work* in the context of the instruction being provided, and how to use the provided instruction to learn. Students need to be explicitly taught the mathematical practices that are core to doing mathematics. They need to be taught how to use mathematical representations to solve and communicate about problems. They need to be explicitly taught how to talk mathematically and how to reason mathematically. Being able to *do* mathematics is essential to being able to *learn* mathematics. For example, if in completing a homework assignment a student does not know to consider the mathematical rationale for the solution to the problems, then the student is likely to forget the material, to misapply the ideas, and to build up a distorted notion of what mathematics is and how it is used (Ball & Bass, 2003). Additionally, students need to learn how to work in their math class. For instance, they often need to learn how to work with other students if they are to use small group work effectively, or they may need to learn how to speak loudly enough for their classmates to hear when discussing a problem in a whole class. Beyond this, they also need to learn how to use the instruction being provided in order to learn from it. For example, they need to be taught to what it is they should be attending, how they can pursue their individual learning goals in the context of the class' collective work, how to read a textbook, and how to organize in ways that they can best accomplish their work.

A third component of getting students to work in math class involves close attention to mathematical reasoning, in particular, students' mathematical reasoning. Careful attention to reasoning — the student's reasoning and the reasoning underlying the mathematics being taught — is the basis for a teacher's ongoing relationship with individual students and the sense of respect it requires, a key feature for engaging in mathematical work, and the basis for making progress over time. Attention to mathematical reasoning requires that the teacher have comprehensive and intimate knowledge of the kinds of reasons that exist for particular ideas and an attentive ear for listening to students' thinking.

Last, in order to get students to work in math class, students must see that the work they are doing is paying off. They need to be able to see that they are learning and making progress. It is the teacher's job to provide work that will lead to learning and to make sure that students can see the progress they are making. This issue becomes increasingly important as one moves up the grades, but even in the early grades, students' sense of payoff is an important factor in the quality and quantity of their investment in mathematical work.

These observations about effective teaching grow from our ongoing investigation of what it takes to teach students to engage productively in mathematical work in the classroom as pursued through our research-in-instruction laboratory classes.

Making the Work of Teaching Visible: Lesson Plans and Lesson Goals

As a community of mathematics educators, our understanding about what is involved in getting students to work in math class is limited. An important approach to developing our understanding is to create common experiences with teaching that tries to do this, to investigate its dynamics, and to explore ways in which it might be accomplished. For collective dialogue about what it takes to get students to work productively in mathematics class to be most beneficial, the shared teaching we experience and discuss together needs to invest in getting students to work (in planning, enactment and reflection) and needs to be visible to those observing. Unfortunately, teaching is not readily visible. In the development of our research-in-instruction laboratories, we have found that making teaching visible requires: (i) the development of teaching practice designed to be more readily observed; (ii) training and support for observers in the observation of teaching; and (iii) technological innovations that afford observers with an over-the-shoulder vantage, being able both to see and to hear (e.g., where a student's pencil is pointing and whispers of direction and encouragement).

One tool for supporting the first two of these features is the generation of detailed lesson plans. In our session at the conference, we will report on our efforts to develop clear statements of instructional goals for getting students to work in math class and to explicitly connect the design of instruction throughout the lesson plan back to those goals. In these efforts, we have found that clear goals and their articulation in instructional plans can support visibility of teaching designed to accomplish such goals and can support collective learning about the improvement of practice. We provide examples from lesson plans developed for our EML and SML and we use the extensive documentation of these lab classes to examine ways in which the instructional goals play out in teaching and learning.

We offer two prospective insights that might have value for the Learning Network. First, investment in clearly articulated, concisely elaborated, and widely shared and used goals can provide a focus to support a system of teaching underserved students. By *concisely elaborated* we mean to suggest that the elaboration of the goals is crucial (Ball, Sleep, Boerst, & Bass, 2009), but that the tension between conciseness and elaboration helps to direct the collective work on goals and helps to make identified goals useful in practice. The second insight is the broader recognition that, when teaching is made adequately visible, it can support productive, collective engagement in the ongoing design of teaching and its improvement.

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